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C O N T E N T S

PAPERS

Abstracts

THE ACCREDITATION EXPERIENCE OF THE GRAPHICAL AND DIGITAL MEDIA DEPARTMENT OF THE UNIVERSITY COLLEGE ARTEVELDEHOGESCHOOL

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This paper concentrates on issues relating to accreditation in general. In particular we draw attention to the experience the University College Arteveldehogeschool, Graphical and digital media department, gained during the process of preparing and participating in the process of this quality assessment.

WHAT IS (INITIAL) ACCREDITATION?

Accreditation relates to the assessment of the **quality** of a degree program and focuses on its **learning outcomes**.

The accreditation procedures of the Netherlands and Flanders relate to both accreditation and initial accreditation. Accreditation concerns programs that are already offered by institutions and which are registered in the official register of recognized programs in the Netherlands and in Flanders (Belgium). Initial accreditation concerns programs that are not yet offered and/or which are not registered in the official registers of recognized programs.

FRAMEWORKS FOR (INITIAL) ACCREDITATION

The starting point for accreditation is the accreditation framework drawn up by **NVAO**, (the Dutch and Flemish Accreditation Organization. The required procedure, the quality standards and the assessment rules are stipulated in it. Frameworks are applicable to the 4 types of programs offered in the Netherlands and to the 3 types of programs offered in Flanders. When drawing up the frameworks, NVAO had to take into account the assessment criteria previously stipulated in Dutch and Flemish legislation. Based on these, a number of themes with underlying standards and criteria were formulated. The Dutch and Flemish (initial) accreditation frameworks were designed after consultation with representatives of institutions/programs and national and international experts involved in assessment procedures.

NVAO applies different frameworks for the Netherlands and Flanders. Differences mainly stem from disparities in the higher education systems of the Netherlands and Flanders. However, these frameworks have been made as analogous as possible. Quality standards and assessment rules are almost identical in both frameworks. To accommodate to the diversity of programs offered in the Netherlands and Flanders and the autonomy of institutions, NVAO refrained from drawing up detailed and normative/prescriptive frameworks. On the contrary, these frameworks have been conceived to be all-purpose and accessible. They can be

characterized as universal and accessible. The standards and criteria were formulated to be highly abstract rather than rigid and constraining.

A specific section of the Flemish accreditation framework relates to the possibility of recognizing the equivalence of an accreditation decision by an international organization. For the Netherlands, there are supplementary protocols for research master's programs and for extended master's programs.

INITIAL ACCREDITATION FRAMEWORKS

The initial accreditation framework for the Netherlands consists of 6 themes subdivided into 19 standards. For Flanders it consists of the same 6 themes and 21 standards. The standards need to be assessed on a 2-points scale: "satisfactory" or "unsatisfactory". This is normally a more limited 'ex ante' assessment, as a more extensive assessment of the learning outcomes cannot yet be undertaken.

ACCREDITATION FRAMEWORKS

The accreditation framework assesses all 21 (for the Netherlands) or 23 (for Flanders) standards on a 4-points scale: unsatisfactory, satisfactory, good and excellent. Standards that are assessed 'unsatisfactory' can - if verified - be compensated within one theme. However, each theme as a whole has to be rated 'satisfactory'.

DIFFERENCES BETWEEN ACCREDITATION AND INITIAL ACCREDITATION FRAMEWORKS

The main difference concerns the **final theme**. In the accreditation frameworks this is 'Results'. In the initial accreditation framework it is called 'Conditions for continuity'. In the case of a program that is already offered, it is important to assess whether it achieves its previously set objectives, i.e. its intended learning outcomes. In the case of a new program, it is important to assess if an institution is sufficiently solvent and whether sufficient financial resources (e.g. for the infrastructure, qualified personnel) are invested in the program. In addition, the new program is also assessed on the basis of the guarantee offered to students that they will be able to complete the program and find employment in this (new) domain.

FOCUS ON LEARNING OUTCOMES

Education in the Netherlands and Flanders has been developing towards a **competence-based education system** since the beginning of the '90s. The focus of education has moved from the teaching process (and a bias on transfer of knowledge of print media) to the learning process (with a bias on adequate performance in a print media working context. Before this development, education used to be seen as an input-based process expressed in workload and length of studies. In a competence-based system, education is seen as an output-based process expressed in the competences achieved. As a result, the degrees awarded in higher education are no longer seen as proof of participation and successful

completion of a program but as the recognition of having achieved certain predefined learning outcomes.

LEARNING OUTCOMES AT 3 LEVELS

In the NVAO's accreditation system, learning outcomes are made at 3 levels. A program is expected to explicitly define its **INTENDED** learning outcomes. These are the competences a graduate should acquire during his studies. An assessment panel first judges whether a program's intended learning outcomes are in line with the required level and the subject of the program. Additionally, it is examined whether these intended learning outcomes are in line with what is (inter)nationally expected of a program in that subject.

NVAO secondly judges the **POTENTIAL** learning outcomes. These are the competences a student can achieve in the program as it is offered. This is mainly done by corresponding the content of the curriculum with the intended learning outcomes. An example: If a program defines laboratory skills as an intended learning outcome, the curriculum of the program should explicitly cover this and give students the possibility to do lab work. If this isn't the case, there is no correspondence between the content of the curriculum and the intended learning outcomes. Certain input elements such as the facilities and the quantity and quality of the staff also contribute to the possible achievement of learning outcomes. These are therefore additionally assessed.

Thirdly, NVAO assesses the **ACHIEVED** learning outcomes. These are the competences a graduate has actually acquired during his/her studies. An assessment panel needs to read the students' work (essays, end of term papers, theses) to be able to judge the achieved learning outcomes and then match those with the required learning outcomes. The required learning outcomes are the level-specific and intended subject-specific learning outcomes as defined by the program.

By combining intended, potential and achieved learning outcomes, NVAO intends to assess whether a program delivers what it promises to deliver (to students and the rest of the society).

INTERNAL QUALITY ASSURANCE SYSTEM

NVAO ALSO judges the internal quality assurance system. When a program is deemed to have the required generic quality, it receives accreditation for several years. A well-functioning internal quality assurance system should then ensure that a program retains its quality during that period.

ACCREDITATION STEPS

The accreditation procedure consists of three consecutive steps: the self evaluation, the external assessment and the accreditation.

STEP 1: SELF EVALUATION

The institution and/or the program is responsible for carrying out a self-evaluation of the program(s) concerned. This process is concluded with a self-evaluation report that contains a description and evaluation of the program. This is done according to at least the themes, the standards and the criteria of the relevant accreditation framework. In addition, the self-evaluation report indicates and substantiates the level and orientation of the program. The institution sends the self-evaluation report to a quality assessment agency.

OUR EXPERIENCE IN WRITING THE REPORT

At the time of writing this paper (June '10) the Graphical and digital media department of University College Arteveldehogeschool finished the initial step: a self evaluation report was delivered to an assessment panel in December '09.
The 6 themes and 23 standards of the framework were carefully explored. These research results were then recorded in an extensive report comprising no less than 168 A4 pages.

The 6 themes in our text focus on:

1. Targets of our education
2. Our program/curricula
3. Personnel availability
4. Facilities
5. Internal quality assurance
6. Results

We experienced that in composing the report a pitfall might occur: people might start to 'force' the text in the direction of the proposed framework. In order to tackle this pitfall we constantly had to bear in mind that the framework cannot *entirely* be realized and that we should describe *realistically* what exists and what is happening. As such it is important to deduce in the proposed framework which elements one can use in order to point the education in the right direction. Additionally, one should use this information to describe the strengths and weaknesses. For sure it is important to demonstrate what the department is busy with and which direction it is going.

In preparing the report we carefully reflected upon 'the scene' of our education: we positioned it in a broad spectrum paying attention to the educational and international context, labor market, partners, etc. We had to demonstrate that we share a vision and strategic plans, how we aim at dealing with them and why we opt for this particular strategy. Subsequently, we had to point out that this strategy gains the required results. Much attention was devoted to justifying choices in terms of curricula, learning paths, methodology, material means and personnel issues. Moreover, we had to clarify the results of our educational activities. This involves that we measured the effects, focused on educational research and quality control, etc. It is important to gather all information, analyze and arrive at a synthesis. No need to say that in this stage the importance of an internal supporting quality assurance service cannot be neglected.

Some points of special interest:

- The report should be *correct*, *complete* and *recognizable*. 'Recognizable' involves that all staff members should be able to identify themselves with the entire text.
- *Harmony* between the text and the perception of it by the owners of the process/product is crucial. This harmony is only guaranteed when feedback of all text parts is constantly communicated.
- The report is to be fine-tuned by *reading committees*, the members of which have responsibilities on all different levels, and are both internal and external parties. Actually all staff should participate. Every colleague collected material in order to make more explicit the choices being made. Some former students and close contacts of the field were invited to scrutinize the report.
- As for some issues we are submerged in a transition period we felt the importance to pay due attention to the *dynamism* that is part of it.

No need to say that the process was a very time and labor consuming one?

STEP 2: EXTERNAL ASSESSMENT

The second step in the accreditation procedure is the external assessment. Later this month (June 28-30) an assessment panel will visit our department in order to verify the assertions and statements contained in the report and to assess the potential generic quality of our degree program and whether the program fulfils the criteria of the accreditation framework. The entire program and organization of this visit was laid down by the commission itself.

The quality assessment agency convened an assessment panel that will be responsible for the external assessment of the program. The composition of the assessment panel is in line with NVAO requirements and includes a large representation of the field and at least one education specialist.

The assessment panel will assess the quality of the self-evaluation (including the methodology used to realize it) and whether the program fulfils the criteria of the assessment framework.

The panel will write down their (objective) findings, (subjective) considerations and conclusions in their assessment report. The report will be sent to our institution and will be made public by the quality assessment agency.

Relevant to point out in this article intended to be published in the IC Journal is that 4 international and strategic partners of the department are invited to join the discussion when it comes to assessing the international dimension of our curriculum. In particular, we invited them to share their personal and institutional experience working with our department with the members of the commission. By doing so the department wants to send out the message that it attaches great importance to intercultural collaboration and international cooperation for both students and teaching corps.

The assessment commission also invited some 10 representatives of the professional sphere of action, some 10 graduates and 20 students. As well lecturers and technical staff are invited for a discussion.

At the next Annual Conference of the International Circle that is taking place in Moscow from 18 to 23 October 2010, in combination with the 80-year jubilee celebrations of the Moscow University for Printing, the department will present a lecture to all conference participants informing them about the experience it gained in welcoming the assessment jury.

Some points of special interest that drew our attention in preparing this visit:

- A thorough preparation is required.
- It is crucial to keep all parties concerned highly involved and motivated.
- It is of major significance to offer all requested material in a very well structured way.
- At any time of the visit contact persons should be available who have control of particular issues or will find the solutions to problems/questions in very short notice.
- Finally a relevant and supporting sample of discussion partners is highly significant.

STEP 3: ACCREDITATION (DECISION)

The third step in the accreditation framework is accreditation itself. The institution submits an application for accreditation of a program to NVAO by sending in the assessment report. NVAO uses the evaluation criteria in the accreditation framework to evaluate the assessment report, the overall conclusions expressed in it, the panel composition and the methodology used. Subsequently, NVAO takes an accreditation decision and lays down its findings in an accreditation report. Finally, the panel's assessment report and NVAO's accreditation report (including the accreditation decision) are published by NVAO.

The accreditation decision is either *positive* or *negative*.

If the accreditation decision is positive, the program is accredited. This means that the program is included in the relevant official register. This registration means that the degree awarded by the program is recognized by the national authorities. Additionally, an accredited program can receive public funding and the students enrolled in these programs can receive student support (e.g. grants). A positive accreditation decision has a fixed period of validity. For the Netherlands this is six years while for Flanders this is eight years.

If the accreditation decision is negative, the program loses accreditation. This means the program is deleted from the relevant official register and can no longer be offered. There is however a possibility of temporary recognition during a recovery period.

CONSEQUENCES OF ACCREDITATION

In Flanders, after a negative accreditation decision, the institution can submit an application to the Flemish government for a temporary recognition. This has to

be done within one month after the notification of the negative decision. A detailed plan for improvement shall be put forward together with the application. Following advice from the Recognition Commission, the Flemish government takes a decision within three months of the application. Temporary recognition may have a validity of one to three years.

In the Netherlands, there is also a possibility for an improvement period. This is seen as a recovery period. This period lasts two years. However, since the program is no longer accredited, the program cannot enroll new students and the institution does not receive funding for the program.

APPEAL PROCEDURES

Both in the Netherlands and Flanders, institutions can lodge an appeal against (initial) accreditation decisions taken by NVAO.

CONCLUSION

No doubt that accreditation is a time and labor consuming operation but still a very rewarding one. Firstly, it pushes the department to define and explicate its vision and policies and to defy external scrutiny of it. Secondly, it compels the department to keep hold and stock of the results of its policies, activities and resource management. Thirdly, it offers the department a unique opportunity to amass and share information that previously might be dispersed. As such, it provides not only management and the commission but also all staff with a thorough and substantiated overview. Fourthly, it provides the department with some crucial, external expert advice regarding its key processes and to the way to go about it. By doing so, the report of the commission will constitute the kick off point from where a new series of continuous internal quality assessment processes will start.

Source and more info on: www.nvao.net

ABOUT THE ORGANIZATION OF TRAINING SPECIALISTS IN KHARKOV NATIOONAL UNIVERSITY OF RADIO ELECTRONICS FOR PUBLISHING AND PRINTING INDUSTRIES

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Kharkov National University of Radio Electronics is one of the oldest technical educational establishments of Ukraine. In 2010 Kharkov National University of Radio Electronics is celebrating its eightieth anniversary.

The history of the university goes back to 1930 when, at the same time and by the same order with Moscow Printing Institute (modern Moscow State University of Print), Kharkov Printing Institute was established, which is now situated in Lvov (Ukrainian Academy of Print). Kharkov Institute of Construction Engineering was established in the same year. In 1944 the latter was renamed into Kharkov Institute of Mining Industry and since 1947 it was known as Kharkov Mining Institute. During the restoration of the national economy wrecked by war, specialists in mining industry and machine building were trained there and later, due to the intensive development of radio physics and technical electronics, the Institute was charged to train specialists in the field of radio electronics and computer science.

The formation of the higher educational establishment as one of the establishments in the field of radio electronics began since 1963 after its transformation into Kharkov Institute of Mining Machine Building, Automation and Computer Science (KIMMBACS).

Decisive changes in establishing the institute in a new direction began in 1966 when, by the decision of Council of Ministers of USSR No.449, KIMMBACS gets a new specialization and name – Kharkov Institute of Radio Electronics (KIRE) created on the basis of KIMMBACS. In five years KIRE became the only specialized higher educational establishment of Ukraine that was training specialists of twelve specialties in the field of radio electronics and computer science.

In 1981 by the Order of the Supreme Soviet Presidium, due to the services in preparing qualified specialists and developing scientific researches, KIRE has been honored by a Red Banner of Labor, and in 1982 it was given a name of the outstanding scientist and space-rocket hardware constructor academician M.K. Yangel. In 1987 by the decision of Ministry of Higher Educational Establishments of USSR KIRE has been included into the list of 70 most prominent higher educational establishments of the country.

For the high achievements in education and science by the order of MES of Ukraine № 605 of 22 August 2001 the university was granted national status, now it was named Kharkov National University of Radio Electronics (KNURE).

By the decision of the State Accreditation Committee of Ukraine from March 28, 2008, protocol №70, and by the order of MES from 04.04.2008, № 868-A as a result of accreditation Kharkiv National University of Radio Electronics was rated as a higher education institution of the accreditation level IV and received the right of training of specialists in educational and qualification levels of Bachelor, Specialist and Master.

Now KNURE is a modern educational and scientific center, one of the oldest state-owned specialized institutions of higher education in Ukraine, which trains specialists in many important fields. The system of training scientific-pedagogical staff, which includes doctoral and graduate students, is effectively functioning. More than 50 doctoral and master's theses are protected each year in the university.

Now the university has 7 faculties, which carry out preparation of bachelors in 23 fields of studies using the three-level system of bachelor, specialist, master preparation, it also offers retraining and advanced training in 36 specialties. At the moment the university educates about 10,000 students. The training process employs 129 professors, doctors, 386 assistant professors, candidates on a permanent basis and 49 professors, doctors and 65 assistant professors, candidates of science in combination.

Over the years the university has trained more than 50 thousand professionals, 2 thousand of whom work in other countries. The level of received training is confirmed by the students' certificates and awards at the All-Ukrainian and international Olympiads.

The University serves the State budget and the Economic agreement scientific work in the above areas, is technically equipped and has its own publishing center with modern computerized equipment.

Over the past twelve years the university is preparing bachelors, specialists and masters in the area of Publishing and Printing.

The department of Engineering and Computer Graphics is graduating students in the field of publishing and printing. It was founded in 1945 on the basis of the Department of descriptive geometry and drawing (1944) Kharkov Mining and Industrial Institute. Since 1997, the Department, responding to the needs of industry in the region, resumed the training of students for the publishing and printing industry in the East of Ukraine. At that time the department was already offering the Computer Graphics discipline for different specialties, so the opening of the specialty "Technology of automated processing of text and graphic information" was quite logical.

Since 2002, in Ukraine, a new training program called Publishing and Printing was opened, and the mentioned specialty was called Computer Technologies and Systems of Publishing and Printing Industries. In 2005, the department got the license for training of specialists and masters in this specialty and the other one called Printing Technologies.

The concept of education in Ukrainian universities is based on a three-level system of Bachelor, Specialist and Master levels. After high school, an applicant may receive a 4-year course of study and gain qualifications of Bachelor, and then can choose one of the specialties included in this program and in a year or so get a specialist qualification or a master's degree, respectively.

Publishing and Printing program includes the following specialties: Printing Technologies, Computer Technologies and Systems of Publishing and Printing Industries, Technology of Electronic Multimedia Editions, Technologies of Packaging design, manufacturing and decoration, Materials for Publishing and Printing Industries, and three specialties of junior specialist level.

The curriculum for Bachelor studies includes disciplines of humanitarian and socio-economic training cycles, natural science training (basic), professional

and practical training. In every cycle, subjects are divided into standard disciplines required to study at all institutions of the country in this area, disciplines that are provided by the choice of the university and that are required for studentsin the university, and disciplines that are left for alternative choice, i.e. free choice of the student. The education ends with the practical internship at the company and preparation and protection of the Bachelor thesis.

The curriculum for Master and Specialist studies is structured in the same way. In addition to in-depth study of theoretical foundations of printing production, Masters also learn methods of conducting scientific research, pedagogy, rhetoric, philosophy. The preparation of the second level ends, as well, with practical internship at the company, preparation and protection of the diploma or Master's certification work.

Graduating department of Engineering and Computer Graphics in KNURE has sufficient logistical and training facilities, experience in teaching and methodological support of academic disciplines in the area of Publishing and Printing.

The department has set up following training labs: Graphical Information Processing and Color Theory, Pre-press and Electronic Media, Printing Equipment; a number of branches at specialized enterprises was created. Together with the printing Lyceum the department has founded the laboratory of Postpress processes. Several educational laboratories are functioning on the branches of the department, such as Laboratory for Printing Processes (Book Factory "Globus" Ltd.), Laboratory for Platemaking (Research Institute of Laser Technologies Ltd.), educational television production studio with modern equipment (telecentre KNURE), etc.

After graduation our students are working in publishing houses and advertising agencies, printing companies, newspapers, magazines, WEB-studios, design studios.

The department maintains relationships with leading printing universities and enterprises in Ukraine and abroad. Traditionally, every year, up to 50 senior students are trained in one of the modern printing companies in Krakow (Poland), which belongs to the European branch of the company RR Donnelley (USA). Students of KNURE repeatedly took part in the scientific and technical conferences in Lviv, Kiev, St. Petersburg, Moscow, etc.

In 2004 a cooperation agreement between Moscow State University for Press and Kharkov National University of Radio Electronics was concluded. The main areas of joint activity are those connected with programs in the field of educational, methodical and scientific activities, creation of conditions for training, retraining and advanced training in the field of publishing and printing. Senior students and teachers of KNURE take part in various internships in MGUP.

Our students are continuously invited to the undergraduate scientific and technical conferences and competitions. Their professional articles are accepted for publication in scientific and technical collections.

Bachelors of the Publishing and Printing specialty, in accordance with the contract, may continue their studies at Master's level in Ukrainian Academy of Printing (Lvov), National Technical University of Ukraine KPI (Kiev), Moscow State University for Press (PM Moscow), Berg University (Wuppertal, Germany).

Under the agreement, students, graduate students and faculty of KNURE can enjoy the educational and scientific base of MGUP, participate in seminars and conferences organized by MGUP.

In 2009, based on previously concluded contracts, a collective agreement about the cooperation between universities specializing in printing and situated in CIS countries was signed. Among them were National Technical University of Ukraine (KPI), Belarusian State Technological University, Tashkent Institute of Textile and Light Industry, Kazakh National Technical University of K.I. Satpayev, Kyrgizsky Technical University of I. Razzakov, Tajik Technical University of M.O. Osima, Moscow State University for Press, Kharkov National University of Radio Electronics.

Leading professors and associate professors are planned to give lectures in KNURE on agreed terms, participate in co-writing of manuals, textbooks for general scientific publications.

International cooperation makes it possible to use the accumulated experience of all the universities to train professionals, ensure a demand for qualified graduates in the area, identify promising areas of cooperation with enterprises and educational institutions of domestic and international profile.

A PEEPIN TO THE CONCEPT OF STANDARDISATION IN OFFSET INDUSTRY

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We all have to deal with COLOUR COMPOSITION, REPRODUCTION , EVALUATION at some point of time in our life irrespective of our basic profession.The appearance of a light or object depends on what is around it. (Hue Depends on Background)Two colors, side by side, interact with one another and change our perception accordingly. The effect of this interaction is called *simultaneous contrast*. Since we rarely see colors in isolation, simultaneous contrast affects our sense of the color that we see.If we have trouble in judging simple things like the Straightness , Length, Width, Colour and Motion where there is none, one must ask himself what other mistakes we will be making while perceiving a colour.

Do we actually see what we want or expect to see? Can we really believe everything we think or believe we see? We all know that the rods and cones are base for perception.

Rods are sensitive to color intensity (black and white sensitivity in dark-123 million-In ach eye) and cones are for colour perception. We have three types of cones known as – S, M and L (7 million-In each eye).

The genes for color vision are on the X chromosome. Females have 2 X chromosomes and if one is deficient the other makes up for it. They even may have more color sensation than males which might explain why my wife notices color mismatches in my clothing much more than I do. The result from a scientific study states that there are only 1 in 200 females who have color deficiencies in Asian population and 1 in 70 among European females.So asian females are blessed with a better colour perception.At the same time color deficiency is more common among Males.

Different books give different figures. But a styles explains in his book as there are about 1 male out of every 12-20 (5% to 7%) group has some color deficiency among Europeans and 1 in 70 among Asians. So among males too Asians are better blessed with good colour perception ability. Another study says left-handed people are more prone towards colour blindness.

It is inherited naturally through the mother who may pass on a defective X chromosome.

The actual ratios vary among different populations and one book reported that colour deficiency is more common in European stock and less common in Asian & Native American. *(Perhaps northern dwellers during the ice ages did not need color vision as much and lost it during a mutation?).*

The major advantage of the stokes in tropical countries is that out of 365 days in a year at least 350 days they can see the complete colours around them in natural sun light (which is supposed to be the ideal light source for correct vision).

By doing so in generations genetically they have gifted with an improved ability of correct colour vision and perception. At the same time in European countries they get very few days with proper sun light to see natural colours in an year. Probably this could be the reason why Europeans have more colour deficiency and lower ability in colour vision, perception and differentiation.

Look at Rajasthan! The most dry place in India! Hottest among all!BUT THE MOST COLOURFUL!!

To understand the principles of standardisation and color management, the most important fundamental study one should note is the 1931 standard observer experiment which documented each of the respective three cone responses which covers a wide band of wavelengths and that there is a considerable amount of overlap. The implication is that samples with different spectral response curves (samples that reflect or transmit different amounts of energy in the visible portions of the spectrum) can appear the same color, by creating the same response from our eyes' cones. For example: Let us say the light reflected from one object

comprises multiple wavelengths that each cause a gentle response from the M cones. Another object with a different spectral composition might match the overall M-cone response with a narrower band of wavelengths that individually cause a sharper reaction.

WHAT ARE THE COMMON CHALLENGES :A SHEET FED OFFSET PRINTER FACE IN HIS DAY TO DAY LIFE?

Some of the common problems we face today.

- Long make ready time.
- More wastage of sheets.
- Gripper to tail variation.
- Up to ups variation.
- Sheet to sheet variation.
- Press to press variation.
- Form to form variation.

What is standardization?

- Standards are a set of measurements agreed by certain organisation and governing bodies in the industry, but also can be " OWN STANDARDS" where by agreeing to follow certain production parameters for measuring and controlling to produce at repeatable and consistent quality.
- Everything is supposed to be the same.
- Paper should always have the same quality.
- Ink should always be the same and look the same.
- All presses should print the same way.
- Printing plates should always be the same.
- All printers should always work in the same manner.
- If everything is always equally good / bad, then you can always expect the same good / bad result.
- All measuring devices should always permit definite conclusions.
- AND THAT IS STANDARDISATION…..

What are the Aims & Objectives of Total standardisation ?

- Standardised printing means working with fully trained committed personals, defined materials, measurement methods, and work procedures.
- The aim of standardisation is to achieve a certain reliability in the work of all persons concerned that permits a prediction of the print result on all presses.
- However, standardised printing according to ISO involves certain tolerances(which we can make more tight) in the individual process

steps to the print result that we can measure and control in our area of work.

Standardise measuring properties which determine the print quality

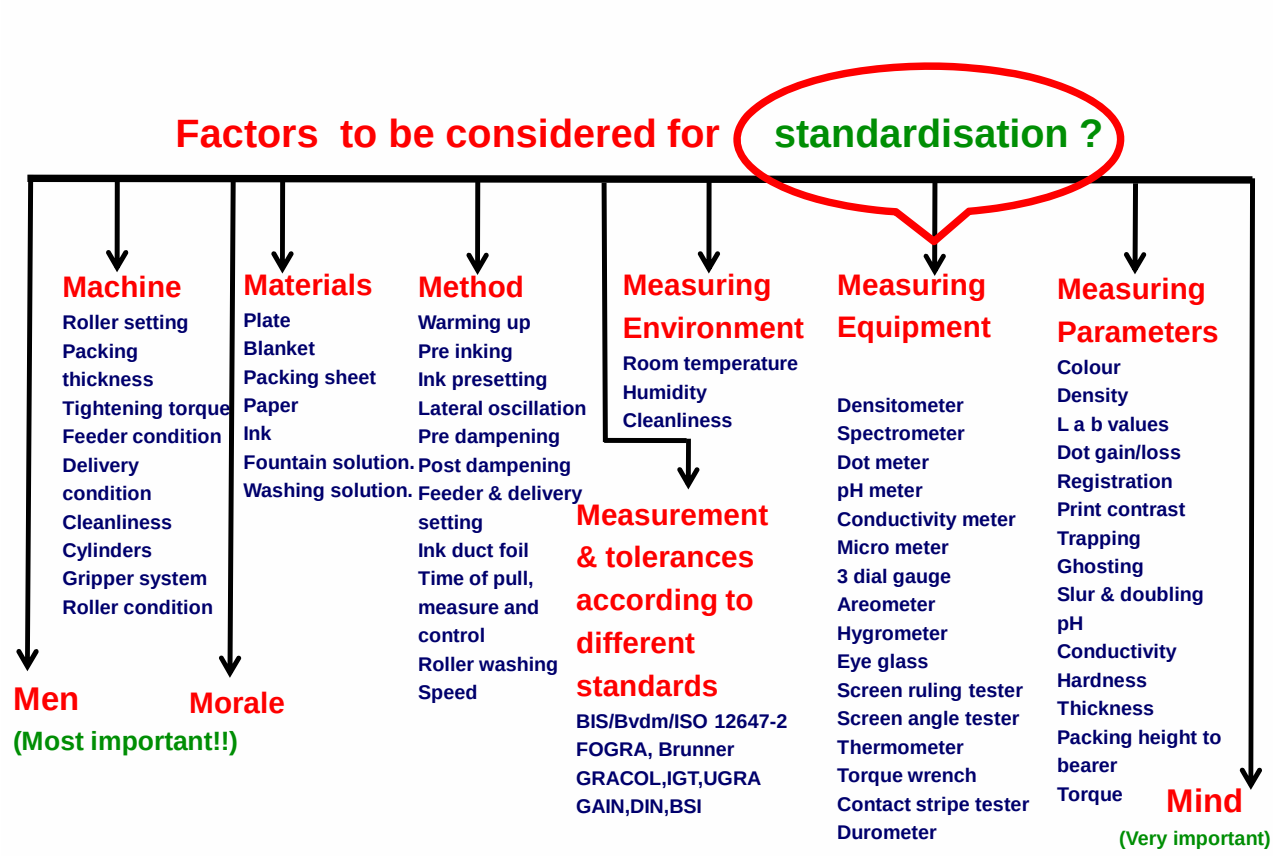
- Helps to understand the working processes
- Stipulating the use of equipment and testing methods
- Stipulating the set points and tolerances
- Standardise Men and their Minds….(toughest job)

This results in .....Total Standardisation

How can you achieve this ?

- Everything, all materials, presses, and work processes must be described in such a way that people can work based on these descriptions rather known as SOP's.
- Everyone who wants to work together must observe these descriptions (standards).
- Majority of the cases these are nothing but ISO- standards.
- Off course other standards are also prominent.

The 10M's of Total standardization



Benefits of having a standard ?

In a print shop with multiple machines one particular job printed in different machine can give the same result.

If dot gain is calibrated then it will be easy to calibrate the scanner, monitor and proofer in a print shop and the Print buyer can experience“WYSIWYG” (What You See Is What You Get)

It helps us in achieving targeted contrast value of the print.

It is a must for printing jobs related to industries like automobile, Pharma, Food, textile and paints where color shade plays a vital role.

It is easy to process jobs across different countries.

Due to standard working conditions repeatable result of the same job will be easy.

It gives preliminary feed back to press operators about condition of the press and input materials.

It is very easy to convince the customer by the press owner.

- Common language means better communication between

Agency, Print buyer, Prepress and Print shop

- Exact reproductions
- Problem-free printing of mixed formes
- Less waste copies
- Shorter make-ready time on the printing press
- Tighter tolerances during print process is possible
- Increased production stability due to a smooth workflow
- Reduced costs for material and time
- Improved quality of the printed product
- AFTER ALL THE MOST IMPORTANT…….
- CONSISTANCY
- Important standards for the printing and media industry

ISO 12647-series	Process control for all printing methods
ISO 2846-series	Printing ink standards for all printing methods
ISO 13655	Spectral measurement and colourimetry
ISO 15930-series	PDF/X - standards for standard data exchange
ISO 12640-series	Standard colour image data (reference images)
ISO 12642	Test chart (928 patches) for measured data, ICC profiles
E 16614	Extended test chart (1,485 patches, ECI 2002)
DIN 19306	Printing paper (general technical delivery specifications)
ISO 12636	Testing criteria for blankets
ISO 12218	Testing criteria for printing plates

LEADING GLOBAL INSTITUTIONS FOR STANDARDISATION

ANSI	American National Standards Institute
BIS	Bureau of Indian Standards
BVDM	Bundesverband Druck und Medien e.V. (German Printing and Media Industries' Federation)
DIN	Deutsches Institut für Normung (German Institute for Standardisation)
FOGRA	Forschungsgesellschaft Druck (Graphic Technology Research Association)
GAIN/GATF	Graphic Arts Technical Foundation
GRACOL	
ISO	International Organisation for Standardisation
SID	Sächsisches Institut für die Druckindustrie GmbH,
UGRA	Swiss Federal Laboratories for Materials Testing and Research

WHAT SHOULD WE DO NOW?
* Is it necessary to accept an international standard as it is?
* Do we need customised standards?

I strongly feel we need to have a customized standard for India.

OPTIMIZATION OF THE PRINTING AND PRE-PRESS PROCESSES FOR FLEXO PRINTING

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Obtaining high quality production, complying with the needs and desires of the clients is connected to several factors, concerning not only the pre-press and plate making processes, but also processes relating to press- ready, the printing itself and finishing. This imposes the necessity of defining the optimal parameters for the plate making and printing and monitoring the print quality using measurement devices.

Based on this every leading company makes at least once per year tests and calibrations of the technical process and equipment.

Key words: digital photopolymer plates, flexo printing, printing machines, optimization of printing conditions.

Aims and purposes of the research

► The goal of the present work is to define the optimal parameters in pre-press for plate making of digital photopolymer plates printed on flexo printing press Gallus EM 280.

Print results are received to the specifications used by the printing house. In the test trial we used Cyrel® DPU 45 and DPU 67 printing plates with solvent washing process.

Methods and means of the research:

The following equipment was used:

► Image recording device – Creo Thermal Plate 4042 of Creo Ltd

► Exposure unit (for back and main expose, as well as for the light finishing and post exposure) DuPont Cyrel® 1000 EC/LF

► Processor for washing the exposed plates - DuPont Cyrel® 1000 P.

►Drying unit DuPont Cyrel® 1000 D

► Printing press Gallus EM 280

The examined print results were received on narrow web printing press, for high quality printing of self-adhesive labels and foils.

As the printing house is specialized for high quality printing of self-adhesive labels and foils used in food, wine and tobacco industries, the settings for the test target was printed at the standard production conditions.

That's why the tests were done with the anilox rolls used in a standard production with the following screen ruling and ink transfer: for Cyan -470/4.0, Mangenta - 320/5.5, Yellow - 470/3.7 and for Black - 280/6.0 and with UV-ink from Sericol Ltd.

To achieve consistency of color reproduction for the repeat runs it is important to keep the ink transfer under control.

The printing house has accepted the speed of 30 m/min. as the average for printing of halftone color images.

The printing house is using tapes with different hardness – for fine screen - soft tapes such as 3M E11 and hard tape such as 3M E15 for solids.

Analyze of the received results:

A set of digital plates with a test target was initially prepared. It was done with a plates with thickness – 1.14 mm. and hardness – 75 A with a test target with a screening ruling of 175 lpi. The plates were produced according to optimal plate making parameters.

The print samples are accordant to the used by the printing house internal standards. Test target was printed on paper Raflacoat+RP/51 using soft tape at medium printing speed – 30 m/min. The used anilox rolls were described previously.

Print results (dot size) were measured with a spectrophotometer - Gretag Macbeth.

Based on the received data a printing curve for tonal value was created to evaluate the printing capabilities – dot size of print compared with dot size of plate for a single color Cyan at 175 lpi: Sprint = f(Splate,%) (fig 1)

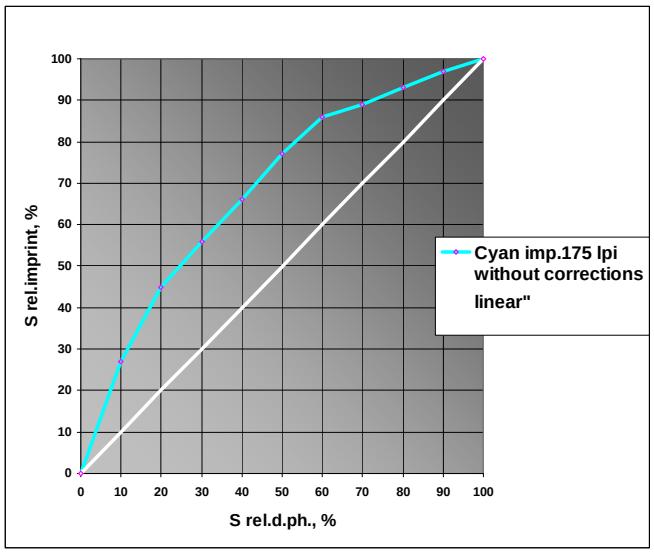

Figure 1. Tonal reproduction curve at 175 lpi.

Analyzing the print results it's visible that dot gain is quite high and needs compensation. The problem is that once a dot gain compensation curves are applied, then result is a lost of gray levels in highlights. So the image will loose details in highlights. This is a well known problem created by using a linearization method – when we apply a compensation curve to make the dot size on plate linear.

Considering the received results, it was agreed with the production department to make corrections in the pre-press processes. Instead of using a linear dot size on plate, a linear image file was used. Based on the received results (fig. 3 and 4) a bump-up curves were specified and applied, that gave a stable reproduction of the fine dots in highlights.

After tonal corrections, two new sets of printing forms where prepared, following the initial conditions. The plates were with the same thickness and hardness as before, but differ by the screen ruling (150 lpi and 175 lpi). The aim is to compare the tonal reproduction with different screen ruling at already corrected tonal curves.

The measuring of dot size on plate was done with Vipflex 334.

The measuring accuracy of the unit is 1%.

Tonal reproduction curves of dot size on plate compared to file values are presented on fig. 2 and fig. 3).

Tonal curves for all colors are clearly very near and in many points practically they overlap, which is not a surprise. For this reason the next analysis and comparisons will be done just for one of the colors.

The analysis of the data received from the tonal curves leads to the conclusion, that the dot size on plates for both screen rulings are reproduced nearly

without any shortcomings. Just a slight deviation in the reproduction of the screen dots in the highlights is observed, which will for sure reflect on printing. Based on this the bump up curves are specified, who should not only compensate the dot shrinking, but also print conditions at Rotoprint printing house.

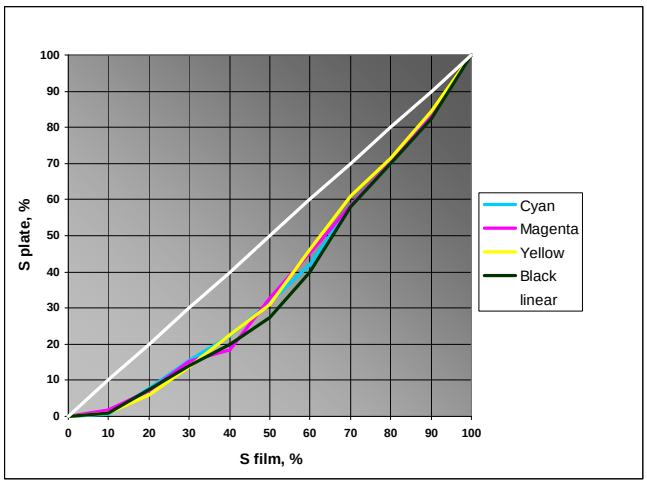

Figure 2. Tonal reproduction curves comparison for screen ruling 175 lpi.

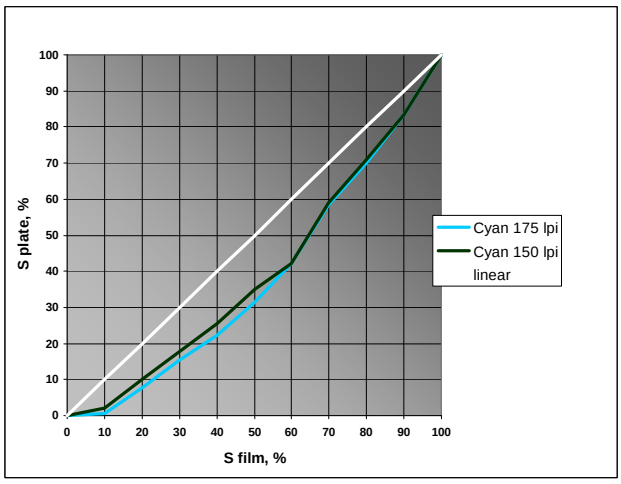

Figure 3.Tonal curves for different screen ruling

The next step of the trial was to print test targets with already applied corrections in pre-press. The plate making conditions, aniloxes and printing speed remain the same. Test targets were printed on 3 different substrates and used tapes were with different hardness.

A wide range of measurements were made, but we concentrated on one of the substrates (Raflacoat + RP/51), mostly used in the production. The other images were visually evaluated. The values of the printed dot sizes were measured.

Based on the received data printed tonal values were compared with the dot sizes on plates. S print = f(S plate) (fig. 4 and fig. 5).

No doubt that the results of implemented corrections significantly influence the tone reproduction in the positive direction, especially in the highlights and mid tones. This is of major importance for the production Rotaprint, because it improves the print quality of vignettes. Also, there is definitely improvement in the gradation in mid tones. And in general the whole reproduction process is significantly improved.

In Rotoprint usually a soft tape is used to avoid “cloudiness” and gear marks effects when printing on paper.

Analyzing the gradation curves of printed test targets for different screen ruling we can conclude that at 150 lpi reproduction is more stable and is less sensitive to the print impression, but the gradation in the highlights remain the same. In highlights the dot gain curves for bought screen ruling are also the same, what can be explained with the fact that higher dot gain for higher screen ruling is compensated by higher dot shrinking in the plate making process. There is

a small difference in the mid tone where the positive dots are transforming to negative dots.

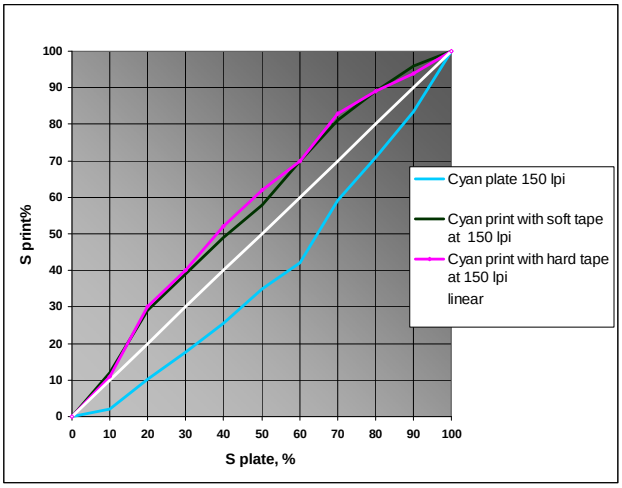

Figure 4. The tonal reproduction curves comparing printing with soft and hard tapes at 150 lpi.

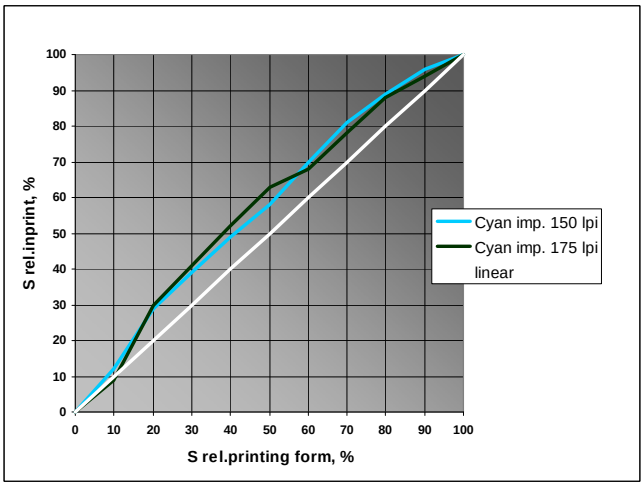

Figure 5. The tonal reproduction curves comparing printing with different screen ruling.

Finally, based on provided measurements and printed test targets was established, that the print quality was highly improved after the corrections made. The main conclusion based on achieved results is that the described pre-press corrections help largely to improve the print quality. The following advises were done – to increase a bit more the bump-up curves and to increase slightly dot gain compensation curves in the mid tones.

The optical densities of solids - the 100% fields, were also measured with a spectrophotometer and were compared with the values given by the ink manufactories. The results are given in Table 1.

Table 1

Optical densities of 100 %-fields

Producer User	Values for the optical densities of 100 %-fields, received with the use of the following anylox rollers			
	D_{cyan}/anylox	$D_{magenta}$/anylox	D_{yellow}/anylox	D_{black}/anylox
1. Sericol	1,35-1,40 470/2,1	1,30-1,35 470/3,5	1,35-1,40 470/3,7	>1,5 470/3,5
2. Rotoprint	1,10 470/4,0	0,93 320/5,5	1,13 470/3,7	1,64 280/6,0

The optical densities at solids for print samples printed with a soft tape on paper (Ralfacoat+RP-51) at a regular printing speed (30 m/min.), are compared to the targets given by ink suppliers

It may be noted after comparing the data from Table 1, that the values for the densities of solids are considerably lower than those recommended by the ink supplier– Sericol. On the other hand, the used anilox rollers have a different and a lower ink transfer than the recommended. Solely the value for the density of the black ink enters into the limits, defined by the producer, but it was achieved by using anilox with much higher ink transfer.

Clogging of the anilox rollers may be the cause, which in the particular case may lead to such deviations. As a result of the analysis and recommendation, the screening rolls were deeply cleaned by means of a supersonic bath.

Conclusions:

► From the analysis made was established, that the printing with screen ruling of 175 lpi causes in a certain extend difficulties in the reproduction quality in the highlights, due to the reproduction of fine screen dots, particularly pressure sensitive.

► Pre-press corrections concerning in highlights are recommended. The so called bump-up of the gradation curve is done in the highlights which guarantee a stable reproduction of the fine screen elements.

► It is established, that after the corrections, the quality of the received print samples is significantly ameliorated. The additional recommendations that were made are the following: it is necessary to be adopted a higher bump-up curve in the highlights because of the printing processes; to be equalized the dot gain in the separate color channels and an additional minimal gradation enhancement in the mid tone when printing with screen ruling 150 lpi can be done.

► Regarding the ink transfer in the solids (optic densities of 100% fields) for the most often used screen ruling (150 lpi) in the production, considering the recommendations given by the ink manufacture was established, that the densities are rather lower than the recommended and the main cause for this turns to be the clogging of the anilox rolls.

It is also recommended, when printing with black ink an anilox with a higher screen ruling should be used and a deep cleaning of all screen rolls in supersonic bath must be carried out two times monthly.

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RESEARCH OF COLOR SPACE CONVERSION BASED ON NEURAL NETWORKS

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Abstract

Color management is a key of pre-press technology in graphic arts’ reproduction. And the conversion of color space is the core technology of color management. Therefore research on the color space conversion has important values in both theory research and practical application. The artificial neural network is a kind of mathematical model which simulates the biological neurons, imitates the behavioral characteristics of biological neural networks, and carries out the distributed parallel information processing by using a lot of small processing units, and it is a kind of important science method to research and solve many practical problems. This paper divides up the LAB and CMYK color spaces based on the artificial neural networks and converts them manually by using the color picker of Adobe Photoshop software, thereby obtaining the date of modeling samples and checking samples. The paper establishes the mutual conversion models between L*a*b* and CMYK color space based respectively on BP neural network and general regression neural network by programming with MATLAB 7.5 software, evaluates the conversion precisions thereof respectively and compares the advantages and disadvantages thereof.

In collecting the modeling samples and checking samples, the paper divides respectively up the $L^*a^*b^*$ and CMYK color spaces relative uniformly by using the method of dividing up of color spaces and carries out full arrangements to obtain the input date of samples, and converts respectively them into the target date of L*a*b* color spaces samples which are independent of equipment by using the color picker of Adobe Photoshop software. In programming using MATLAB software, the paper regulates the names of matrix variables and files according to the abbreviations, capital and minuscule letters of English words, which greatly enhances the readability and portability of programs. In evaluating the precision of two conversion models from L*a*b* color space which is independent of equipment to CMYK color space which are correlative with equipment, because the emulating output values are in the CMYK color space which are correlative with equipment, the color differences of conversion thereof cannot be calculated, the paper uses the “indirect method”, i.e. CMYK values of emulating output are converted back L*a*b* values manually by using color picker, then the color differences are

calculated with the values and the input values of original L*a*b*. Hence the precisions of models are evaluated indirectly.

The modeling and checking results indicate that the precisions of all conversion models of neural networks established by this paper are higher. Whereas the conversion model of BP neural network training needs more time and the number of neurons in hidden layer is not easily determined. The conversion model based on general regression neural network has a high precision and very fast training speed, and it can be used for digital proofing, direct checking of images, computer color matching, color separation of image, image remedying, development of color control software and other relative technique fields of color management.

Key words: Color Space Conversion; MATLAB Software; BP Neural Network; General Regression Neural Network

1. Introduction

Accurate color reproduction is always the key task in graphic arts technology. According to the fast development of printing technology, digital printing process and different kinds of input, output devices are used widely. In order to obtain the stable, accordant and high-grade images in the whole workflow color management is absolutely essential. As the central part of color management technology, research on color space conversion is very necessary.

Till now there are many algorithms to realize the conversion of output color spaces and device independent color spaces. They are mainly divided into polynomial regression method, color models based on optics and ink mixing include the Neugebauer equations, the Yule-Nielsen model, the Clapper-Yule model, the Kubelka-Munk theory, and the Beer-Bouguer law [1], 3D-LUT with interpolation and neural networks. Of particular relevance to this study are nonlinear regression models based on artificial neural networks and they can achieve higher precision. So there are some applications performed by using BP neural networks of color space conversions in color scanners, monitors and printers. But there are usually two main problems existing in BP neural network applications, one is low convergent speed and the other is local minimum point occurring in object function [2].

Generalized regression neural network is presented by American scholar-Donald F. Specht in 1991[3]. GRNN has very strong nonlinear mapping ability, flexible net structure and high fault tolerance and robustness. It's very suitable for nonlinear issues' research and it has advantage over BP neural networks in approximation ability and learning speed[4].So in this paper a new efficient generalized regression neural network (GRNN for short) is adopted to research CMYK and L*a*b* color space conversion.

2. Selecting of Modeling Data

Modeling CMYK data are obtained from Adobe Photoshop CS3 color picker under the condition of U.S. Web Coated（SWOP）v2. C,M,Y,K dot percentage values change from 0 to 100. They are set separately as 0,20,40,60, 80,

100 and then each number of these values do permutation and combination together. Therefore the modeling sets' numbers are 6×6×6×6=1296.Then put these arrays' value to color picker and corresponding $L^*a^*b^*$ values should be transferred. For example, put C,M,Y,K values as 10,20,40,60, the $L^*a^*b^*$ values are transferred to 46,6,18.These putting CMYK values and corresponding $L^*a^*b^*$ values are used to train the BP and GRNN neural networks for color space conversion. In the same way the 625 sets data used to verify the precision of the model are obtained, too. Set C,M,Y,K as 4,27,50,73,96 separately and do permutation. These data (5×5×5×5=625) are input into the Adobe Photoshop CS3 color picker, the corresponding $L^*a^*b^*$ values are then transferred.

3. Structures and Building of BP Neural Network for Color Space Conversion

3.1 Introduction to BP Neural Network

The Back-Propagation Neural Network is presented by Rumelhart, ect, in 1986. It functions as follows: Each neuron receives a signal from the neurons in the previous layer, and each of those signals is multiplied by a separate weight value. The weighted inputs are summed, and passed through a limiting function which scales the output to a fixed range of values. The output of the limiter is then broadcast to all of the neurons in the next layer. So, to use the network to solve a problem, the input values is applied to the inputs of the first layer, allow the signals to propagate through the network, and read the output values. As show in figure 1 the 3-layer BP neural network is selected to build the color space conversion model.

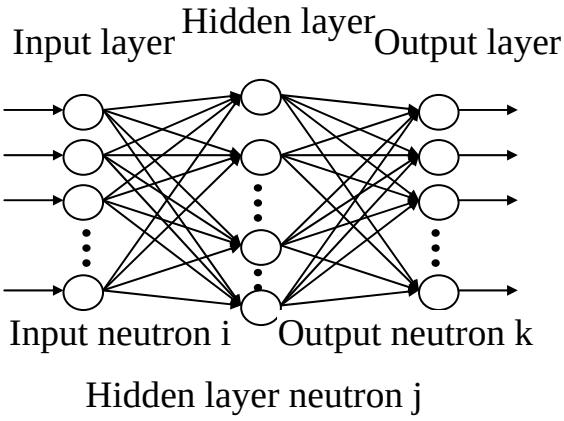

Figure 1. Three layers of model structure of BP Neural Network

By means of network training, calculating and judging the deviation of the output values of training model and objective samples. If the result misses the aim, back calculating is done from output layer to the first hidden layer and the net connecting weights are adjusted according to the principle of minimum deviation. The connecting weights of every net node are determined until total training

samples meet the requirement. In this way the BP Neural Network for Color Space Conversion could be built up.

3.2 Establishment and Accuracy Test of Color Space Conversion Model between CMYK and L*a*b* based on BP Neural Network

In this part BP Neural Networks for Color Space Conversion from CMYK to L*a*b* and L*a*b* to CMYK are built up separately using the 1296 sets CMYK values and corresponding L*a*b* values. The difference exits in the input layer and output layer variables. They are reversed, CMYK or L*a*b* sets. And the precision of models is tested using the other 625 sets CMYK values and corresponding L*a*b* values.

The neutron numbers of hidden layer varied to build and train the models. Then the models' deviation is calculated. As a result it is set to 15.And the testing result of BP neural network model from CMYK to L*a*b* is calculated by using the CIE L*a*b* 1976 color deviation formula, as shown in Fig.2. The biggest color deviation between L*a*b* values of training model and objective L*a*b* values is 6.2545, while the smallest one is 0.2431. Among all testing samples the average color deviation is 1.5030 and the percentage bellowing 6 is 99.84%.

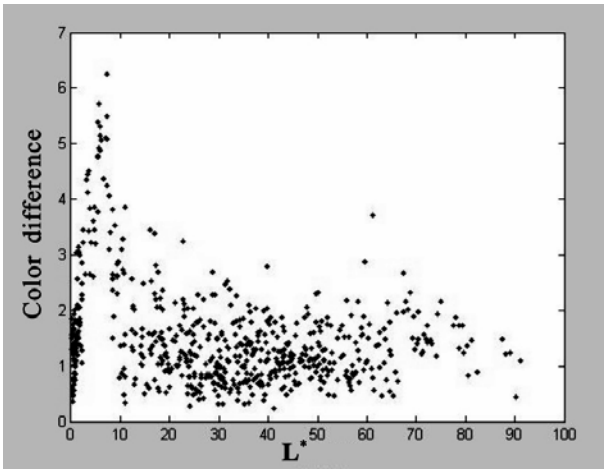

Figure 2. Distribution chart of conversion color difference from CMYK to L*a*b*

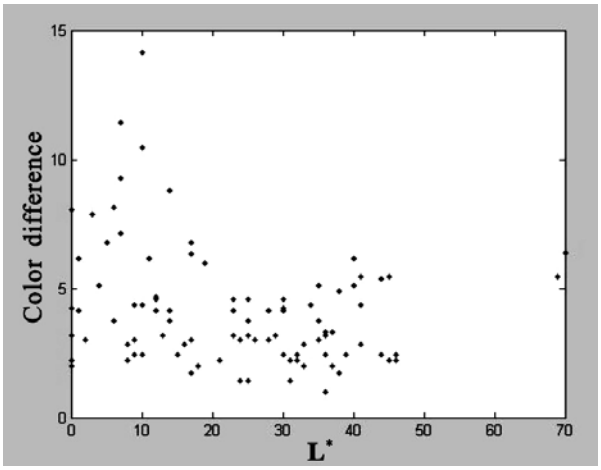

Figure3. Distribution chart of 100 samples with the upper bigger error converting from L*a*b* to CMYK

The precision testing process of BP neural network model from L*a*b* to CMYK is shown in Fig.4.

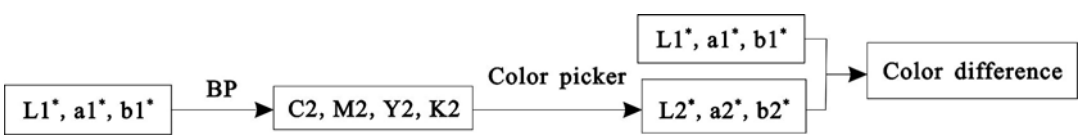

Figure 4. Precision testing Workflow of color space conversion from L*a*b* to CMYK of BP neural network

At first the testing result of BP neural network model from L*a*b* to CMYK is calculated according to formula (1).Selecting the 100 samples of upper bigger meanE values. And then convert these training C2M2Y2K2 values in Photoshop color picker to L2*a2*b2*.Finally calculate the color difference between the modeling input L1*a1*b2* and L2*a2*b2*.

$$meanE = \sqrt{(C1-C2)^2 + (M1-M2)^2 + (Y1-Y2)^2 + (K1-K2)^2} \qquad (1)$$

Distribution chart of 100 samples with the upper bigger error converting from L*a*b* to CMYK is shown in Fig.3.Among these 100 testing samples, the biggest color deviation between modeling and converted L*a*b* values is 14.1421, while the smallest one is 1. The average color deviation is 4.0603 and the percentage bellowing 6 is 83%. Because the statistical result is based on the upper bigger error samples, the actual precision of all testing samples is much higher.

It's obviously that the color conversion based on BP neural network has higher precision. But when there's more training samples, the training speed of the neural network is very slow and the results fluctuate along with each training and simulating process.

4. Structures and Building of General Regression Neural Network for Color Space Conversion

4.1 Introduction of General Regression Neural Network

General Regression Neural Network (GRNN in short) structure is showed in Fig.6. The GRNN predicts the value of one or more dependent variables, given the value of one or more independent variables. The GRNN thus takes as an input vector x of length n and generates an output vector (or scalar) y' of length m, where y' is the prediction of the actual output y. The GRNN does this by comparing a new input pattern x with a set of p stored patterns xi (pattern nodes) for which the actual output yi is known. The predicted output y ' is the weighted average of all these associated stored outputs yij. Equation(2) expresses how each predicted output component y'j is a function of the corresponding output components yj associated with each stored pattern xi. The weight W(x, xi) reflects the contribution of each known output yi to the predicted output. It is a measure of the similarity of each pattern node with the input pattern [4].

$$y_j = \frac{N_j}{D} = \frac{\sum_{i=1}^{p} y_{ij} W(x, x^i)}{\sum_{i=1}^{p} W(x, x^i)} \qquad j = 1,2,\ldots,m \qquad (2)$$

It is clear from Equation (2) that the predicted output magnitude will always lie between the minimum and maximum magnitude of the desired outputs (yij)

associated with the stored patterns (since 0≤ W≤ 1). The GRNN is best seen as an interpolator, which interpolates between the desired outputs of pattern layer nodes that are located near the input vector (or scalar) in the input space[6]. A standard way to define the similarity function W, is to base it on a distance function, D(x1,x2), that gives a measure of the distance or dissimilarity between two patterns x1 and x2. The desired property of the weight function W(x, xi) is that its magnitude for a stored pattern xi be inversely proportional to its distance from the input pattern x (if the distance is zero the weight is a maximum of unity). The standard distance and weight functions are given by the following two equations, respectively [4]:

$$D(x_1,x_2)=\sum_{k=1}^{n}\left(\frac{x_{1k}-x_{2k}}{\sigma_k}\right)^2 \qquad (3)$$

$$w(x,x^i)=e^{-D(x,x^i)} \qquad (4)$$

In Equation (3), each input variable has its own sigma value (σk). This formulation is different from Specht's [3] original work where he used a single sigma value for all input variables. Figure 6 shows a schematic depiction of the four layers GRNN. The first, or input layer, stores an input vector x. The second is the pattern layer which computes the distances D(x, xi) between the incoming pattern x and stored patterns xi. The pattem nodes output the quantities W(x, xi). The third is the summation layer. This layer computes Nj, the sums of the products of W(x, xi) and the associated known output component yi. The summation layer also has a node to compute D, the sum of all W(x, xi). Finally, the fourth layer divides Nj by D to produce the estimated output component y'j, that is a localized average of the stored output patterns [4].

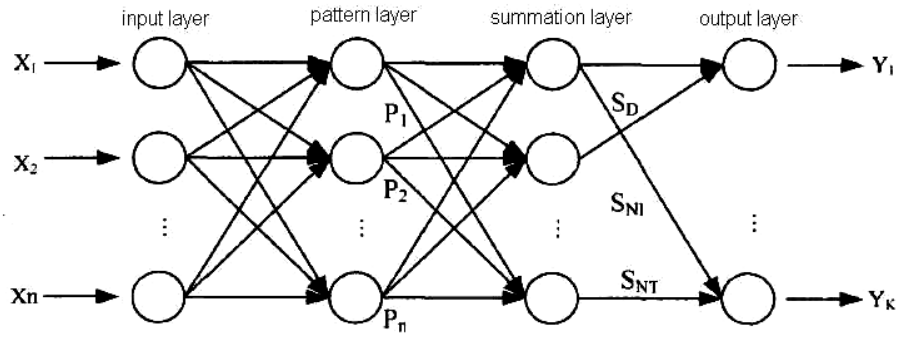

Figure 5. Structure chart of GRNN

3.2 Establishment and Accuracy Test of Color Space Conversion Model between CMYK and L*a*b* based on GRNN

For GRNN if the learning data is determined the corresponding network structure and weight values between neurons are also determined. So the training of network is the process to determine the SPREAD value. SPREAD value which determines spread of radial basis functions has great effect on forecast performance

of the network. This paper determines SPREAD value by aid of performance function ***mse*** in Matlab. It is determined as follows:

Firstly give an initial value to SPREAD.

Secondly compute the training MSE (mean squared error) and testing MSE (mean squared error).The network can be evaluated by the training MSE and testing MSE.

Thirdly make SPREAD value change from a to b and for each SPREAD value repeat step two. The SPREAD value which is corresponding to least testing MSE and tolerable training MSE is chosen.

By using Matlab 7.5 software running result of spread constant optimizing program is shown in Fig.6. And the mean square error of testing sample' objective value and model' training output value is minimum to 0.7453 when spread value is 11.5.So, the optimum spread value is got. Then The GRNN transferred from CMYK to L*a*b* is built up.

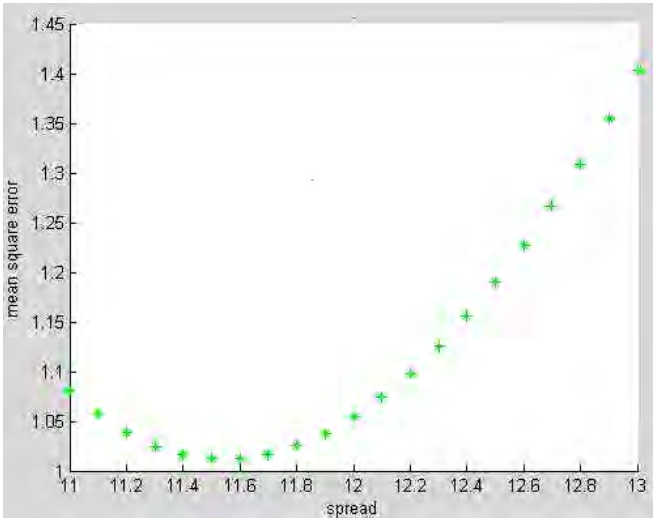

Figure 6. Optimizing chart of spread constant

The average color difference of checking patches is $1.4139\Delta E_{ab}^{*}$ and the percentage of checking patches'chromatism less than $6\Delta E_{ab}^{*}$ accounts for 99.84%. And the maximum color deviation of training and modeling objective L*a*b* is 6.1254 while the minimum one is 0.0669.Comparing with the BP neural network built with same modeling samples, the precision of GRNN is higher and the training speed is much faster.

Use above method to determine that the SPREAD value is 3.6.Then the color space conversion model from the input L*a*b* space to the output CMYK space based on GRNN is built. Finally colorimetric data of 625checking patches are fed into the color space conversion model for predicting the CMYK dot area coverage values. According to the workflow of Fig.4, the upper bigger error converting from L*a*b* to CMYK is selected. Among these 100 testing samples, the biggest color deviation between modeling and converted L*a*b* values is 6.5574, while the smallest one is 0. The average color deviation is 3.1519 and the

percentage bellowing 6 is 94%. It's obviously that the precision is much higher and the training speed is much faster than corresponding BP network.

4 Conclusions

This paper introduces GRNN into color conversion research and puts forward determining the spread values by aid of performance function MSE in Matllab. According to the entire training process and results analysis, it can be concluded GRNN which structure can be automatically adjusted has advantage over BP neural networks whether from the simplicity of training, training speed or accuracy. Hope that this work can provide wider basis and a new way for color space conversion study in color management. And further more the study could be used in on-line image detecting, computer color matching, image color separation, digital proofing and image impainting, ect. Hence the research work is valuable both in theory and application.

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GLOBALIZED GRAPHIC COMMUNICATIONS EDUCATION: WHERE DO WE START?

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The internationalization of businesses and industries in the digital age has opened opportunities for collaborative curricular efforts toward a worldwide study of graphic communications. Moreover, opportunities exist for universities and colleges to use technology to reach other schools of higher education offering graphic communication to expand learning opportunities for students and faculty. The availability of an international dimension to graphic communications education provides students and faculty with opportunities to do research collaborations, exchange ideas for project assignments, as well as learn language and culture. In order for college level students studying graphic communications from the United States to be competitive in a global workforce, an international graphic communications curriculum must therefore be developed. Consequently, guidance from industry advisory board members becomes

essential in ascertaining a relevant learning path to produce an international curriculum in graphic communications.

Introduction

The question, “what are students expected to know” in preparation for a career in graphic communications is challenged by the evolving technology driving the curriculum. As noted by Wood and Davis (1978), for higher education, most curriculum change is piecemeal, incremental, and unplanned (p. 3). The intricacies involved in the development of a college course of study are due to perceptions of educators and their definition of curriculum. According to Eraut (1994), qualifications–which are based on competencies– that professionals have, are different from the competencies that are derived from the syllabi found in universities preparing students for occupations such as management. He noticed that there is disagreement with the higher education design of what students are expected to know in order to become qualified for entry-level positions in industry.

The introduction of new technology to a course of study furthers the complexity of curriculum design (Craft, 1998). The accelerated change occurring in the graphic communications industry has placed pressures affecting the college or university graphic communications management curriculum (Lewis, 1996: Peck & Compton, 1994). Rapid change is a challenge for anyone involved in the design and development of the curriculum (Lauda & McCrory, 1986).

Major computer software upgrades generally occur every 18 to 20 months–caused by demand for efficient tools. Refinements to printing and digital media continue to improve, as well. Students choosing graphic communications, as a major study must realize during their three to four years of education, they have to be ready for a career that may span thirty to forty years. The graphic communications educator has to develop a curriculum that prepares students to become adaptable to a changing technology and workforce.

As technology continues to develop, the world gets smaller. Students are finding “study abroad” as a great opportunity to enhance their learning and increase their marketability in the graphic communications industry. Universities such as Appalachian State University, are including in the general education requirements, provisions for international studies.

The importance of Advisory Boards

Efforts to develop a curriculum guide for graphic communications attempting to address the personnel needs of the printing industry are being made on account of an evolving technology. Guiding the learner towards preparation and practice in developing competencies or skills in being able to produce a printed product have been approached by educators in consultations with members of the graphic communications industry. These representatives of industry are voluntary and serve as members of an advisory board bringing their professional expertise from outside of the university community (Dorazio, 1996). Advisory boards made up of members from the industry or the business of print offer graphic

communications education a tremendous amount of support in developing the curriculum or providing support in the way of financial or "gift-in-kind" donations.

The role of the advisory board is to confirm that instructional content is relevant to the practice of the graphic communications industry. Advisory board members in cooperation with the faculty examine curriculum revisions and may make recommendations contributing to the refinement of the graphic communications curriculum. For example, the advisory board for the Northern Alberta Institute of Technology provides advice to faculty to make the graphic communications curriculum "reflect current technologies and trends" (Retrieved May 15, 2009, from http://www.nait.ca/program_home_15318.htm).

The formation of an advisory board begins by identifying key leaders in the industry located in the state or region of the university. The Printing Industries of the Carolinas (PICA) maintains a list of printing companies (members or nonmembers in North and South Carolina). Service on the advisory board is typically by invitation of the program or department representative from within the university. A representative of the university will determine those companies able to participate and contribute to the growth of the graphic communications education. Advisory board members also provide recommendations for equipment and sources of supplies. The key to an effective advisory board is in communication and its ability to apply expertise in areas of job descriptions, employee preparation, and equipment needs. It is imperative that regular contact with the board be managed by a liaison such as the presiding chairperson.

Bylaws are necessary for advisory boards to guide them on proper protocols in their relationship with the graphic communications program, department, college, or university. Having bylaws are typical of the requirements by accrediting agencies such as the Accrediting Council for Collegiate Graphic Communications and the Association of Technology, Management, and Applied Engineering (formerly the National Association of Industrial Technology).

Involvement of the advisory board in organizing career specific events also contributes to awareness of job titles and descriptions. Every year the Graphic Arts and Imaging Technology program at Appalachian State University, conducts *Career Connections*- an event that brings together industry representatives, students, faculty, and administrators. About 15 to 20 companies participate in this event that provides students with the opportunity to interview for internships or an actual job. Students prepare for Career Connections by taking a seminar course offering topics on résumé and cover letter writing.

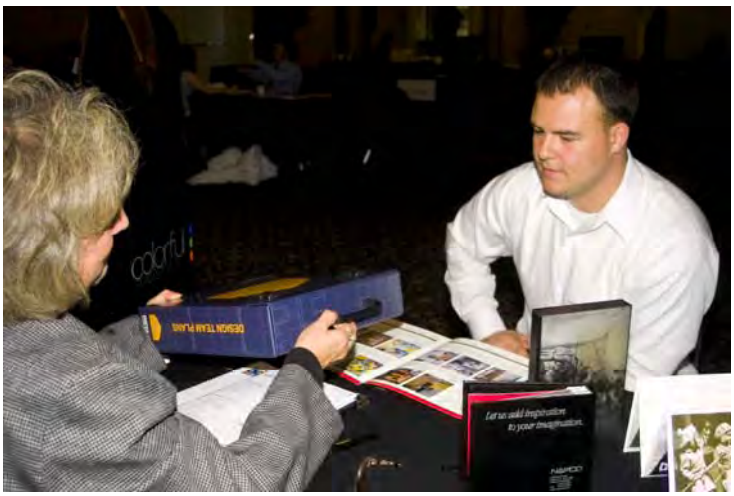

Figure 1. Adam Caudle, an Graphic Arts and Imaging Technology major, interviews with Tammy Wyatt of NAPCO during the 2009 GAIT Career Connections.

Engaging advisory board members in the process of revitalizing the graphic communications curriculum requires an effective means for gathering opinions. Open-ended questions can be asked to begin the process of shaping a curriculum to the expectations of industry. This is necessary in gaining a perspective from industry on a curriculum that prepares individuals with the proper preparation for a career in graphic communications.

The Industry Perspective of the Graphic Communications Curriculum

A pilot test to gather opinions from members of the graphic communications industry was developed to obtain industry perspectives. Five categories were established to provide a starting point for industry members to provide their option.

The first category provides a view of their company. Two members of the Graphic Arts and Imaging Technology Advisory Board participated in the pilot study to test the effectiveness of the opinionnaire. The two advisory board members were then asked to share their options on student preparedness. The form was kept short with open ended questions, similar in design to the first round of a Delphi Technique. This is based on their impressions of graduates from the Graphic Arts and Imaging Technology program at Appalachian State University.

From this pilot study, refinements to the opinionnaire can be made so that more industry professionals can be contacted for their view on the preparation of students and the refinement of the Graphic Arts and Imaging Technology curriculum. Although this was a small test sample, useful information was obtained from those participating.

Results from the Pilot Study

Comments from the first and second respondents are included in the following:

Category 1: Company Information (all information provided will be kept confidential)

- Number of employees: R1 = 225, R2 = 13
- Primary business: R1 = Advertising / Marketing / Public Relations], R2 = Business, Printing]
- Location: Greenville, SC (both companies are from the same city)

The first respondent works in a company employing 225 workers, with a primary business of advertising, marketing/public relations, and business printing. This company is located in Greenville, South Carolina.

Student Preparation

The second respondent works in a company employing 13 workers, producing "business and printing" products. This company is also located in Greenville, South Carolina.

Category 2: Student Preparation

- Has your company hired a graduate from a 2-year or 4-year graphic communications program/department/school or college within the last five years? R1=Yes; R2=Yes
- Do you feel the graduate was prepared/qualified to adequately meet the production expectations of the company? R1=Yes; R2=No
    - Describe areas in which the graduate was most prepared (example: highly knowledgeable with computers, understood the production workflow, quickly adapted to the expectations of the company, or other expectations.)
      R1 = They had a good understanding of all printing processes, color theories, graphics software and had interned with either an ad agency or commercial printing company.],
      R2 = Well Rounded Background but not in-depth on any subject
    - Describe areas in which the graduate of a graphic communications program/department/school or college required more preparation.
      R1 = They needed more time working 'hands-on' with files and printing processes to make sure the two were compatible. In the end, we accepted these deficiencies and supplied additional training for these new, entry-level graduates to bring them up to standard.
      R2 = Understanding practical printing instead of theory.
    - Would you please comment on this category:

R1 = Each new employee has the opportunity to lend their own unique skills and we as the employer have the opportunity to allow them to use these skills. Ultimately, employees are happiest when they are performing a job that is both challenging and rewarding in an area they enjoy.
R2 = No response provided.

The second category's purpose was to gather opinions concerning student preparedness from colleges/universities. It was clear from the response that the smaller company was not satisfied with the student or students graduating from college/university graphic communications program. There is the potential to gather more information regarding the level of preparedness and the college or university program the graduate or graduates hired matriculated. Further refinement to this question is necessary to determine why the respondents were satisfied or not satisfied with the recent hire of a college or university graduate of a graphic communications program/department/or college.

However, useful information was provided, specifically from the item "Describe areas in which the graduate of a graphic communications program/department/school or college required more preparation." Respondents recognize the importance of preparing students with more practical "hands-on" experience.

Respondent Two did not add a comment to the final section of the second category question.

Category 3: Curricular Development and Improvement

- What do you feel is most important for college-level education in the study of graphic communications?
  R1 = A good knowledge of all printing processes and applications for these processes.
  R2 = Understanding digital workflow applied to real world expectations
  - What is college graduates expected to know when considered for employment at your company?
    R1 = That they can fit into a current job position or add another needed, new skill (See accompanying job description for assoc production manager)
    R2 = Basic understanding, more important is the newly employed individual and their attitude/potential
  - Are you familiar with the National Council for Printing Skill Standards? R1 = No; R2 = 2
    If so, do you use it as a guide for identifying employee competencies? R1 = N/A; R2 = No response provided
  - Are you familiar with PrintEd? R1 = No; R2 = No

If so, do you use it as a guide for identifying employee competencies? N1 = N/A; R2 = No response provided.

- Please comment on your experiences with the National Council standards and/or PrintEd? R1 = N/A, R2 = No response provided.

The opinions collected from the third category revealed both respondents are not familiar with PrintEd and the National Council for Printing Skill Standards. Furthermore, recommendations were offered as what is most important for college level graphic communications education.

Category 4: Curricular design

- What would you expect students to experience from an international graphic arts/communications curriculum? R1 = Not sure what would be different than a national program.

- What is most important? R1 = Not sure; R2 = Basic understanding, good work ethics, honesty and integrity.

- Expectations from partnered college or university offering graphic arts/communications. R1 = That all have a common curriculum.

Clarification is necessary for Category 4 based on comments received from the participants**.** They were not certain as to how to respond to the question without knowledge on the status of a national graphic communications curriculum**.**

However, Respondent One provided recommendations for the globalized graphic communications curriculum to include core values or acceptable work ethics.

Category 5: Other

Can you think of other factors that should be considered in the design of a graphic arts/graphic communications curriculum that prepares students for a globalized print industry?

R1 = JDF / PDF workflows; Color management across platforms/processes; Ability to work with foreign type faces like Kanji, etc

R2 = Better understanding of the merge of media, such as print, World Wide Web Marketing, even audio visual. If it touches the senses, we should be embracing it.

Category Five provided respondents an opportunity to offer recommendations that can be examined from an industry perspective. Respondent Two expressed the nature of the business ("If it touches the senses, we should be embracing it"), changes occur rapidly and regularly. Educators would have to determine strategies for integrating the recommendations in the existing curriculum.

The representative from the larger company of 225 employees had a different option concerning graduates from college-level graphic communications programs compared to the opinion of the representative of the smaller company.

Professional/Trade Organizations

Professional organizations are also involved in shaping the graphic communications curriculum. The Graphic Arts Technical Foundation produced instructional materials useful in training learners to understand the process of printing. They used to produce learning modules requiring an audio cassette player and a 35 mm carousel slide projector. Currently, new technologies and the trend in branding organizations have caused a change in the philosophy and options for instructional delivery. Michael Makin, President of the Printing Industries of America announced the removal of Graphic Arts Technical Foundation from the title—PIA/GATF—and presently (as of January 2009) are referred to as *Printing Industries of America: Advancing Graphic Communications*.

Other examples of developments in desktop computer technology have generated a new wave of production tools such as desktop publishing, image processing, computer animation, and World Wide Web. Apple Computer Corporation's introduction of the Macintosh line of computers with a graphical user interface to the public market in 1984 caused a digital revolution impacting all segments of the printing industry. A year later Aldus was formed by Peter Brainerd to produce the PageMaker desktop publishing.

An example of how institutions can use curriculum guides to offer the latest technology to their students is with Clemson University (Clemson, South Carolina). They produced a Graphic Communications curriculum in 1977 that was supported by the PICA and adopted by the South Carolina Department of Instruction. This curriculum guide included the instruction of process photography, cold type composition, offset lithography, bindery and finishing. The purpose of this curriculum was to instruct the learner toward becoming qualified for jobs available in the printing industry. This curriculum was a massive effort that provided lesson plans, recommended textbooks, self-learning tutorials, and instructional guides useful in the printing laboratory environment.

Responding to a critical need by businesses to identify skills needed to succeed in "today's workplace", the United States Departments of Education and Labor funded twenty-two business-education-labor partnerships to develop voluntary skills standards for various industries in 1992 and 1993 (McNeil and

Barnicle, 1996). Printing was specifically funded by the Department of Education for $2,359,295 (McNeil and Barnicle, 1996). Through this funding, the Graphic Arts Technical Foundation conducted the National Printing Skills and Knowledge Standards Project to identify standards for three major occupational areas of the printing trades. These standards derived from industry professionals were used as a guide in developing the PrintEd Curriculum.

PrintED is another competency-based program that is supported by industry and is administered by the Graphic Arts Research Foundations. This national program is used as a guide for secondary and post secondary graphic communications education. Although PrintED does not offer a curriculum, the standards are used as a guide for aligning or shaping curriculums for secondary and post secondary education in the United States.

The Technology of Language

The technology of desktop or notebook computers and the portability of electronic devices combined with learning content formatted for Web Browsers reach larger populations of learners than any other media. Humans have many forms and sources of technology for learning that have been commonly available through schools having the funding to provide tools and environments to enhance education. The Internet or World Wide Web provides learning 24-hours a day, seven days a week. Time zones are not a problem for learners from various countries.

Although language may be a problem for the learner, there are options for students using technology to translate audio and/or text from other languages. Students with access to the World Wide Web can use translator applications such as Systran's Babelfish or Google Translator. However, these translators are not completely accurate and may cause miscommunication or misunderstanding from the native speaker.

There are many electronic devices having capabilities of translating spoken or written languages. Google offers a translation Web page so that translations can be performed by inputting the language in a text field and then clicking the translate command button displayed in the Web browser. Although these translators are often an imperfect system of translation, they do provide the international learner with quick reference for essential translations—such as greetings. Most universities are equipped with computer technology including access to the World Wide Web, thus, providing the international learner access to these tools.

While this Google Web site does not address all of the 6,912 known human languages, it does allow translations of the most common or 41 languages such as English, Spanish, French, and Chinese (traditional and simplified).

Students are at an advantage for international study or exchange programs by having learned the language and culture of countries planned for coursework. Findings from studies indicated increases of students' thinking skills and academic achievement from having at least twenty minutes of a second language instruction

affirms the benefits learning a second language (Johnson, C. E., Flores, J. S., & Eillson, F. P., 1963). When developing an international graphic communications curriculum, student exchange agreements must be established between or among universities.

Integrating International Studies into the Graphic Communications Curriculum

Carlson (1991) found that students deciding to study in other countries for the reasons of "cultural experience, foreign language improvement, desire to live or make acquaintances from another country, interest in gaining another perspective on their home country, desire to travel, and enhancement of understanding of a particular host country". It was also found that approximately one quarter of the students surveyed planned careers in international business.

Barbara Burn (1991) explained reasons international study becomes difficult for undergraduate students to pursue:

- Students perceive that international study is expensive and would prolong their degree studies.
- International study is not clearly implemented in degree programs as integral to a specific program of study or as an elective for undergraduate students.
- Returning students have difficulty in receiving proper credit without articulated agreements with the host institution located in another country.

Faculty may also have their reasons to become involved in an international exchange program or activity. Theirs are driven by professional goals or what is perceived as scholarly requirements towards building their status and reputation as an international scholar. If the faculty member is intrinsically interested in collaborative work or building connections professionally with faculty of similar disciplines but living in different countries, then there should be support from the university's administration to encourage faculty involvement in international activities. A reason that might prevent faculty from doing international exchanges or activities has to do with family commitments. Long-term travel requires provisions for the family—a large enough home, schooling for children and full commitment of all family members with a willingness to adapt to the culture of the country.

Appalachian State University has the Office of International Education and Development that facilitates student and faculty exchange agreements. The purpose of this organizational unit on campus is to offer services such as "international student admissions, study abroad programs, visiting exchange scholars and faculty". There are "41 institutional partnerships in over 17 countries", thus allowing students at Appalachian an opportunity to experience a "diverse community of students, faculty, and staff from around the world (Retrieved May 18, 2009, from http://www.international.appstate.edu/)." Enrolled students at Appalachian State University interested in participating in an exchange

program would need to contact a representative from the International Education and Development to meet with a representative.

Additionally, the Department of Technology at Appalachian State University, provides Web access to students interested in international study. This site provides partial guidance in getting stared with an international studies program. Pertinent forms to guide students in the process of gathering required information are available for downloading to their computer.

In order for students to consider international studies in their plan for a college degree, there must be value associated with the international experience. Courses at the host (international location) universities offering graphic communications must have a graphic communications curriculum or related courses in place to contribute to the student's plan of study.

Since the graphic communications industry is becoming more of a global enterprise, agreements between two universities must be established so that articulation of course credit and tuition payment are obtainable for the student planning to include international study towards fulfillment of their university degree.

Having an agreement established between two universities provides students with a financial advantage since they would pay the tuition at their resident university and then enrolls in courses at a university located in another country.

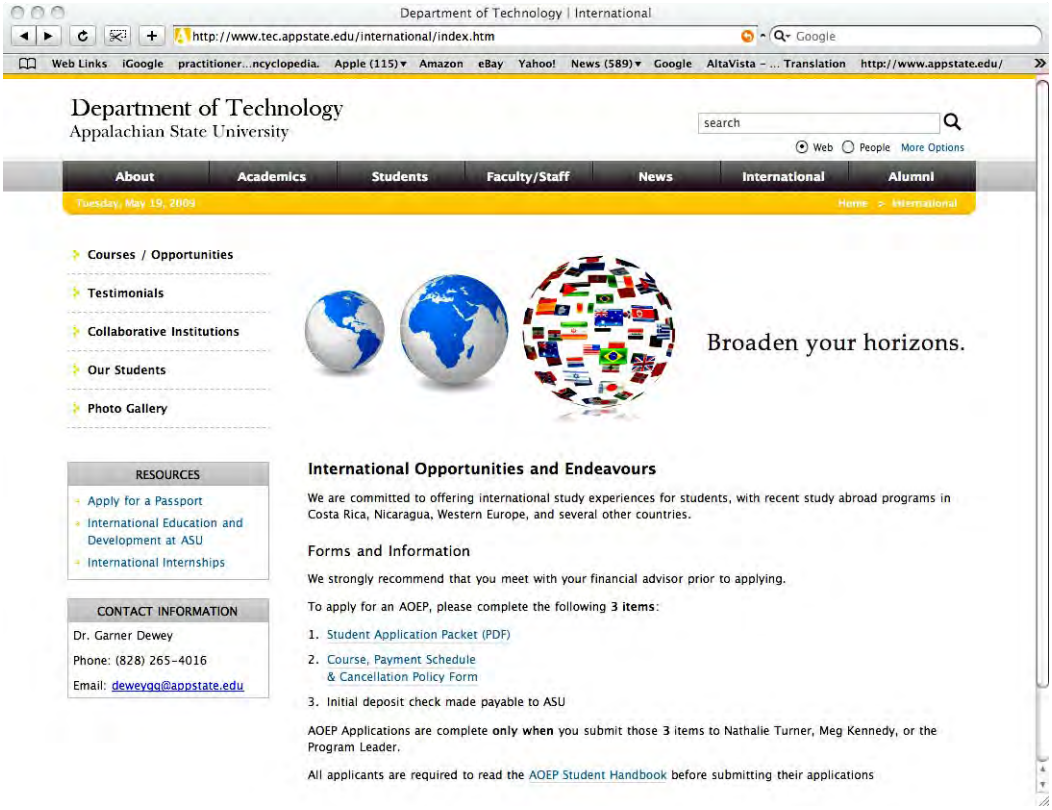

Figure 2. The Department of Technology at Appalachian State University International Studies Web page.

Recommendations for continued study

Further examinations of industry perspectives are needed in shaping the globalized graphic communications curriculum. Improvements to the opinionnaire based on comments received from pilot study participants could be used to generate more data for analysis to determine a trend of opinions from industry representatives.

The other purpose of the opinionnaire is to involve members of the graphic communications industry in providing recommendations toward building a globalized graphic communications curriculum.

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INFLUENCE OF DIFFERENT ILLUMINATIONS ON COLOUR APPEARANCE OF MICA PIGMENTS PRINTED ON SYNTHETIC PAPERS

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Abstract

In the present paper effect pigments, based on natural mineral mica, were investigated. The investigation was focused on the flop index of pigments determined from lightness values measured at different illuminations (D50, A and F11), the haze index and the print gloss of pigments. Two effect pigments were used: pigment *Iriodin® 119 Polar White* and pigment *Iriodin® 325 Solar Gold Satin*, which were overprinted on dried CMYK offset prints. As printing substrates, a film synthetic and a fiber synthetic papers were used. The results showed that at both printing substrates the gold pigment Iriodin® 325, which was overprinted on black offset print obtained the highest flop index. The differences were also obtained between the different illuminations. At D50 illuminant the values of the flop index were the highest, while at illuminant A they were the lowest. Further, the analysis have shown that higher values of the haze index were obtained at the silverwhite pigment Iriodin® 119 printed on the fiber synthetic paper, and the gold pigment Iriodin® 325 printed on the film synthetic paper. Overprinted gold pigment Iriodin® 325 resulted in the highest print gloss for all CMYK prints.

Key words: mica pigments, synthetic paper, flop index, haze index, print gloss.

1. Introduction

Today effect finishes play a dominant role in many applications as they make an object distinctively appealing. In contrast to conventional solid colours, effect finishes change their appearance with viewing angle and lighting conditions. As metallic finishes show a lightness change with different viewing angles, the sample needs to be titled to create the same effect during visual evaluation. This effect is also referred to as “light-dark flop”. The bigger the lightness changes between the angles of view are, the more contours of an object will be accentuated [1].

The most requested class of effect pigments at the moment is basically a mica flake coated with single or multiple thin layer of metal oxide. The interplay of colours produced by these pigments is due to the layered structure of the metal oxide, which is also responsible for the rich deep glossy effect. Effect pigments on mica are typically produced by the deposition of metal oxide layers on the mica in aqueous suspension followed by a calcinations process [2, 3].

We can classify mica pigments as:

- TiO_2 – silver mica pigments (brilliant white) and interference mica pigments (dual colour);

- Iron oxide – high luster earth tones mica pigments (vibrant colour with improved hiding power, especially red metallic like colours);
- TiO_2/Fe_2O_3 or TiO_2/Cr_2O_3 gold or green mica pigments (strong interference effect with improved hiding power due to additional mass tone colour) [4,5].

Possessing very high refractive index (2.5 to 2.7) and chemical and thermal stability, titanium dioxide is the most important white pigment on the market today. Luster and hiding power of effect pigments in the application system are the two most important properties influenced by the particle size distribution of the chosen mica. There is a general rule as follows, larger mica particle diameters lead to increased luster and smaller mica particles diameters generate increased hiding power. The development of mica pigments began with TiO_2-types. The earliest types of pearl luster pigments were silverwhite. As the TiO_2-layer thickness is so thin in this case, there is no interference effect present. Figure 1 showsw schematic illustration of TiO_2 - Mica Pigments and Figure 2 Fe_2O_3 - Mica Pigments. With increasing TiO_2 layer thickness on the mica, an interference colour develops, varying from gold to green. Unlike with colour pigments, there is little or no absorption.

Figure 1. TiO_2 - Mica Pigments.

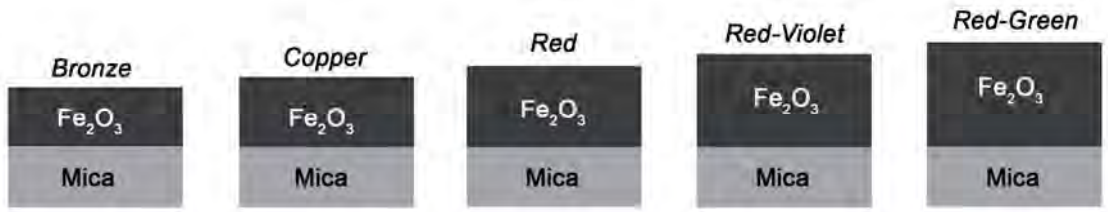


Figure 2. Fe_2O_3 - Mica Pigments.

Effect pigments can be used in various printing techniques, including offset printing. The new generation of effect pigments requires a totally different system of measurement and characterization [4, 6].

2. Experimental

2.1 Materials

In this study, two different effect pigments based on mica were examined: *Iriodin® 325 Solar Gold Satin* and *Iriodin® 119 Polar White*, manufactured from the Merck company. Effect pigments were overprinted in offset technique (printer

KBA Performa 74) on dried CMYK prints on two types of synthetic papers; on fiber synthetic paper *Pretex* and on film synthetic paper *Yupo*. The fiber synthetic paper Pretex is made from selected pulp and synthetic fibers (PES) in combination with a special binder system. Paper is coated on both sides. Yupo is a biaxially-oriented film synthetic paper. It consists of three extruded polypropylene - PP layers with inorganic filler (Calcium Carbonate – $CaCO_3$). This substrate is smoother than most typical base papers. It doesn't contain wood pulp or other bio materials and has a penetration layer on both sides.

2.2 Measurements

The effect pigments were evaluated by the following methods: SEM analysis, flop index, print gloss, and haze index. Microscopic analysis of pigments particles were made by Scanning Electron Microscope JEOL JSM-6060LV at 1000x magnification and 10 kV voltage. Overprinted pigments on CMYK prints were measured by *X-Rite MA68II* multi-angle spectrophotometer. The X-Rite MA68II spectrophotometer illuminates the surface from an angle of 45º and offers viewing angles of 15º, 25º, 45º, 75º and 110º. Paper gloss was measured at 75º using a Zehntner Glossmeter (ISO 8254), while the print gloss was measured at angles of 20º and 60º, using GlossMaster manufactured for quality imaging products. Measurements conform to the ASTM D523 standard measurement protocol.

3. Results

3.1 Properties of effect pigments and synthetic papers

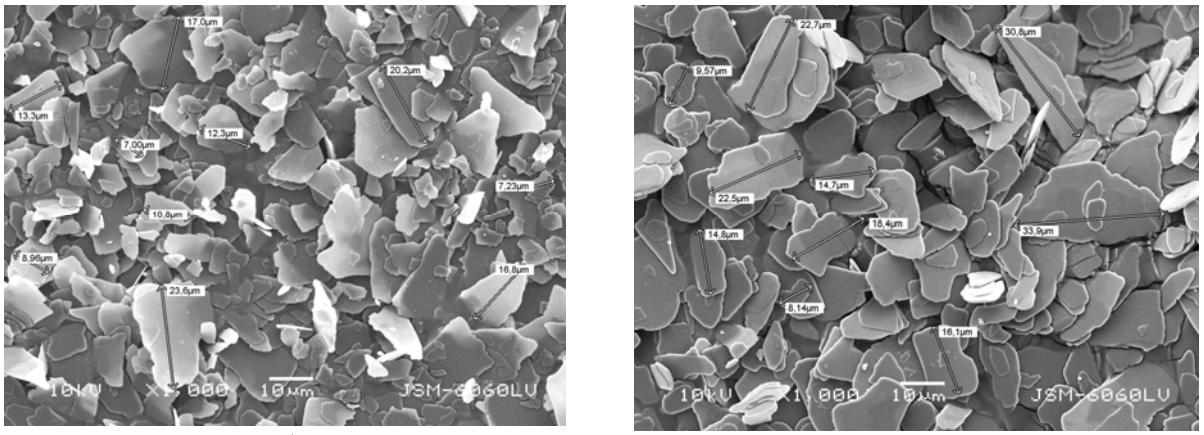
The natural mica is the basis for both pigments, Iriodin® 325 Solar Gold Satin and Iriodin® 119 Polar White. Iriodin® 325 Solar Gold Satin is based on an innovative special metal oxide coating offering a combination of high luster and colour intensity. In the Table 1 the properties of effect pigments are presented.

Table 1

Properties of effect pigments.

Properties	**Iriodin® 119 Polar White**	**Iriodin® 325 Solar Gold**
Physical form	Dry, free-flowing powder	Dry, free-flowing powder
Composition	Mica, TiO_2, SnO_2	Mica + SiO_2, TiO_2, Fe_2O_3, SnO_2
Colour	Silverwhite	Gold
Particle size	5 - 25 µm	5 - 25 µm
pH - value	8 - 11	5 - 10

The pigments can be used independently or in combination with other pigments. Effect created with Iriodin® depend on the pigment type, the pigment particle size and the method of printing [7]. Figure 3 shows a Scanning Electon Micrograph (SEM images) of effect pigments.



a) *b)*

Figure 3. SEM images of effect pigments: a) Iriodin® 119 and b) Iriodin® 325.

Table 2 presents properties of synthetic papers (film synthetic paper Yupo and fiber synthetic paper Pretex) used in this study.

Table 2

Properties of synthetic papers.

Properties	**paper Yupo**	**paper Pretex**
Grammage (g/m^2)	100	100
CIE Whiteness	90	82
Roughness, PPS [µm]	1,2	3,83
Gloss at 75 º [%]	53	27

Synthetic printing papers are defined as products composed of at least 20% synthetic substances. These papers have a well-developed surface capable of absorbing printing inks, a coefficient of maximum ink absorption of at least 50%, and the capability of fixing the printing inks, even those with low adhesiveness to the base paper. Papers that are completely free of natural components can be distinguished from papers containing partially processed natural fibers combined with synthetic fibers. These papers are manufactured differently, and they use different base materials. Synthetic papers can be further divided into papers manufactured from synthetic materials in the form of infinitely fibers or short fibers and products made from granulated materials formed by extrusion in the form of a biaxially oriented multilayer paper. The CIE Whiteness of synthetic papers was measured using a spectrophotometer (Spectroflash 600; Datacolor

International), in compliance with ISO 11475 (D65/10°, D/0, 2r = 6.6 mm). Film synthetic paper Yupo has higher values of whiteness and also of gloss. The paper type, particularly its surface properties, plays a fundamental role in the appearance of the finished printed properties. The roughness of the paper is a very important property for print quality. Surface roughness is usually divided into microscale and macroscale components. There is a difference in roughness between the synthetic papers examined here: Pretex is rougher than Yupo [8, 9, 10].

3.2 Flop index of effect pigments

Flip-flop effect is quantified by flop-index. A flop index (F) was derived as a function of the CIELAB L* measured at three angles in order to quantify an appearance attribute as given in Eq. (1).

$$F = 2.69 * \left(\frac{a}{b} \right) \qquad (1)$$

with $a = \left[L*(15°) - L*(110°) \right]^{1.11}$ and $b = \left[L*(45°) \right]^{0.86}$

The high flop index means a superior appearance [11]. Factors affecting flip-flop effect are the shape and size of pigment particles and the way they are laid down. Flop index is the measurement on the change in reflectance of a metallic colour as it is rotated through the range of viewing angles. A flop index of 0 indicates a solid colour, while a very high flop metallic or pearlescent basecoat/clearcoat colour may have a flop index of 15-17 [2, 12]. Tables 2 and 3 show the flop index calculated from lightness values (L*) measured at different illuminations (D50, A and F11).

Table 3

Flop index of effect pigments printed on film synthetic paper Yupo

Pigments/ Illuminants		**Flop index**		
		D50	**A**	**F11**
Iriodin® 119	**C**	4,50	5,23	5,04
	M	5,08	4,19	4,59
	Y	1,92	1,84	1,84
	K	16,63	16,51	16,61
Iriodin® 325	**C**	4,63	5,45	5,11
	M	5,34	4,51	4,89
	Y	2,11	2,07	2,08
	K	16,96	16,79	16,94

Table 4

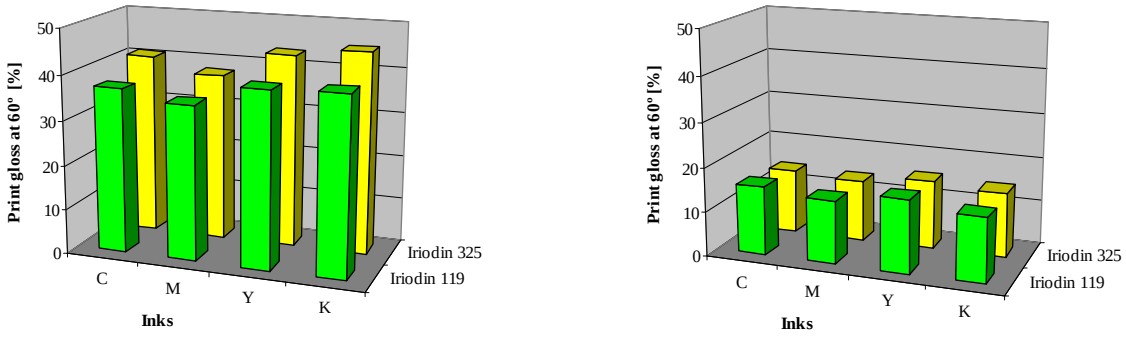
Flop index of effect pigments printed on fiber synthetic paper Pretex.

Pigments / Illuminants		Flop index		
		D50	A	F11
Iriodin® 119	C	3,43	4,02	3,81
	M	4,31	3,57	3,89
	Y	1,34	1,28	1,29
	K	12,07	11,94	12,03
Iriodin® 325	C	4,48	5,20	4,88
	M	5,49	4,68	5,05
	Y	2,08	2,02	2,03
	K	12,75	12,63	12,72

In quality control at least two (or better three) angles should be used to characterize the appearance of effect pigments. An angle 25º [=L*(25º)] has become accepted to describe the visual effect on face. Often angles closer to the reflected light ("nearer to the gloss") are used. If for example, measurements are taken at an angle of 15º [=L*(15º)], the accuracy of the measurement will be less at the measurement is "nearer the gloss". Other angles used are 110º [=L*(110º)], and 70º, which measure the darker appearance on flop. Besides an intermediate angle around 45º [=L*(45º)] is common [13]. As can be seen from Table 3, the flop index is higher at gold pigment Iriodin® 325 in comparison to silverwhite pigment Iriodin® 119. From all CMYK prints, the highest flop index obtained black print and the smallest yellow print. At illuminant D50 (average daylight) the values for black print was F=16,63 at Iriodin® 119 and F=16,96 at Iriodin® 325. Also magenta and yellow print obtained the highest flop index at illuminant D50, while cyan print at illuminant A (incandescent/tungsten). Flop index of effect pigments printed on fiber synthetic paper (Table 4) is also higher at gold pigment Iriodin® 325. Also in this case the black print obtained the highest values at illuminant D50, the flop index was F=12,07 at Iriodin® 119, while at Iriodin® 325 was F=12,75. Flop index at yellow print obtained the smallest values at illuminant A, values at pigment Iriodin® 119 was F=1,25, while at pigment Iriodin® 325 was F=2,02. In contrary, cyan print obtained the highest flop index at illuminant A at both overprinted pigments. If we compare the flop index between printed synthetic papers, we can see that for all CMYK prints the values were higher at film synthetic paper Yupo.

3.3 Print gloss of effect pigment

The geometric attributes of objects such as gloss and haze are perceived as being distinct from colour. In Figure 4 the print gloss of effect pigment printed on two types of synthetic papers is presented.



a) *b)*

Figure 4. Print gloss of effect pigments printed on: a)film synthetic paper Yupo and b) fiber synthetic paper Pretex.

Print gloss is one of the most important aspects of a printed surface. Gloss is the attribute of surfaces that causes them to have a shiny or lustrous appearance [14, 15]. Print gloss depends upon the printed substrate. Two papers with identical colour may produce very different prints if they have different gloss and absorbencies. Gloss can increase by applying an overprint varnish or lamination and is also influenced by effect pigments. The smoother the substrate surface, the better effect pigments can demonstrate their typical features [7, 16, 17]. The synthetic papers and pigments have effect on the print gloss, which can be seen in Figure 2. After printing the pigments on CMYK prints, the print gloss obtained different values on particular print. At film synthetic paper Yupo, the gold pigment Iriodin® 325 contribute to higher print gloss in comparison with silverwhite pigment Iriodin® 119. Black print obtained the highest print gloss at both pigments (at pigment Iriodin® 119 values was 39,80% and at Iriodin® 325 was 45,17%), while magenta print obtained the smallest (at pigment Iriodin® 119 values was 34,70% and at Iriodin® 325 was 37,67%). In the case of prints made on fiber synthetic paper Pretex (Figure 2/b) the values of print gloss were very low. The reason is in the paper's surface properties (see Table 2). Paper Pretex is rough and isn't so glossy as paper Yupo. Another interesting thing is also that, that both printed pigment behaved similarly on paper Pretex. Among them weren't significant deviations. The highest print gloss obtained on yellow print, while on magenta print the smallest.

3.4 Haze index of effect pigments

Haze index (H) is useful for evaluating the haze in clear finishes on non-glossy substrates and in reflected images on opaque glossy pigmented finishes. The most common US standard, ASTM D 4039, specifies two gloss measurements (60º/60º and 20º/20º) to obtain a haze index. The formula for haze index is:

$$H = R60 - R20 \qquad (2)$$

Measured gloss values of specimens depend on the angle of illumination, refractive index of the material, and the geometric distribution of the reflected light. Haze is produced by irregularities in the reflecting surface that affect the distribution of flux reflected around the specular angle. Values for reflection haze are obtained from two measurements of specular gloss, one made with a large receptor aperture and the other made with a small receptor aperture. The geometric conditions have been chosen to permit the use of glossmeters that provide 60° specular gloss measurements (large receptor aperture) and 20° specular gloss measurements (small receptor aperture) [19, 18].

In Table 5 the haze index of effect pigments printed on film synthetic paper Yupo and in Table 6 the haze index of effect pigments printed on fiber synthetic paper Pretex are presented.

Gold pigment Iriodin® 325 printed on film synthetic paper Yupo achieved the highest haze index. The values of haze index on CMYK prints on fiber synthetic paper Pretex were lower, which is influenced by lower paper and print gloss. At both papers, pigment Iriodin® 325 gave the highest haze index for black prints, and the smallest for magenta prints. Pigment Iriodin® 119 gave the highest values for yellow print and also the lowest for magenta prints.

Table 5

Haze index of effect pigments printed on film synthetic paper Yupo.

Pigments	**Haze index**			
	C	**M**	**Y**	**K**
Iriodin® 119	29,40	27,93	30,83	31,13
Iriodin® 325	30,33	29,40	32,47	33,83

Table 6

Haze index of effect pigments printed on fiber synthetic paper Pretex.

Pigments	**Haze index**			
	C	**M**	**Y**	**K**
Iriodin® 119	13,07	12,07	13,23	12,47
Iriodin® 325	12,00	11,40	12,30	12,27

4. Conclusions

In research study the relationship between mica pigments and synthetic papers were investigated on the bases of flip-flop effect, print gloss and haze index. Silverwhite pigment Iriodin® 119 has different influence on CMYK offset prints compared to gold pigment Iriodin® 325. It was found that at film synthetic paper Yupo, the flop index for all CMYK prints were higher as at prints at fiber synthetic paper Pretex. From all CMYK prints, the highest flop index obtained black print and the smallest yellow print at both papers and both pigments. The deviations was also observed between different illuminants, at D50 illuminant the values of the flop index were the highest, while at illuminant A they were the lowest. Significant differences in print gloss were also noticed. At film synthetic paper Yupo, the print gloss was very high, the gold pigment Iriodin® 325 contributes to the highest print gloss. In the case of prints made on fiber synthetic paper Pretex the values of print gloss were very low. The reason is in the paper's surface properties; paper is rough and isn't so glossy as paper Yupo. The haze index is higher at CMYK prints overprinted by gold pigment Iriodin® 325 made on film synthetic paper Yupo, which is consequence to the high print gloss.

Acknowledgement:

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THE IT ORGANISATION AT THE UNIVERSITY COLLEGE ARTEVELDEHOGESCHOOL AND THE COLLABORATION WITH THE GRAPHICAL AND DIGITAL MEDIA DEPARTMENT

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Introduction

University College Arteveldehogeschool (AHS), one of Flanders' largest universities of professional education, situated in Flanders' number one student city Gent, offers a wide variety of study programmes in the fields of teacher training, economic and graphical education, health care and social work. Campuses are spread city-wide. The Graphical and digital media (GDM) department, offering a 3-year professional bachelor degree, is located in Mariakerke, a suburb of Gent.

IT-organization at AHS is partly centrally administered, partly departmentally.
This paper explains how for both hardware and software we monitor this issue.

Hardware

Monitored by AHS

Management of fileservers

All server hardware is centrally governed. This as well accounts to servers located in other campuses than the main campus. At the moment we are adapting the connection between these servers from telephone to fiber backbone. GDM already completed the transition to this fiber network for both long distances on our campus itself and for the connection with our central AHS-services.

On Windows domain controllers in the network an Artelveldhs-domain and a child domain Student were created. The school administration including lecturers reside on the parent domain Arteveldehs; the educational part is located on the child domain Student. Lecturers can reach servers in the child domain but students can't reach the administrative network.

Domain controllers register the computers in the network and every computer gets an IP-address from the system by DHCP. Consequently each computer has a unique number in the network. The computer name is attached to the given IP-number and this is stored in a DNS-table. From this moment on the computer can be reached by its name or by its IP-number.

A centrally provided AHS-wide login and password are stored in a domain database, a so-called Active Directory (AD). Student login resides on the AD in the child domain and the lecturers and administrative workers logins are situated on the AD of the Arteveldehs domain controllers. When someone logs in with his/her login and password for a given domain on a pc or mac in the AHS-network this input is checked with the information in the AD. If there is a match this person is accepted – and known – to the network. The user can now access the pc, no matter the campus where the computer is situated and can reach all resources he/she is allowed to on the complete domain (and child-domain).

On the campus where the department of the user is situated a homefolder for this user is available on a fileserver. Only the user himself/herself is allowed to access this folder. Thus, documents stored here are locked away for others. Lecturers have their own homefolder too. But, as you may expect, this homefolder is on a separate fileserver on their campus in the Arteveldehs domain. Students' homefolders are also situated on their campus but in this case on a fileserver situated in the Student domain.

Helpdesk and IT-emergency team

Everyone, both students and lecturers, can call the helpdesk in an attempt to report any IT-problem during office hours. The IT-specialist always aims at helping the user on the phone.

In case phone intervention fails to solve the problem, the call is registered in a database. As such every problem gets its own "call number". These "calls" are classified in terms of urgency and location. A team of IT-specialists goes on the spot in order to solve several problems during one visit at a certain location.

Local network

Biggest part of the network is cabled from a pc to a central switch in a classroom. These classroom switches are connected to the fileservers in a server room. At the GDM-campus one server room (including air-conditioning) is available. Mostly normal UTP-cabling is used, but at our GDM media campus we have fiber connections between two classrooms and the server room due to distance problems with UTP.

Multimedial and graphical files may become large in size. Therefore and especially for our campus we have upgraded
– from 100 mbs (cat 5) to 1000 mbs (cat 6) UTP;
– from megabit switches to gigabit switches;
– from phone-connections to fiber between our campus and the central campus. We only 'go wireless' in free zones because of its flexibility for laptops, but we don't use it in classrooms because of its slower speed: 54 mbs.

Internet use

There is a farm of proxy-servers in the AHS-network. Per campus we dispose of one proxy-server for caching and distributing internet data locally. All proxy-servers are connected with one centrally managed firewall in an attempt to keep malicious attacks outside the network. Problem might be the bottle neck caused on some moments by heavy external internet usage.

Web servers are installed by IIS (Internet Information Services) on windows servers, but without AD attached to them. By doing so we put them in a so-called demilitarized zone. This is a safe approach, but they don't know logins of students nor lecturers. We can't give them rights on web folders without producing for these new accounts locally on that machine.

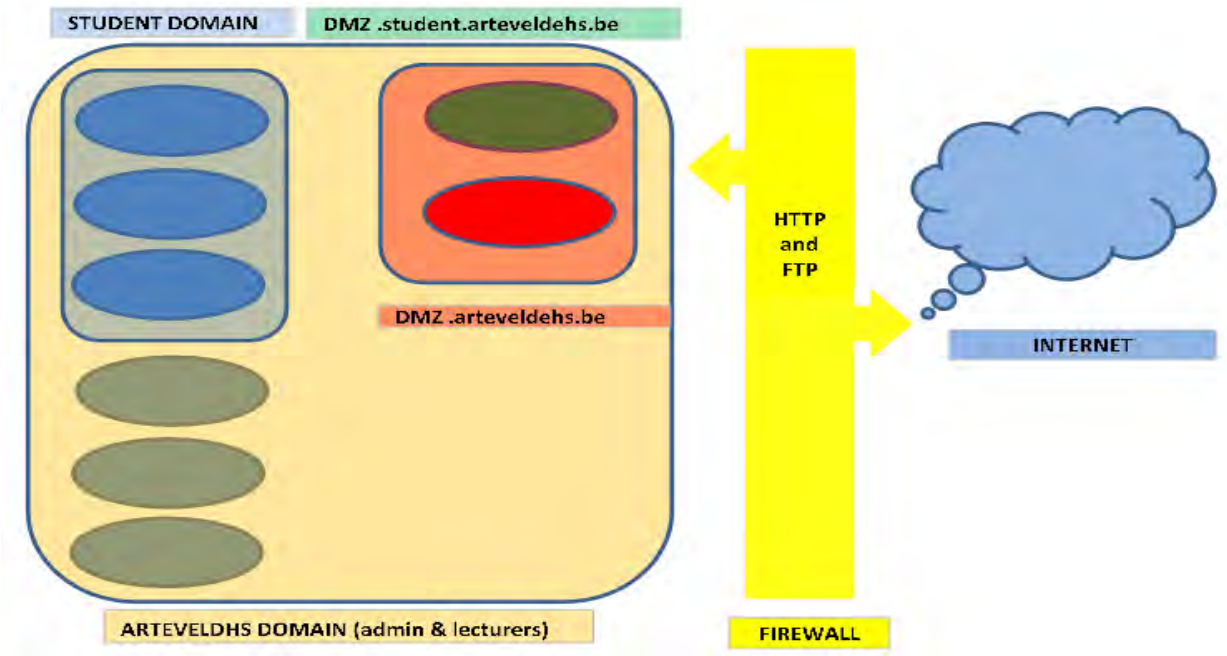
Antivirus server

This server pushes antivirus software on every computer that is hooked in the network to keep malicious attacks and viruses outside the network. It also takes care of the necessary update files when a computer gets back on-line.

Mail servers

Microsoft Exchange servers are centrally managed for all mail in the AHS-domain as well for mails in the Student domain. But this final functionality will be replaced by an external on-line service provider included in a so-called Skydrive.

The domain structure of AHS



Hardware

Monitored by GDM

Web server updates used by GDM for our web designers

Because web servers for safety reasons are not integrated in the AD structure we put all account information and all web folders for our web designers on the machines ourselves. For this purpose we generate VBS-text files from the central student database.

Example of creating an account

```
Set colAccounts = GetObject("WinNT://ahs-ftp1")
Set objUser = colAccounts.Create("user", "aarovspe")
objUser.SetPassword "XXX1XX"
objUser.Description = "Student Mariakerke"
objUser.Fullname = "Van Speybroeck Aaron"
objUser.AccountExpirationDate = "01/01/1970"
objUser.SetInfo
objUserFlags = objUser.Get("UserFlags")
objPasswordExpirationFlag = objUserFlags OR &h10000
objUser.Put "userFlags", objPasswordExpirationFlag
objUser.SetInfo
set WshShell = WScript.CreateObject("WScript.Shell")
WshShell.Run "cmd.exe /c NET USER aarovspe /PASSWORDCHG:NO /TIMES:ALL"
WshShell.Run "cmd.exe /c NET LOCALGROUP Mariakerke aarovspe /Add"
WshShell.Run "cmd.exe /c NET LOCALGROUP Users aarovspe /Add"
```

Example of creating a folder

```
set WshShell = WScript.CreateObject("WScript.Shell")
WshShell.Run "cmd.exe /c md ""d:\GDM\Webtechnologie 2\Sweron Wouter"""
```

```
WshShell.Run "cmd.exe /c cacls ""d:\GDM\Webtechnologie 2\Sweron
Wouter"" /T /G woutswer:C ASPNET:F IUSR_AHS-FTP1:R ADMINISTRATORS:F
WILLVAG:F ANNAUD:F /YES"
WshShell.Run "cmd.exe /c NET LOCALGROUP ""Webtechnologie 2"" woutswer
/Add"
```

GDM's ICT-coordinator

GDM is situated a suburb of Gent. In our department the education is very closely ICT-related. We dispose of much specialized hardware that is solely used in our department, for example scanners, densitometers, microscopes, large-format printers, plotters and plate setters. As well we have lots of specialized software like workflow and multimedia stuff. The ICT-coordinator of GDM takes care of all of these special issues.

Hardware administration

We have a database with all the hardware material included: serial number, central ICT-number, date of delivery specifications and the location where to find it. We have developed software that uses this information for registering digital tools being hired by students so that a good follow-up of this material is guaranteed.

Budget proposals and orders

Once a year we question lecturers about their next year's needs in the area of hard- and software. After collecting this information we compose a budget proposal. For requested purchases that are approved of we decide at what time in the year we place an order. The central office responsible for all purchases controls the budget approved of and buys the material.

Software

Monitored by GDM

Producing a listing of our software needs

After having agreed in the educational board upon which software will be needed during the lectures of the next academic year, we examine where the software can be purchased or what the download links are. For software that is already used we search for updates or we are looking for freeware or cheaper alternatives. For specific GDM-related software we try to make deals with our software-partners: Kodak, Agfa…The central office responsible for all purchases gathers all the needs and make agreements for the entire university college.

Installing one computer from scratch

When all the new software is delivered we install it on one mac an one pc from scratch including the downloading of latest updates over the internet and the installation of all recent players.

Creating an image of the hard disk

After testing the software we make an image of the hard disk by using network startup and dhcp-services. For windows we use SMS-software and for mac we use deploy studio (freeware).

Ghosting mac and pc

Together with the ICT-team of AHS we "ghost" the image to all the other machines. As such we get exactly the same well installed and well functioning machines year after year.

Development of software by colleagues ghosting mac and pc

All kinds of software is developed by our own GDM lecturers in function of the well-functioning of our department:

- registration of feedback, internship;
- sign up for seminars;
- class lists;
- lists quoting absent students;
- personal route of students, their degree choices.

Development of software by students

If students develop software we try to let it be useful for us or others (AHS or even broader in society).

Software

Monitored by AHS

The Arteveldehs website – http://www.arteveldehs.be

A portal with all kinds of information:

– for students and for lecturers;
– for everyone interested in our university college;
for instance: **ECTS-files** give detailed information about the courses

Administrative employees can make changes in the site:

– putting ad valvas messages online;
– add new documents: timetables of lectures, exams…

Digital learning platform – http://dileahs.arteveldehs.be

Communication channel between lecturers and students about a specific course:

– lecturers can place documents on-line that students can download from home;
– lecturers can make announcements (including mail);
– students can drop documents from home in a folder of a lecturer or in folders of others students;

– lecturers can drop results in students' dropfolders too.

Students' portalsite – http://portaal.arteveldehs.be

An overview of information and links bundled on one single page:

– online ad valvas information from the ahs-website posted by our GDM-administrative employees;
– recent announcements by lecturers in DileAhs;
– links to the DileAhs-courses they belong to;
– AHS-central placed information;
– Quick links to ECTS etc.

THE INFLUENCE OF THE SURFACE ROUGHNESS OF AQUEOUS COATED OFFSET PRINT SAMPLES ON THE COLORIMETRIC VALUES

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The appearance is of increasing importance in the production of premium products since it is strongly connected to the quality impression. The optical characteristics of the packaging and other graphic products and the overall appearance of an objects are defined by a combination of their chromatic attributes (colour: declined e.g. in lightness, hue and saturation) and its geometric attributes (like gloss, translucency, texture, shape). In this paper we investigated several area averaged surface roughness and spectrophotometric and colour difference values of aqueous coated offset printed samples. The topography was area measured

and averaged with an Atomic Force Microscope and correlation between the surface roughness and chromatic values for coated and non coated offset samples were studied. The samples were coated with two different amount of aqueous coating to study the change in topography and the resulting colorimetric values. The result show correlation between the amount of the coating, surface levelling and colorimetric value for the glossy and matte coated samples. The surface roughness parameters for the average roughness show linear decline with the increasing amount of glossy coating and increasing roughness with the matte type of coating.

Keywords: colour difference, coating, surface roughness, offset printing, appearance

Introduction

The role of Value Added Printing is to increase differentiation by enhancing the graphic design with the substrate selection, the choice of inks, special effects or metallic pigments, foiling, coatings, and finishing. The application of these different combinations of materials in the printing process renders different colour appearances of the product. The appearance defined in measureable value (reflectance, specular gloss) is mainly influenced by the physical and chemical properties of material itself, the applying process (coating technology and drying) and the resulting surface characteristics of the final printed product. The influences of the different coatings and surface changes and their influence on the colour appearance were tested by (Collin, 2001), (Elias at al., 2006). Other studies have extended the research of the surface roughness to spectral reflection models (Hebert and Hersch, 2005), to gloss (Simonsen et al., 2005), where studies confirmed a mutual interaction of surface characteristics and light reflection values. Extending the research to the coating amount variation can give valuable results to quantify the final resulting colour values, which can lead to more precise production control, production efficiency and reduction in waste material.

Experimental

For the determination of the correlation between the surface roughness parameters and the applied aqueous coatings on the colorimetric values, we have printed offset samples which parameters were measured and calculated. The prints were produced with conventional inks (Sun Chemical) on glossy coated paper (Type 1 defined by ISO 12647-2:2004) and two different amounts of glossy and matte aqueous coating was applied on the printed samples. For the coatings we have used two commercial aqueous coatings H6055/55 for the glossy and H260/55 for the matte coating effect. The amounts of the coatings were regulated with two anilox rollers (60L/cm and 90L/cm), and the average coating amount was calculated for the surfaces. The surface topography was measured with Veeco CP-II atomic force scanning microscope, and area average parameters from six measurement points were calculated for the samples. The sampling areas sizes were 80 x80 μm. The effect of roughness on the colorimetric values was determined by measuring the reflectance curves of the CMYK patches and calculating the CIE DE_{94} colour difference values. The measurement geometry for the printed samples was $0^0/45^0$, with D50 ilumminant and the 2^0 standard observer.

Results

The measured amount of the coatings applied to the printed glossy surface was determined by calculation of coating volume transfer determined in g/m^2. The glossy aqueous coating applied with the 90L/cm anilox rollers was transferred in the amount of 1,9 g/m^2, while the anilox roller with 60L/cm transferred 3,96 g/m^2. For the matte aqueous coating for the 90L/cm anilox roller produced 1,13 g/cm^2, and the value of 2,15 g/cm^2 for the 60L/cm anilox roller. The reflectance curve values were measured on the CMYK tone patches with 100% tone values using the standard measurement values. The results for the reflectance values of the averaged values of the samples coated with glossy aqueous coating are presented in Figure X.

As we can observe from Figure 1 a) to d) the samples with applied aqueous coating have a smaller reflection value throughout all the samples reflection region. On the black patch samples it can be clearly seen that the higher applied amount of coating (60L/cm) resulted in smaller relative reflection values and thus the samples appearance will change. The type of the appearance change and the resulting colour difference values are presented in Table 1.

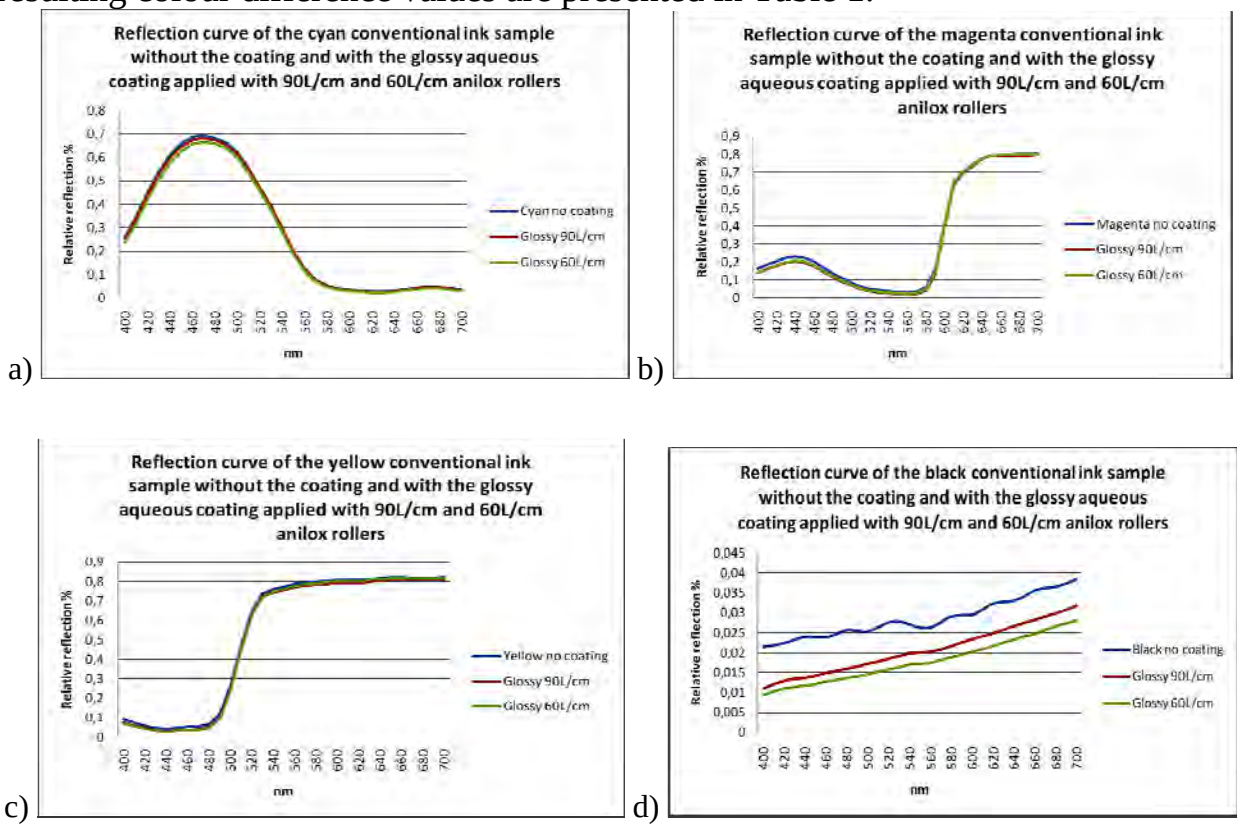

Figure 1. The reflection curves of the samples for the non coated and glossy coated samples of the a) cyan patch b) magenta patch c) yellow patch d) black patch

From the Tabel 1. measured data values we can see that the higher coating amount resulted in higher colour difference values for almost all samples except

black which has a nearly identical colour difference values. For the cyan, magenta and yellow samples the highest offset from the reference samples (printed non coated sample) was in the chromatic parts (Δa and Δb) while the lighntess difference ΔL yielded smaller differences for all samples except the black colour patch (-5,6 and -5,92 which indicate a darker sample).

To determine the resulting colorimetric values after the applied glossy aqueous coating the appropriated colour difference values (ΔE and ΔE_{94}) were calculated and presented in Table 1.

Table 1.

The colour difference values of the glossy coated offset samples

Samples	ΔL	Δa	Δb	Delta E	DeltaE94
Cyan 90L/cm	0,54	-0,99	1,24	1,68	0,96
Cyan 60L/cm	-1	-1,22	0,8	1,77	1,25
Magenta 90L/cm	-0,86	1,84	1,75	2,68	1,29
Magenta 60L/cm	-0,59	1,78	2,3	2,96	1,32
Yellow 90L/cm	0,29	0,11	2,87	2,89	0,63
Yellow 60L/cm	0,24	0,22	3,49	3,5	0,72
Black 90L/cm	-5,92	1,19	3,06	6,77	6,58
Black 60L/cm	-5,6	1,29	3,44	6,7	6,46

The reflection curve results for the matte coated samples are presented in Figure 2. while the colour difference values of the samples is presented in Table 2.

As we can observe from the reflectance values of the matte coated samples presented in Figure 2 a) to d) the coated samples showed a higher reflectance values for both quantities of the applied coating (90L/cm and 60L/cm values). The higher reflectance values indicate lighter samples which are connected to the used type of the colour measurement geometry.The difference in the reflection spectra for the coated samples is that the higher amount of coating yields a higher reflection values in the areas where due to the colour values of the measured pigments is smaller (red region for the cyan sample), where the smaller amount (applied with the 90L/cm) yielded a slightly higher values in the regions of higher reflection for the selected colour sample patches, except for the black colour patch where a higher amount resulted in higher reflectance values throughout the measured region (400 to 700 nm).

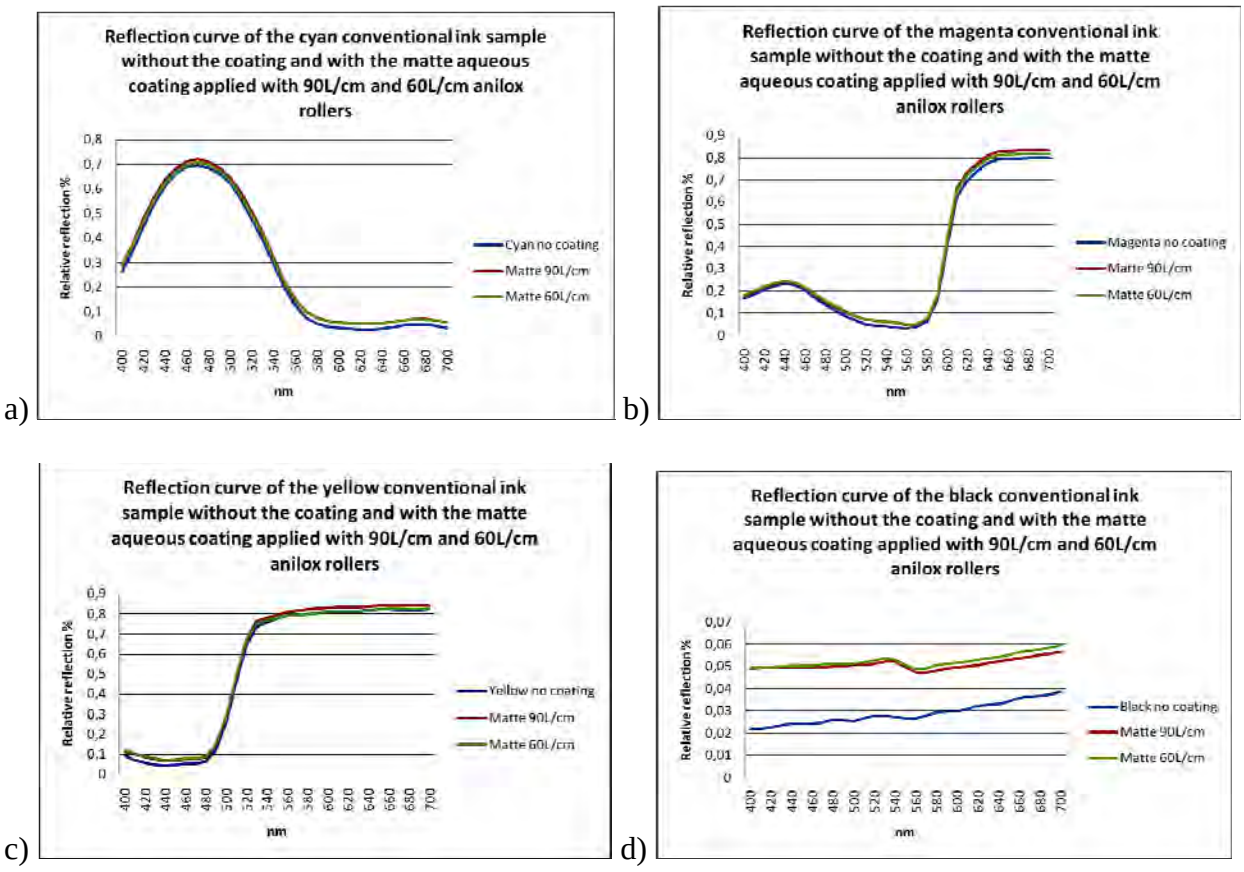

Figure 2. The reflection curves of the samples for the non coated and matte coated samples of the a) cyan patch b) magenta patch c) yellow patch d) black patch

To determine the resulting colorimetric values after the applied glossy aqueous coating the appropriated colour difference values (ΔE and ΔE_{94}) were calculated and presented in Table 2.

Table 2.

The colour difference values of the matte coated offset samples

Samples	ΔL	Δa	Δb	Delta E	DeltaE94
Cyan 90L/cm	2,29	2,06	2,43	3,93	2,45
Cyan 60L/cm	2,43	2,71	2,11	4,2	2,63
Magenta 90L/cm	2,64	-3,5	0,92	4,48	2,8
Magenta 60L/cm	3,38	-4,68	0,62	5,8	3,56
Yellow 90L/cm	1,11	-0,11	-6,09	6,19	1,61
Yellow 60L/cm	1,27	-0,65	-8,64	8,76	2,12
Black 90L/cm	4,91	-1,28	-2,45	5,63	5,48
Black 60L/cm	6,32	-1,15	-2,29	6,81	6,7

As we can observe from Table 2. the higher coating amount resulted in higher colour difference values ranging from 3,93 to 8,76 for the ΔE and 1,61 to 6,7 for the ΔE94 colour difference calculations. All the lightness ΔL difference has a positive value indicating lighter samples for all the process colours, while there are still quite large offsets from the reference values for the chromatic part of the difference (Δa and Δb) especially in the region of the chromatic part of underlying ink pigment (Δa for the magenta or Δb for the yellow colour patch).

After measuring the colour difference values the surfaces were analyzed with the AFM Veeco CP-II microscope and using the Image Metrology SPIP software. One of the most common surface roughness parameter is the S_a the arithmetic average of the absolute values of the measured height deviations from the mean surface taken within the evaluation area. For a rectangular array of M x N digitized profile values Zjk, the formula is given by:

$$S_a = \frac{1}{MN} \sum_{k=1}^{M} \sum_{j=1}^{N} [Z_{jk}] \qquad (1)$$

where M is the number of points per profile, and N is the number of profiles within the sampling area. All the samples were plane corrected and the averaged results from six point measurement results are presented in Table 3.

As we can see from the results presented in Table 3. the glossy coating significantly reduced the average height deviations, while the matte coating gave rougher surface with larger height deviations then the uncoated printed sample. The larger amount of the glossy coated resulted in smaller S_a value then the samples with smaller applied quantity of the coating.

Table 3.
S_a values of the print samples coated with different amount of glossy and matte coating

Sample	Sa values (nm)
Glossy coated paper	99,11
Printing ink (no coating)	100.52
Glossy coating 90L/cm	66.41
Glossy coating 60L/cm	47.93
Matte coating 90L/cm	229.42
Matte coating 60L/cm	244.07

In matte agents this effect was the reverse where the smaller amount of matte coating resulted in S_a value od 229.42 nm and the larger amount resulted in rougher surface with the Sa value of 244.07. The correlations between the surface roughness parameters and the applied coating are presented in Figure 3.The

correlation factor for the linear fitting gave the value of R^2=0,842 for the glossy samples, and R^2=0,884 also for the linear fitting of correlation for the matte coating.

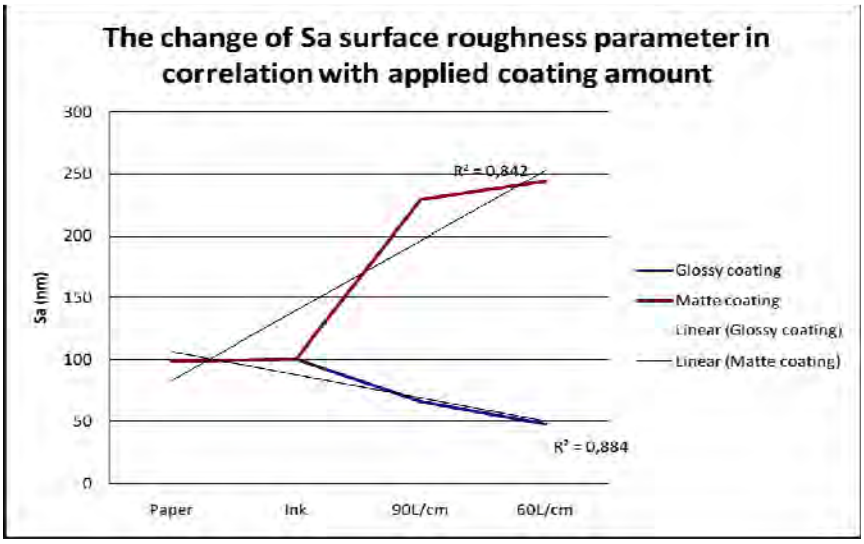

Figure 3. The correlation between the S_a surface roughness parameter and the applied glossy and matte coating

Discussion

The results of the measurement have shown that the quantity of the applied aqueous coating influences both the measured colour difference values and the surface roughness of the print samples. We have found that there is an indication of a linear correlation between these factors. The glossy coating yields a larger colour change values with every additional applied amount, while the matte coating also increases the measured colour difference value with larger quantities of coating. The glossy coated samples had primarily lower offset in lightness difference which indicate darker samples and higher chromatic differences which results in visually more saturated samples. The matte coating had positive values for lightness difference indicating lighter and also less saturated samples then the glossy and non coated samples. These results are very important for final visual appearance prediction, as well to establish an efficient economical and ecological production, in terms of choosing the right amount of coating for the desired visual, mechanical or any other effect and property linked to the applied aqueous coatings with anilox rollers

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ADAPTIVE SCREENING DEVELOPMENTS AT THE GRAPHIC TECHNOLOGY DEPARTMENT

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Abstract

The locally adaptive approach to an image data encoding at the screening stage is disclosed. The results of its realization in High Definition Halftone Printing – HDHP technology and its industrial application in conventional and digital printing environment by the joint effort of teaching staff and of a few student generations of NWIP Graphic Department are presented.

Introduction

Screening has always comprised the actual, cornerstone R&D issue of illustrative printing as far as the basic quality features of a print image such as color, tone rendition, sharpness and definition are fundamentally dependent on the halftone dot area, form and geometry of its placement.

This procedure, meanwhile, enables the conflict in providing both tonal and spatial resolution. The trade off is used to be solved in graphic practice on behalf of the image contrast, i.e. of the first of these requirements. So, following this practice, the ISO 12 647 [1] prescribes to keep the tone value range from 3-5 to 95-97 percent for all variety of screen rulings. At such condition the screen frequency depends on the minimal size of a dot which is steadily available for given type of a job, i.e. for the particular kind of print stock, ink/toner, equipment, etc. As result, the definition of a halftone is usually many times less of a printing system resolution because, according to the sampling theory prepositions, the upper frequency of an original reproduced on a print copy comprises just the half of a screen ruling.

At the same time, the prepress technology of today formally pretends to reproduce (to transmit through the printing channel) any detail of an image and, for example, the quarter of millimeter thick line in as much as 16 million colors (256^3). Fact that the eye can scarcely tell if such a line is somewhat darker or lighter, and is it green, cyan or grey isn't taken into account. In spite of such excess of an input data, the image fine detail stays, from the other hand, badly damaged on a print by the halftone dots (Figure 1 a,b).

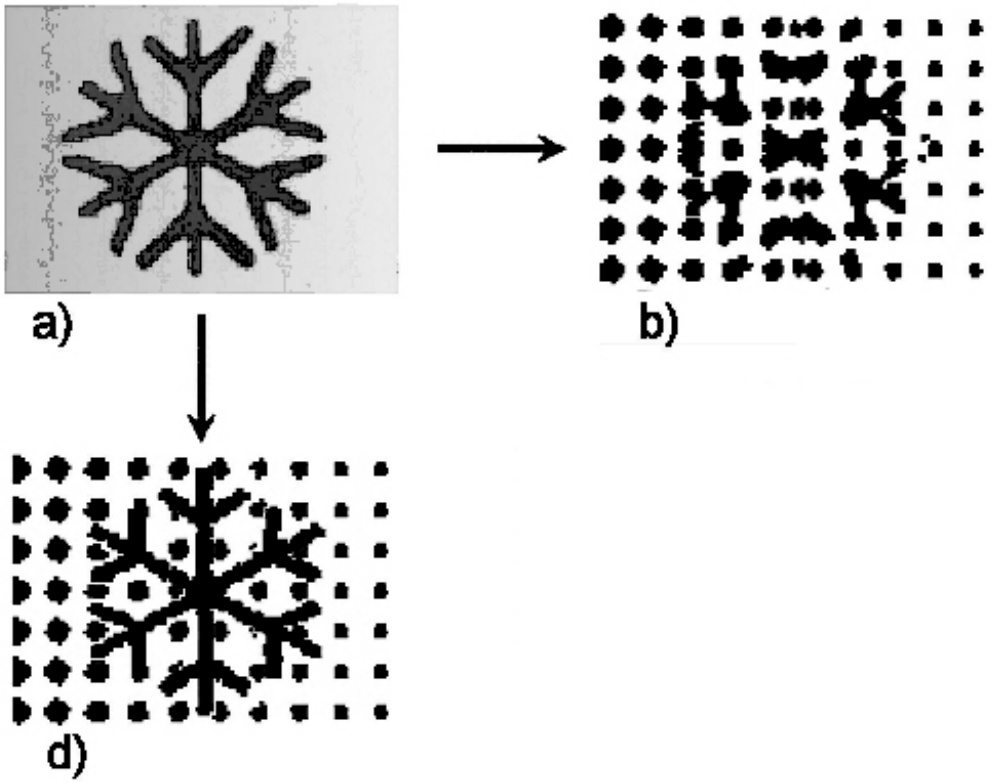

Figure 1. The fine detail (a) of CT original and its halftone copies provided by the conventional method (b) and by the adaptive screening (c)

These distortions can't be corrected by processing an image file with the use of some sharpening filter, such as USM, previous to screening. So, the fundamental objective of optimal encoding the illustrative printout is to shorten the above mentioned resolution gap by more effective use of the imaging system resources.

Similar to optimal encoding techniques used in color TV and an image data compression approaches our *tone gradient dependent* screening procedure explores the specific of decrease Human Visual System sensitivity to tone and color variation with reducing the image detail angular dimension [2, 3, 4]. The image nature is evaluated in the closest vicinity of a processed pixel by the differential operator to form the parameter which controls the dynamic mutual replacement of different screening algorithms over a picture area.

Technology description

During over a decade research of adaptive screening the number of HDHP versions was created at the Department of Graphic Technology of SPb SUTD with participation of its post graduate and doctorate students [5, 6]. Along with the technology development and testing there was suggested the novel method to measure an image fine detail distortions involved by screening [7].

In the latest HDHP version [5] the input pixel tone value S is divided on two parts S_1 and S_2 in proportion depending on the local image area content characterized by busyness factor q:

$$S = (1 - q)\, S_1 + q\, S_2$$

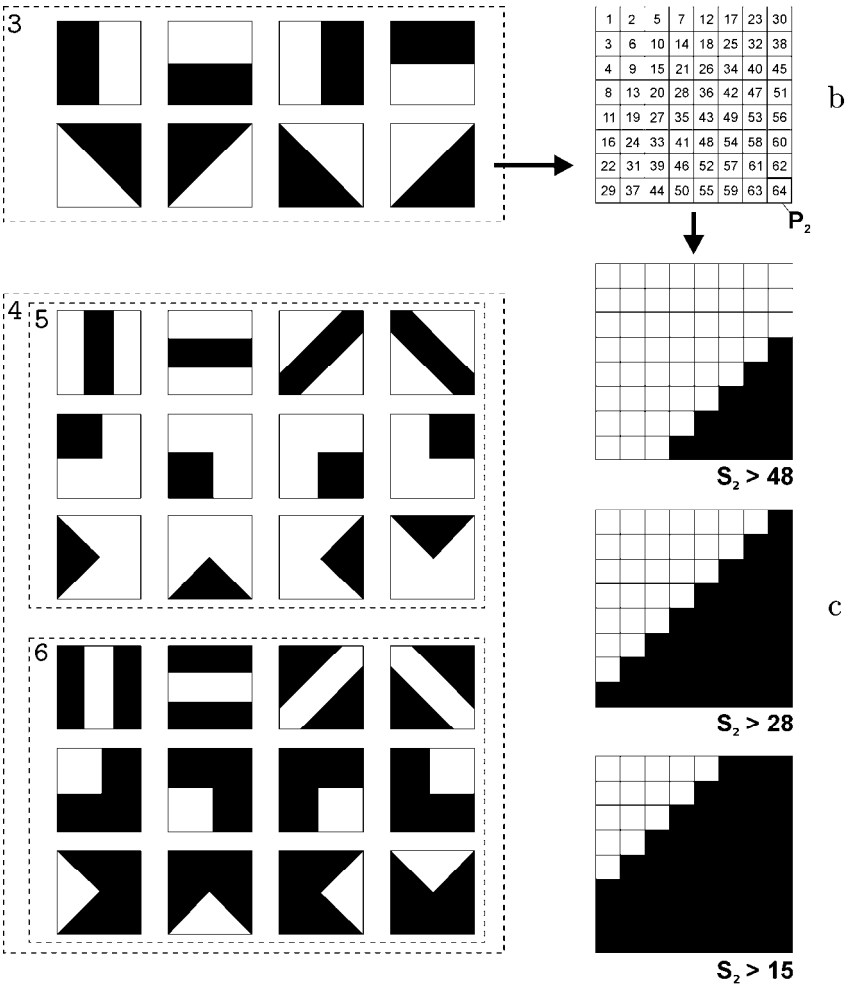

Figure 2. The set of exemplary geometries (a) of tiles; the auxiliary screen function (b) for one of them and the tiles (c) produced with its use for three tone values S_2.

The first part S_1 is processed by any kind of basic, practically approved screening procedure which provides the proper printability and tone/color rendition for the stationary image area. The other one S_2 controls the screen functions having shorter quantization scale but providing the accurate reproduction of fine detail and counter due to generating the tiles of corresponding geometry (Figure 2).

To identify the proper auxiliary function within this set the pattern recognition technique is used in the closest vicinity of a processed input pixel.
The constrained use of busyness factor q for isolated lines, which are thinner of an input pixel area, allows for their reproduction by the ink solid instead of scattered dots of traditional halftone.

As compared to some other computationally busy screening techniques the HDHP algorithms don't include iterative procedures and, as result, allow for on fly image data parallel processing at the clock frequency of an output device.

Architecture

Current HDHP version provides the output device independent local/remote processing of an original image CT TIFF file with producing the EPS or PDF file previous to ripping the page for particular print output.

HDHP software (Figure 3) divides the input image on two constituent components one of them comprising the stationary image area and the other relating to its contours and fine details.

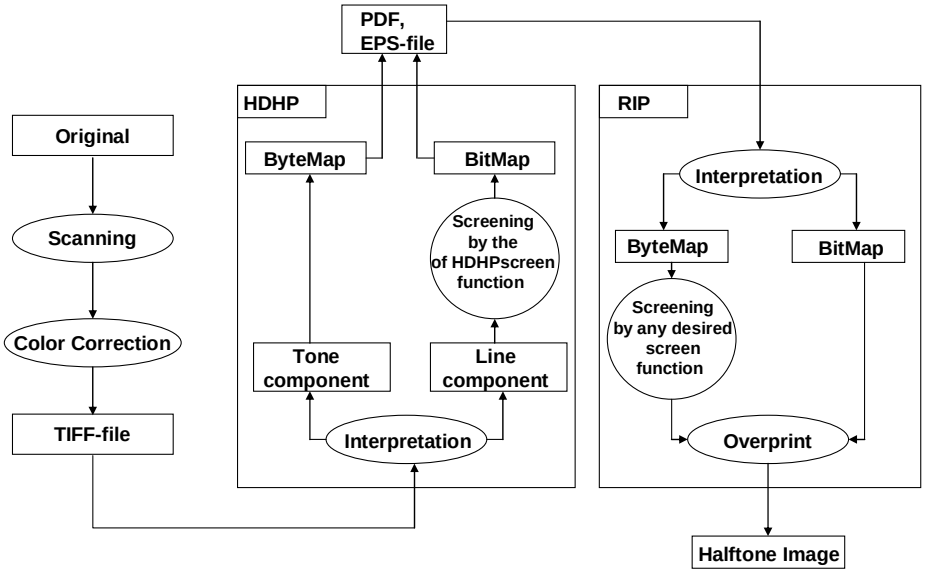

Figure 3. The current version of HDHP workflow

HDHP output contains the matrix of modified multilevel input values presenting said first image component and two bit map masks related to its other component. After HDHP file interpretation the RIP provides the screening of first component at any of its settings: screen geometry (periodic, non-periodic), ruling, angle, form of a dot, etc. and then generates the final halftone output under control of those masks in overprint mode.

Such architecture allows for improvement the image definition and sharpness with keeping its other quality parameters (tone/color rendition) exactly the same as at the default print settings, i.e. without need of additional calibration or profiling the particular print output.

Performance and test results

One of our test PDF image files contains the two variants of resolution target elements to be output on the same sheet (A4). The first of them is the usual CT file while the other one comprises this file processed by HDHP. The test also includes the realistic CT image seamlessly divided in the middle according said variants.

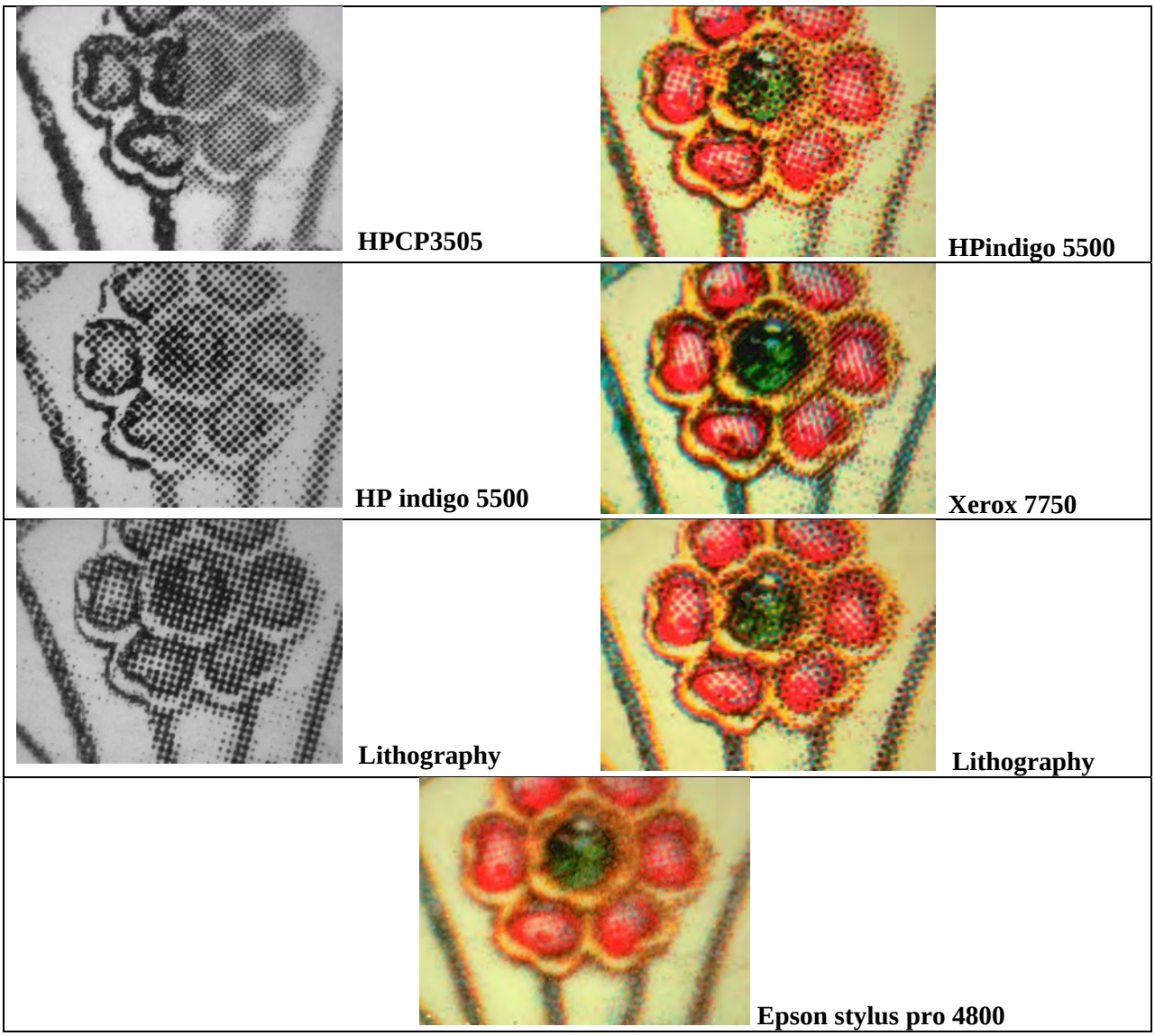

Figure 4. Microphotogaphs of the fragments of realistic test image reproduced with different printing technologies

This test output at the number of available RIPs/printers objectively shows the following HDHP advantages:

- about twice higher definition and sharpness as compared to that usually achieved at these devices;
- reproduction of thin lines by the ink solid, i.e. with complete use of a printer resolution, instead of scattered halftone dots of any conventional digital screen;
- increase of the perceived contrast and saturation of an image accompanying the growth of its sharpness and definition.

Microphotogaphs of the fragments of realistic test image reproduced with different printing technologies are presented on Figure 4.

The HDHP effectiveness was also confirmed by the successful pilot production of the number of periodicals and art books.

Competitive landscape and industrial implementation issues

The print image quality improvement is nowadays predominantly achieved by the use of the better and, hence, costly consumables and equipment. According to these costs, the print products are used to be classified in such different levels as: newsprint, magazines, home/office, commercial….

HDHP allows for the non-costly image quality improvement at each of such levels due to effective exploring the concealed resources of printing processes. The latter stay unused in existing practice due to the drawbacks of an image data encoding for the halftone print output.

The list of specific technologies and services implementing the practical use of this novel way of an image encoding may comprise:

- High Definition Halftone Printing (HDHP) technology to be incorporated by a RIP or a printing device;
- service of other party image file processing within the prepress workflow to provide the significant printout quality improvement;
- realization of HDHP processing as the commercial software application to be distributed among the current users of printing equipment to enhance its output.

Conclusions

The conventional and digital printing technologies enable the high potential of halftone image quality improvement staying still unused due to the non-optimal image data encoding for the print output.

It can be much more effectively explored with the use of locally adaptive screening approach and, in particular, by the implementing the High Definition Halftone Printing – HDHP technology in the prepress workflow, RIPs or/and printing devices.

Modern graphic educational institutions are able to teach students not only for proper use of equipment but also to make this equipment to work better than its vendors do.

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RESEARCH OF PAPER STRUCTURE WITH WATERMARKS

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The roughness parameters of paper with watermarks were analysed by profilometry method, and surface profilograms of test specimens were built on its base.

Statement of problem

A paper surface has inequalities which appear as a result of influencing of row of factors. Mikro and makro inequalities of paper surface are distinguished. Inequalities are surface inequalities related to the primary elements of structure: not dense adjoining of structural elements of paper (fibres, particles of filler), sizes of fibres. Inequalities are inequalities with a big step, which spread on the large areas of paper surface. They violate the general level of surface and give it inequality. Calendering of the chaotically formed paper aligns his thickness, but creates a paper with a heterogeneous closeness and ability to absorb ink. Inequalities of systematic order also distinguish. They are met in the papers of the special setting and have the appearance of watermarks.

During forming of watermarks a paper thickness changes on a papermaking machine, and calendering influences on different areas of a sheet differently, that is why it is possible to assume that a paper roughness on different areas differs substantially.

Surface microgeometry can be characterized by deviation of inequalities from the middle line of shape or maximal height of shape inequalities and distance between them (by the wave step). The estimation of shape inequalities of surface can be carried out by the method of profilometry. This method is based on the contact analysis of paper surface area by a thin needle which enables to get the increased image of surface shape by profilometer. In such devices the surface is analyzed by a diamond needle with the radius of rounding of 10-12,5 mcm. [1, 2, 3]

Purpose of work

The purpose of this work is research of profilometry roughness of different areas of paper a method with thread-marks.

Research results

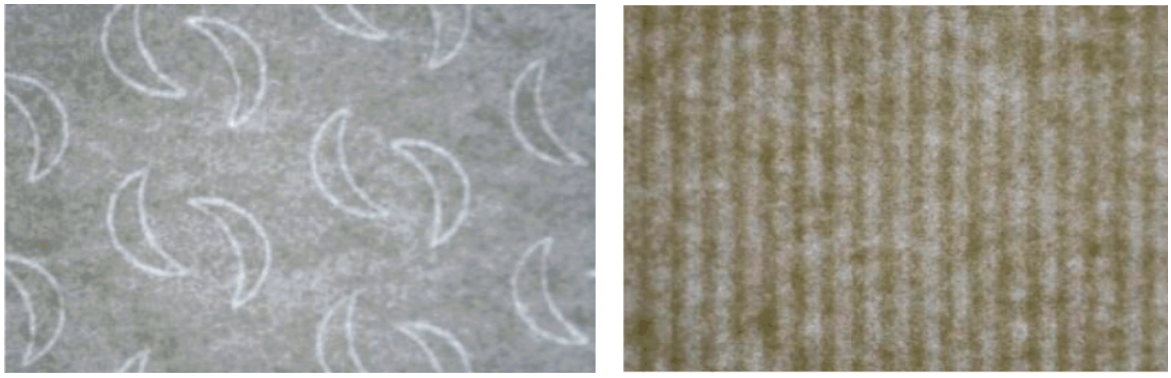
For carrying out the experimental researches a few types of paper protected with watermarks were used. The descriptions of select papers are resulted in Table 1. The pictures of paper samples on a sight check are represented on the Picture 1.

To get the printed sheets the triad inks were used for the offset sheet print of firm Huber group series of Rapida. Printing of the ink layer was carried out on the proof press of IGT. It is got the profilograms by profilometer with an inductive transformer, model 296, for measuring of shape and parameters of roughness of surface. Measurings were carried out with speed of sensor tracing of 0,15 mm/s. [4, 5]

Table 1

Descriptions of select types of paper

№	Name of paper	Presence of optical brighteners / protective fiber	Whiteness, %	Opacity, %	Smoothness, (Bekk), s		Absorbency, Kobb	Mass, g/m^2
					Netside of paper	Frontside of paper		
1	Security lune	-/ +	79,3	85,6	28	29	27	90
2	Filidoro laid avorio	-/ -	72,7	86,2	9	13	18	80



a *b*

Pic. 1. Pictures of paper samples are on a sight check
a – a sample №1 Security lune: a color is white milk; a watermark is a half "moon";
b - a sample №2 Filidoro of laid avorio: a color is ivory; a watermark is a "strip"

The surface structure measurings of paper samples were carried out without ink and with the inflicted paint by profilometer, which diagrams are built on its basis. Profilometer measurings must be carried out for identical sides, both for clean and for printed sampleds. So whether from front or from the net side of sheet. Measuring of roughness was carried out on the module for measuring of the shaped types, which is profilometer, connected to the PC. Thus, got information is digitised, and profilograms [6] are built for it. Measuring of roughness was carried out for net and front side of sheet, on the areas with a watermark and without it, on the clean samples and with inflicted ink spot. The results of measurings are resulted in Table 2.

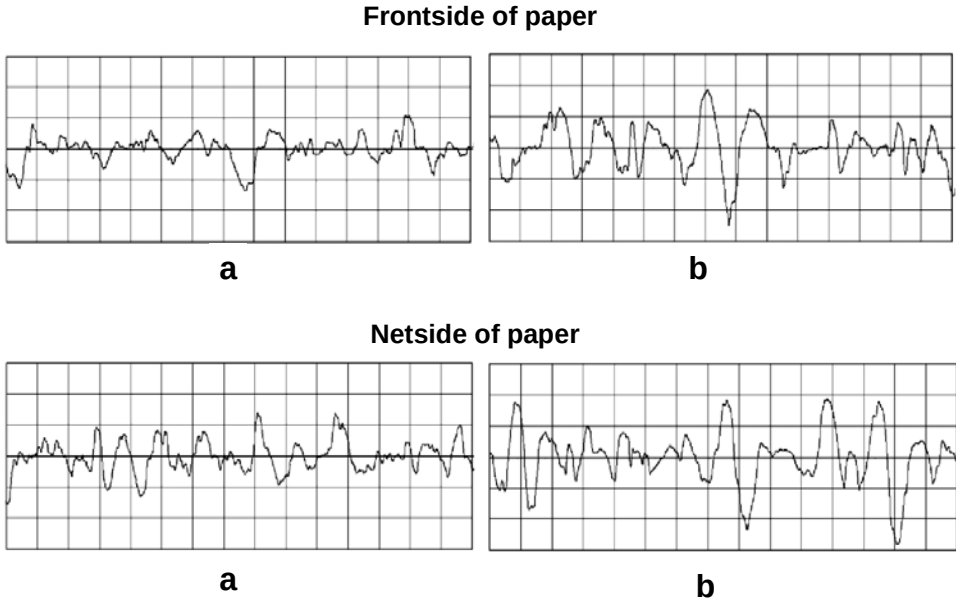
Mean arithmetic deviation of shape R_a, height of shape inequalities after ten points R_z, the most height of shape inequalities R_{max}, middle step of local shape appearances S are determined for SUST 2789-73 and SUST 19300-86.

Table 2

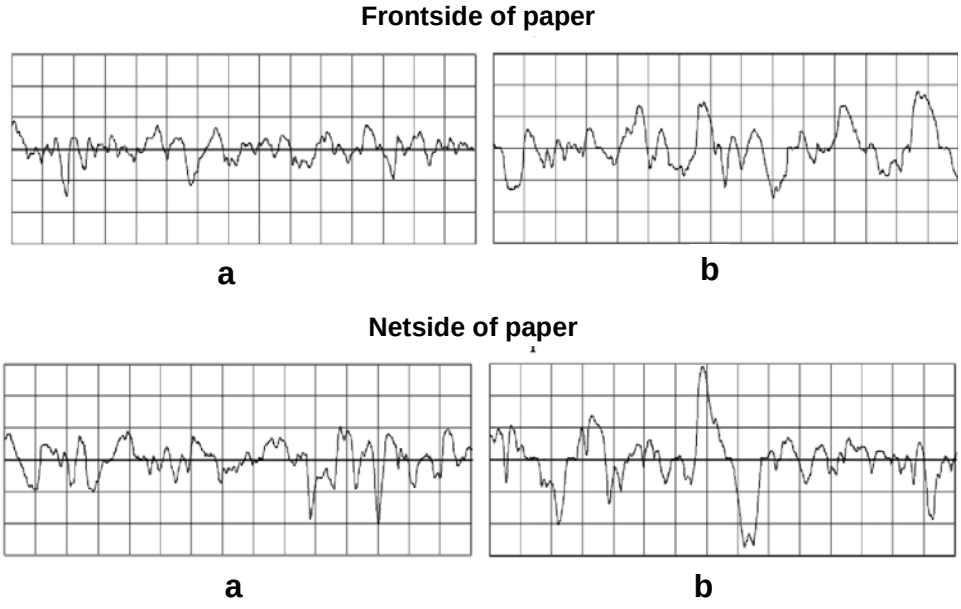
Parameters of paper roughness

№	Areas with a watermark (WM-) and without it (without WM)	Paper without ink or with the ink coating (100%)	Parameters of paper roughness, mcm							
			Netside of paper				Frontside of paper			
			R_a	R_z	R_{max}	S	R_a	R_z	R_{max}	S
1	(WM-)	without ink	3,334	3,039	20,974	0,020	2,883	1,982	20,010	0,018
		100%	3,283	3,042	20,222	0,027	2,276	1,389	18,624	0,018
	(without WM)	without ink	1,906	2,495	12,591	0,017	1,541	1,041	11,566	0,015
		100%	1,225	1,661	10,902	0,019	1,077	1,854	11,910	0,017
2	(WM-)	without ink	3,208	2,578	22,891	0,018	2,605	1,537	15,328	0,018
		100%	2,908	2,276	18,718	0,019	1,984	1,195	11,484	0,017
	(without WM)	without ink	1,983	1,371	12,358	0,018	1,328	1,082	9,941	0,017
		100%	1,554	1,178	11,855	0,017	1,160	1,003	10,715	0,018

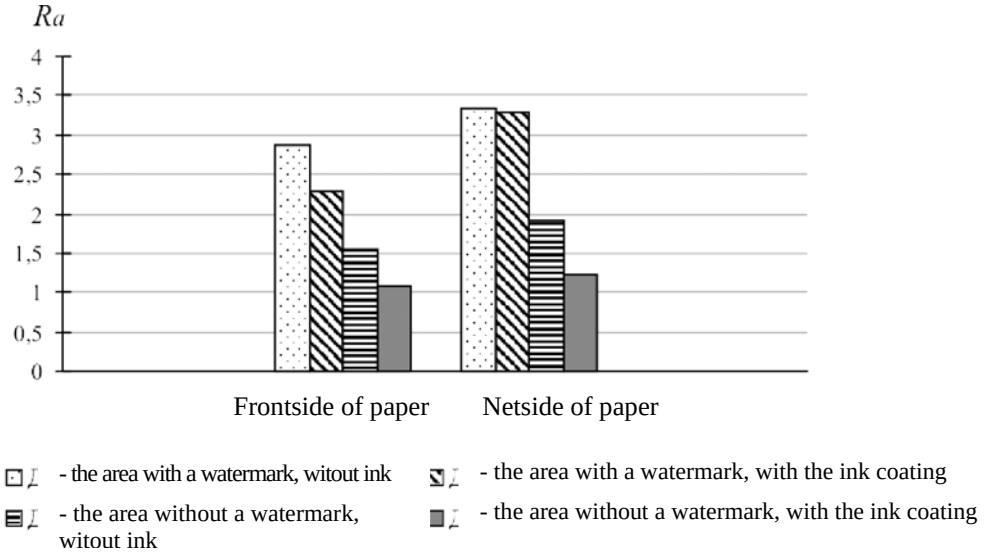
The surfaces` profilograms of paper samples without ink are shown on the Picture 2, 3. The diagrams of roughness are built for the explored paper samples on the basis of values Ra (Picture 4, 5).



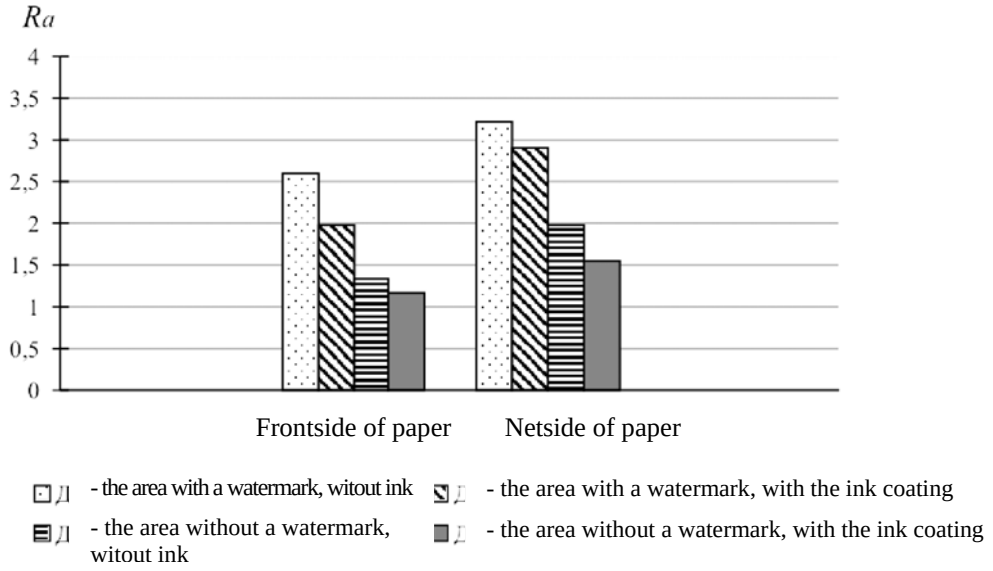
Pic. 2. Surface profilograms of sample №1 Security lune:
a – the area without a watermark; b - the area with a negative watermark



Pic. 3. Surface profilograms of sample №2 Filidoro laid avorio:
a - the area without a watermark; b - the area with a negative watermark



Pic. 4. Diagrams of paper roughness №1 Security lune



Pic. 5. Diagrams of paper roughness №2 Filidoro laid avorio

Conclusions

Got profilograms and diagrams give a base to assert that the value of roughness on the different areas of paper differs substantially. On the areas with the negative watermarks of roughness value is maximal, and on the positive ones - minimum, a roughness diminishes on the samples with the printed ink. A paper smoothness is bigger on the front side of sheet.

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TEAR AND WEAR PROCESSES IN PRINTING EQUIPMENT

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Analyze of a modern tear and wear problems of details in a offset printing machines is made in the present issue, and the methods of increasing their operational characteristics is offered.

Modern equipment, which is used in press and postpress segments, is an important and expensive part of printing production technology. In such way, continuous work is the main task of every printer. But equipment's durability is not only provided by manufacturer's design department, it is also in the hands of service company and, of course, in the competence of printing house. The only question – what processes do we need to analyze to predict production problems?

We think that reliability and durability of printing machine's parts and mechanisms mostly depends from the quality of the surface coating and its finishing.

As a rule, the main origin of destruction of construction elements during its working life is laying in the surface – chafed places, tear and wear, microcracks, pulldowns etc.

When analyzing a workload, which is common for the sheetfed and web offset presses, one of the most important factors in decreasing of detail's working condition is appears. It is the processes of tear and wear, corrosion and attenuation. There are a lot of different factors can cause such processes, but printing house's management can't avoid all of them – because of the specific of offset printing. In the same time we can predict what factor will do more harm or less (see Figure 1).

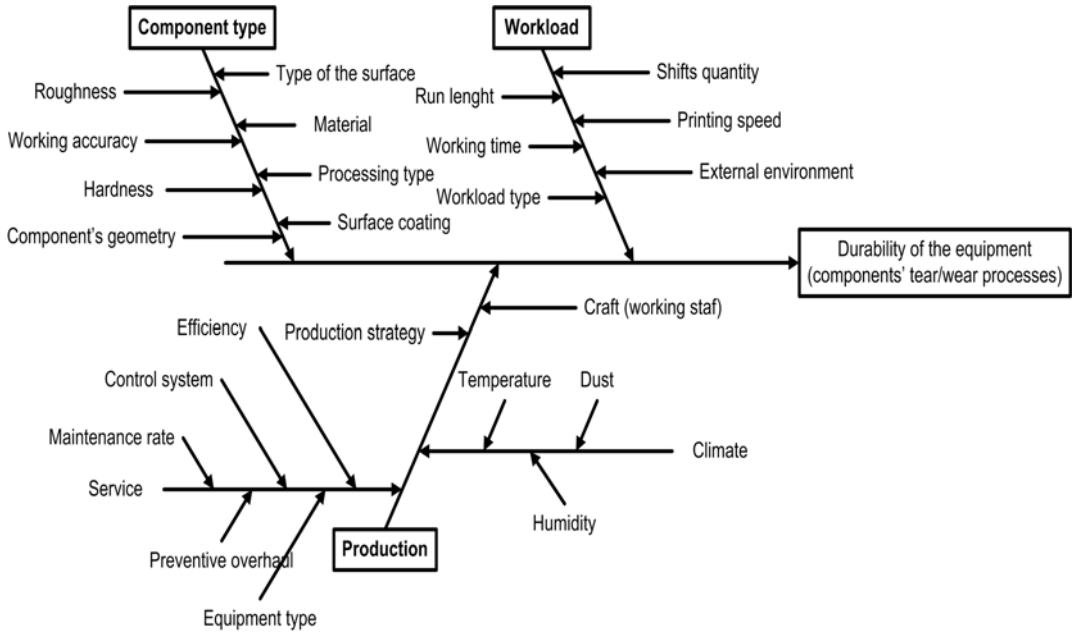

Figure 1.

As we see, there are three main groups of factors which are influence on durability of the equipment – component type, workload and production. This means that changing of one will change all processes of tear and wear in mechanism parts. Of course, we can't decrease or move out some of them (f.e., humidity or paper dust), but we can control them and achieve the best standards. In the same time we know, that every company is working in a competitive market, the workload must be on maximum. So, printer will change or cut this group – increasing of the runs means better progress in business.

But looking only for a production factors, like service, preventive overhaul or maintenance rate, we must not forget about preventive factors – component type. To predict tear and wear printing house and manufacturer of equipment can:

- change material of the component;
- change working accuracy;
- improve surface coating;
- change type of the surface etc.

Some of these methods are not effective; some can bring additional benefits to the production process.

There are a lot of different methods for obtaining a trouble-free operational cycling. Some of them are based on the component's surface dynamical strengthening [1], other are offering the complex system of printing machinery control [2]. But one of the most universal and modern methods is strengthening with a help of vibration roll burnishing [3]. The method is based on strengthening of surface with a help of micro deformation of material's top layer.

During the analysis which was made in the Ukrainian printing houses some main problems were found. The main – is dependence between workload for printing machinery and tear/wear rate, control system which is working at production, preventive overhauls and quality of printing. In the same time, paper dust, aggressive chemistry, dampening solutions and other factors are lead to progressive declining of printing equipment and its components.

To prevent such defects and problems the model of technical ensuring of printing machinery detail's rebuilding; the processes and algorithms of additional strengthening processing is offered with a help of application of fully regular surface microrelief (IV type).

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THE DEVELOPMENT OF THE MONGOLIAN PRINTING TECHNOLOGY AND THE STATE ITS TRAINED SPECIALISTS

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Abstract

History of Mongolian literate culture has a chronicle of many centuries. In VII century there was developed uiqhur script, in 1267 the clear script, in 1686 the soyombo script, and in XIII century Mongolians begun to block print a book. We have 106 volumes of "Kanjur" scripture and 236 of "Danjur", that were block printed in those times. "Kanjur" and "Danjur" are the perfectly clear evidence of honor of nomadic Mongolians to the book. Block printing of each 1500000 letters of the above mentioned two books was a persistent work and demanded a great endurance from printing specialists.

For a block printing there was built a temple on the bank of Orkhon river , 1000 disciples of which were skillful prominent literates.

Our ancestors made the book creating work as a combination of craftsmanship and art. One of examples is the scripture of "Sanduin jud", which was made of 55 kg of silver, 13 kg of gold and other treasures.

Contemporary printing house was founded in 1912. Until 1941 only one printing house has been providing the country demand of books and magazines. During the 1944-1948 were founded printing houses in each province. Since 1954 printing houses were established in Railway, Academy of Science and some ministry and organizations.

In 1956 the offset printing technology was introduced. In 1961 Gravure printing begun to operate, in 1970 the Cartography as well. The technical and economical supports of Soviet Union and Democratic Republic of Germany played an vital role in the establishment of these enterprises.

Policy of preparing printing specialists was implemented since 1920-s. Until 1987 there were prepared 212 specialists in Soviet Union and DRG.

Internal preparation of printing technology specialists begun in 1998. Nowadays 158 specialists are working in 78 printing branches

In Mongolia there are about 200 printing enterprises that 95 % of which are offset printing houses.

Furthermore for the purpose of bringing to a more affluent practical level the cooperating and specializing process of printing houses were extended toward the strengthening the base of preparing specialists through the foreign cooperation.

Key words: Printing technologies, Printing specialists, Offset Prinring, Gravure printing, Letterpress Prinring

Introduction

Printing houses have played a significant role in human kind development for keeping the script culture to future generations.

At that time of printing technology it was necessary to purvey their scripts, duplicate books and to enlighten the population. “Kanjur” and “Danjur” are the ones of the testimonies and these requirements were resolved since long ago.

Mongolia is the nation with extensive fortune of culture which handcraft of making books became an art and used in many kind of treasures for making some books.

In establishment process of modern printing house in Mongolia, some countries has played significant role such as Russia (USSR) and GDR in providing the technical and economic assistance for the specialized staffs.

The 100th anniversary of establishment of modern printing house in Mongolia and the 10th anniversary of first graduation of printing engineers in Mongolia will be held in 2012.

It is necessary to develop foreign cooperation to bring new printing technology and prepare competent specialists in globalized world and Science and Technology University of Mongolia gives a weight to expanding the scope of cooperation in the future.

In this speech run down information about development of Mongolian scripts of how the books we made, the establishment of modern printing houses and to prepare policy of printing specialists.

One. History of printing technology development

Since the script was composed, it has been played a significant role in human life and the development of the society. In BC 4000, first form of script, one of three revolutions of information, was composed and developed step by step such as picture script, matter script and pictography.

Between 90s’ to 745 of VII century, first phonetics script (Rhuni script) was composed in Tureg nation in territory of Mongolia and it was a big success of nomads’ culture. After that uiqhur script was developed and came in as a basic script of Uiqhur nation.

By fiat of the king Hubilai, in 1267 there was developed the clear script, and in 1686 the soyombo script with 90 characters by the Proud Saint Zanabazar of Khalkh was a valuable contribution of Mongolia to the history of human kind development.

The Mongols are the nation which has an extensive fortune of culture to prefer books and cover a book in cloth since the development of vertical script. Since XIII century Mongolians begun block printing of books and 106 volumes of “Kanjur” and 236 volumes of “Danjur” scriptures (block print) was printed and has kept to present generations as a holdover of script is a priceless culture for Mongolians.

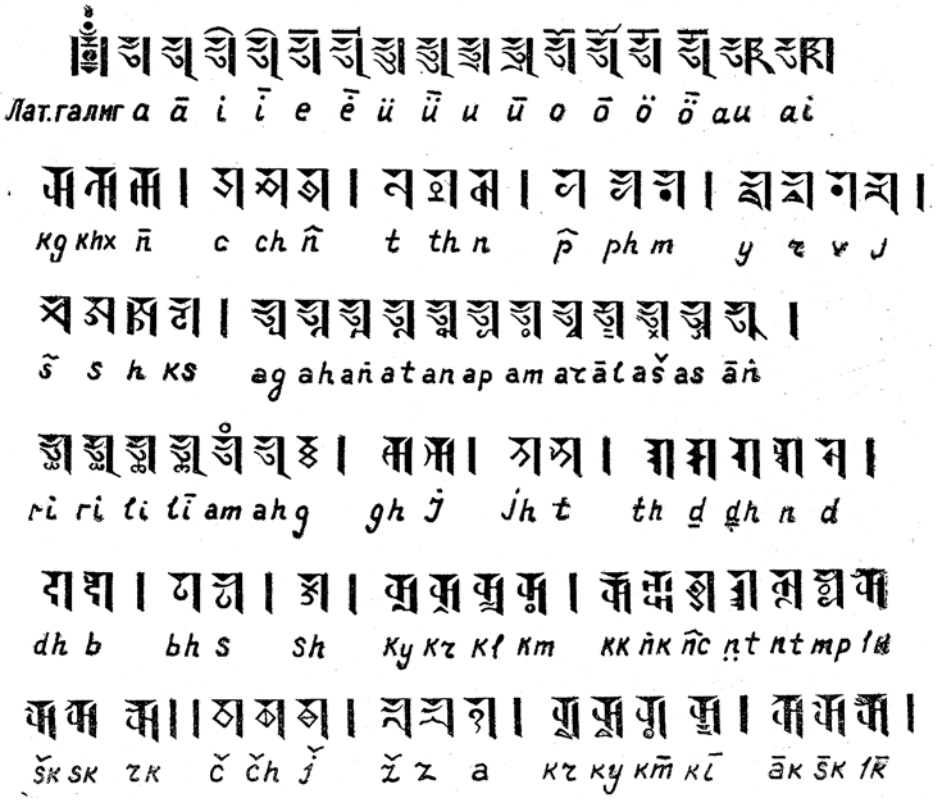

Figure1. The clear script which was developed by fiat of the king Hubilai, in 1267.

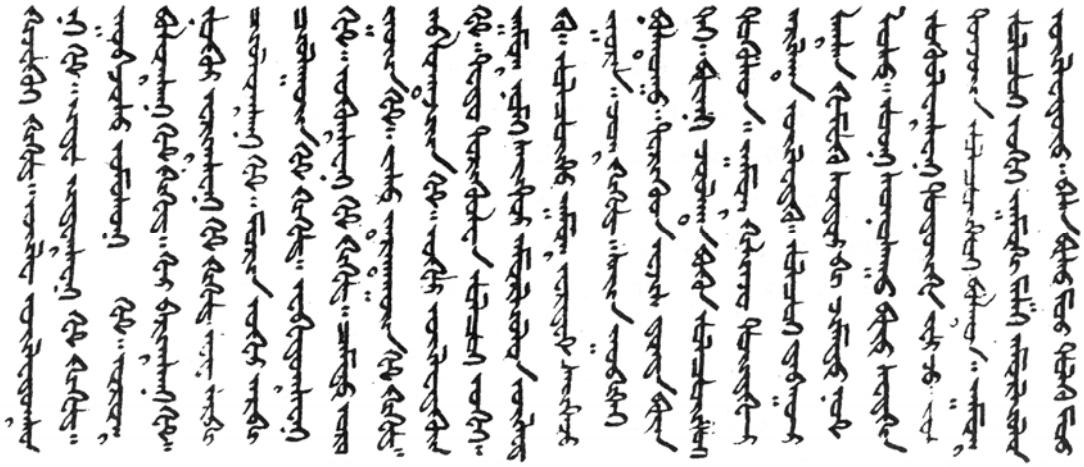

Figure2. The Soyombo script which was developed by Proud Saint Zanabazar, in 1686.

If we consider this in printing technology and calculate, these 2 scriptures have 185000 printing pages with 1500000 blocks of chipped out in a mirror formed anaglyphs and Tibetan scripts, it has required a lot of complicated tasks from “printing professionals” and it has been made with a lot of labour.

An overall view of block printing is the type metal which carried an information was the block, printing material was papyrus, and printing ink was an ink (cinnadar) which has been prepared by block printers.

Mongolian wooden block printed books were in folded, scripture and bind forms. To view the structure of books, it started with blessing words, after that main text of the book, afterword and printing information (scripture author, name of the translator, editor, name of the xylographer and printing data).

The block. The blocks were prepared in printing block temple by printing block school. Students learned Mongolian script grammar rule, scripture letters and learned to write them. Scriptures were written by bamboo pencil or birch pencil. Autograph of books were written by printer's ink or studiously written and xylographer did a woodprint of this scripts.

The main raw material of wooden block printing was wood. The wood from mountain was processed to plate and scripture sized plate cuts were called binding. This binding was boiled in wood resin to remove the moisture and dry it in a shadow. It will be ready to engrave scripts after shaving and furbishing this wood.

Figure 3. Printing Plate (bar)

The paper for block printing of scripture is called mounted paper and it was folded and cut into one fourth to print detailed scripture, but to print standard scripture the paper was folded and cut into 8 pieces and it called sextuple block paper. The third material of block printing the scripture is ink. Block printers prepared inks by themselves. Main raw materials of ink were grime, which has been dried in tightness and birch cork. The grime was watered with birch resin and for a flavor they put some honey of carnation, allheal and other flowers.

The book made of treasures. Except the block printing of books, the book creating work became an art and some scriptures such as "Sanduin Jud" was made of treasures. Nowadays this scripture is kept in Central Library of Mongolia. To create this scripture they spent 13 kg of gold, 55 kg of silver and a lot of other treasures.

According to expert on Mongolia, Ligeti from Hungary, among 1256 Italian famous tourist Marco Polo, who was beside the king Hubilai, wrote about printing of paper currency. We acclaim ancestors' intelligence and genius which historical holdovers of book printing and culture are numerable from several hundred years until nowadays and let's shift to historical development of modern printing houses and technology. Scientists and printing professionals have been trying to consider all sides of information about establishment date of modern mounted printing house and to rattle it off.

According to the scientists' literature and historical documents from chancery, the establishment date of Mongolian modern printing house is 30, December of 1911. But it has put down that 18th of October, 1912 is the establishment date of printing house in Mongolia. Russian played a big role in development of printing houses in Mongolia. Mongolian first newsletter was printed in Irkutsk and one of the first printing houses was built under the Russian Council. We approve that next generation of Mongolian printing development has begun in 1940 by Central Committee of Communist Party's resolution to shift into Cyrillic alphabet. Actually until 1941, there was only one printing house was working and catered for all needs of books and newsletters. Since 1941 expanding and refurnishing activity of this printing house has begun. During 1944-1948 printing houses in provinces have established (in 1941 established a news printing house "Jana-Umir" of Bayan-Ulgii province) and the printing service has spread all over the Mongolian territory. Technology of these printing houses was plumb letter based letterpress and it has fully changed to new technology only in 1990s.

In 1956 started to use modern technology of offset printing. In February 1961, came up to a great advance in color printing of press products by developing an intaglio house with grants of Democratic Republic of Germany.

Also activity of building a printing house under some organizations has begun. For example, in 1954 Railroad printing house, in 1956 a printing house of Scientific Academy, in 1964-1970 printing house and Press & Art development of Light and Food Industry Ministry and a map printing house of Geodesy and Cartography Agency was founded in 1970. Hence printing house of Geodesy and Cartography had a variant technology for printing big formatted maps and atlases with color hit accuracy. Also technology to prepare preprint of maps and atlases on material of no deformations has been used which didn't use in any other printing houses.

Like this Mongolia came to the market economy with a few printing houses such as 20 publishing houses of newsletter in provinces and National Printing House, Military printing house, printing house of Scientific Academy, printing house and Press & Art development and map printing house of Geodesy and Cartography Agency in the capital city. By specialization of printing houses in Mongolia, offset printing is dominated and letterpress elements are in use to limn hard covers. In recent times use of a flexography printing in encasement production is getting intensifying. Moreover slowly intensifying digital

technology is eligible for Mongolia which has a little population, but there is a lot of problems occur in service during operation.

The specialization of printing houses is shown as following:

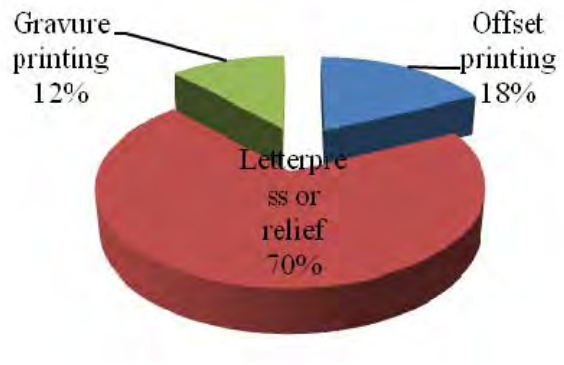

Figure4. Specialization of printing houses by individual products Mongolia (1985)

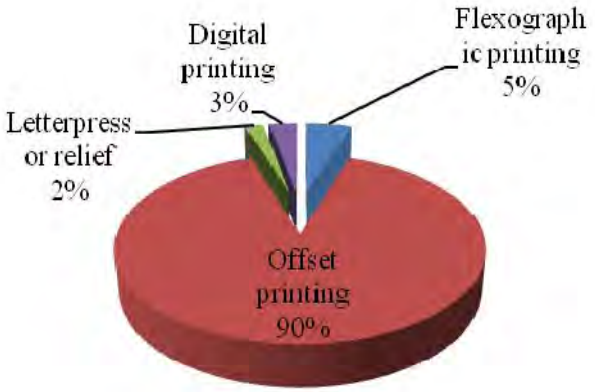

Figure 5. Specialization of printing houses by individual products Mongolia (2009)

The history of development of Mongolian printing houses shows some special character such as:

1. Mongolia started to use separate plumb script after 100 years since it has been in use all over the world.
2. And offset printing technology has come to Mongolia just after 80 years when Asian and European developed countries started to use.
3. Since the above mentioned countries started using presensitized printing plate, it has come to Mongolia in about 30 years.

4. Within globalization of the world new printing technologies come to Mongolia faster. For example, Computer to Print technology-has come to Mongolia after 2 years since developed countries started to use it, Computer to Film technology-after 10 years, Computer to Plate technology-after 15 years and Computer to Press technology-after 20 years. The conclusion is that development of Mongolian printing technology is intensifying considerable compared with other industrial sectors.
5. Quality of printing products is getting into new phase by foundation of private sectors and start of new techniques and technology development stage.
6. Further these printing houses are noticed to make technological innovation and specialization of activity and service, protect their market and cooperate with each other.

Modern advanced technology and new equipments are playing a leading role in further development of Mongolian printing sector, but humane factor, especially proficient specialists are more important. In development of economy based on knowledge, we give a weight to foreign cooperation for retraining and specializing of printing specialists, hence we have a purpose to bring our cooperation with MGUP and Heidelberg Print Media Academy in a new stage.

Two. Preparing policy of printing specialists.

In historical document noticed that Mongolian gave a weight to person who will work in block printing of books. Orkhon River with 1000 disciples of which were prepared block prints of books. These disciples purpose was to prepare block prints and print books. They were handy disciples which were educated and learned the spelling very well.

The printing sector is develops rather intelligent products using equipments operated by modern high power digital techniques whereas it requires considerably knowledge and mastership from specialists who is working in this sector. Thus in 1911 first 2 specialists were sent to Kharbin city to be trained in setting letters and printing process to start modern printing house in Mongolia. Later in 1924 4 people were sent to Germany to study as printing engineer (2 of them were printing engineers and 2 were engineers of map).

Between 1940 and 1955, there was a policy to invite experts from USSR and to implement sort term trainings and practices for Mongolian specialists in USSR.

According to the agreement of intaglio house's establishment, in 1956 5 people studied in line of color printing for 1 year in Leptsick, in 1960 12 people studied for 6 months. Since 1955 printing specialists have en studied in printing universities and vocational schools of German Democratic Republic and USSR. Until 1987 18 specialists studied in GDR, 96 specialists studied in USSR, 88 specialists with secondary education and they have been working in printing and

other sectors of national economic. Specialization of 96 students, graduated in USSR is shown in following table.

Table 1

Printing engineers graduated in USSR

№	Studied vocations	Number
1.	Printing technology engineer	36
2.	Printing mechanic engineer	23
3.	Economist of printing industry	20
4.	Printing artist (designer)	12
5.	Printing editor	5
	Total	**96**

These 96 engineers and 88 specialists, with secondary education, have studied in Moscow, Leningrad, Tashkent and Ryabinsk of USSR.

Since 1998, printing technology engineers have been trained in Mongolian University of Science and Technology and 10^{th} graduation will be in 2012. Our 10^{th} graduate of printing technology engineers is coincided with 100^{th} anniversary of modern printing house establishment in Mongolia. Employment information of graduated specialists is shown as following diagram.

Among Mongolian universities students who is studying as printing technologist have practiced in Moscow 7 times since 2001 and it has become tradition of Mongolian University of Science and Technology. We have expanded our foreign relationship and a professional practice was held in Beijing University of Graphic Communication in 2009.

2 students have studied in Moscow State University of Printing Arts's master degree program and they are working in Mongolian University of Science and Technology as a teacher.

We raptly accent the assistance of MSUPA and Print Media Academy in Moscow for providing with professional books of modern technology and development of resource base. We are grateful Print Media Agency of Heidelberg in Moscow, for bestow of compact equipments for printing technology training base.

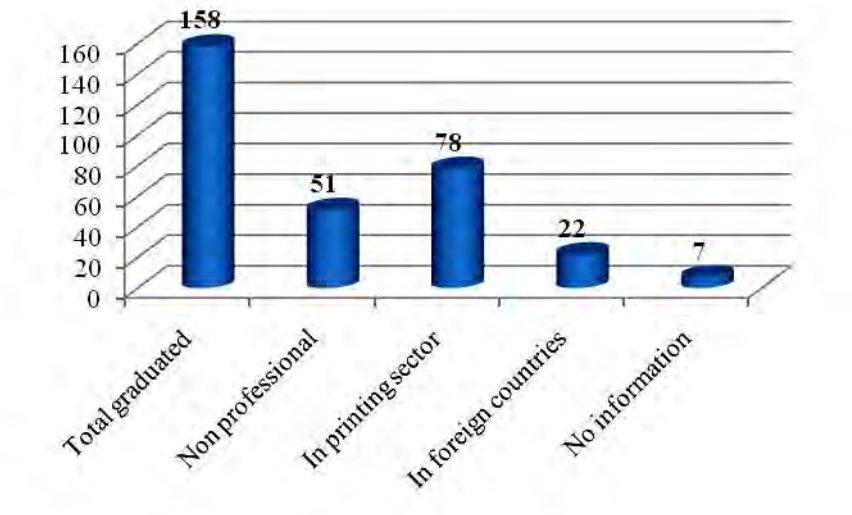

Figure 6. Employment of graduated printing technologists

Now we need a electric equipment of control-measurement and we aim to furnish our laboratory by spectrophotometer and densitometer of Swiss GRETAG, which is a leading industry of this equipment.

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MEDIA CONVERGENCE: BUZZWORD OR REALITY?

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Introduction

Media industry is evolving! This is not new, if one thinks about the improvements between Gutenberg (15th century) work and up to date trade printing companies. This evolution was slow and mainly related to technology progress. It then became faster and faster: industrial revolution in the 19th century, transistor and computer science in the late 20th century and the communication and Internet social aspect nowadays, each gave its own acceleration boost in the whole process.

This has a lot of impact in our media field and business habits. The way to transmit messages and information is dramatically changing, and will continue to do so in the foreseen future.

This is a giant challenge that raises many questions in different sectors – press agencies, “traditional” publication (newspaper, magazine, television, radio, …), companies and of course individuals – and on different levels – communications, technical, financial, organizational, …

This challenge may be a source of worries for some actors, but also a seed for new ideas and opportunities to adapt usual processes, or better, invent new ones!

New professions will inevitably emerge and, as teaching institutions, we have to anticipate this as much as possible, investigates new ways of publications and mixing new and emerging technologies.

This paper addresses the issue faced by media companies in Switzerland.

Some definitions

Language is prone to misunderstanding and misinterpretations. In order to minimize these we propose the following small lexicon.

Term	Definition
Media producer	A company producing publications. Including also non-media companies. Examples: newspaper, television, radio, administrations, manufacturing, …
Media	Analog or numeric data resulting of an input process: typing, recording sound or video, conversion, . Examples: pieces of paper, films, files (video, image, texte, webpage, pdf files, …).
Message	The content of the communication. May be a mix of media.
Publication	The combination of the message and the media that “render” it.
Crossmedia	When using more than one media to publish a message. The message is here split somehow on different media.
Polypublishing	A way to use a given message on several media. Here the source is unique and the publishing process will eventually adapt it on the given media.

To illustrate some of these terms, let us think about an article. From author’s point of view, it is a message. When printed on a newspaper, or published on a web page, the article becomes a (part of a) publication. The publishing process is the manipulation of the message to make it fit on the chosen publication.

Advertisement often uses crossmedia campaigns in which each publication is used as a part of the whole message. Involved traditional publications are newspaper or magazine ads, posters, radio, tv and movies ads, web sites, sms (and sometimes smart phones applications).

Polypublishing is interesting for newspapers: the same article is published on the paper and on the web site. Of course, the layout of the two publications will be different and some content must be adapted (image resolution for example). The publication process will take care of these differences.

Media and communication challenges

Electronic media are split into different categories; text, image, video, info graphics, animation. They all have their own rules of publication. They depend on publication technologies. For example a video cannot be viewed on a print product.

These media can be combined to form a message. A recorded interview (sound) may be written for a printed publication and presented with the sound on a web page. The choice of (a set of) publication is crucial to meet the message goals.

All actors are concerned with these aspects of technology and communication. The message and the target audience help to determine the publications to use. Then the required media have to be produced. In a crossmedia application, the used media have to be adapted to the specific publication: the same text should not be used on a printed page, on a blog page or on twitter. This changes the usual publication processes we know.

Today it is easy to produce technically good quality media. An HD digital camera and the related editing software are available at a reasonable price. However, to get high quality content still requires a good knowledge and experience. Technology is simple but communication is complex.

Traditional professions, such as journalism, are changing. People and organizations have to adapt themselves.

Radio and television merging

Media producer need to be more powerful in this convergence, this is why some of them merge together. In the French speaking part of Switzerland, the public radio and television haved built a unique company. That fulfils the wishes of the SSR national project “convergence and efficiency of medias”. The SSR is the Swiss company of radio and television broadcasting which is the biggest public audiovisual group of Switzerland.

The goal is to create synergies between their various publications on one hand, and generate essential savings on the other hand. The will is to guarantee the offer’s plurality, the programme quality and the coherence of the respective editorial policy and finally, encourage reciprocal improvement.

With this new organization, synergies between programmes should be created. This new configuration will favour new content production, bi- or tri-media (television, radio, web), as results of the convergence. Specific contents of each media which have no reason to fuse (like fiction TV, musical programmes on radio) will keep their existence as usual.

As mentioned before, journalists have to change their mentality regarding this change. The reality shows us that it is not simple. The organization of the enterprise may change. The workflow as well as the working environnement

(offices) may have to be addressed, like the example with the “Blick” mentioned below.

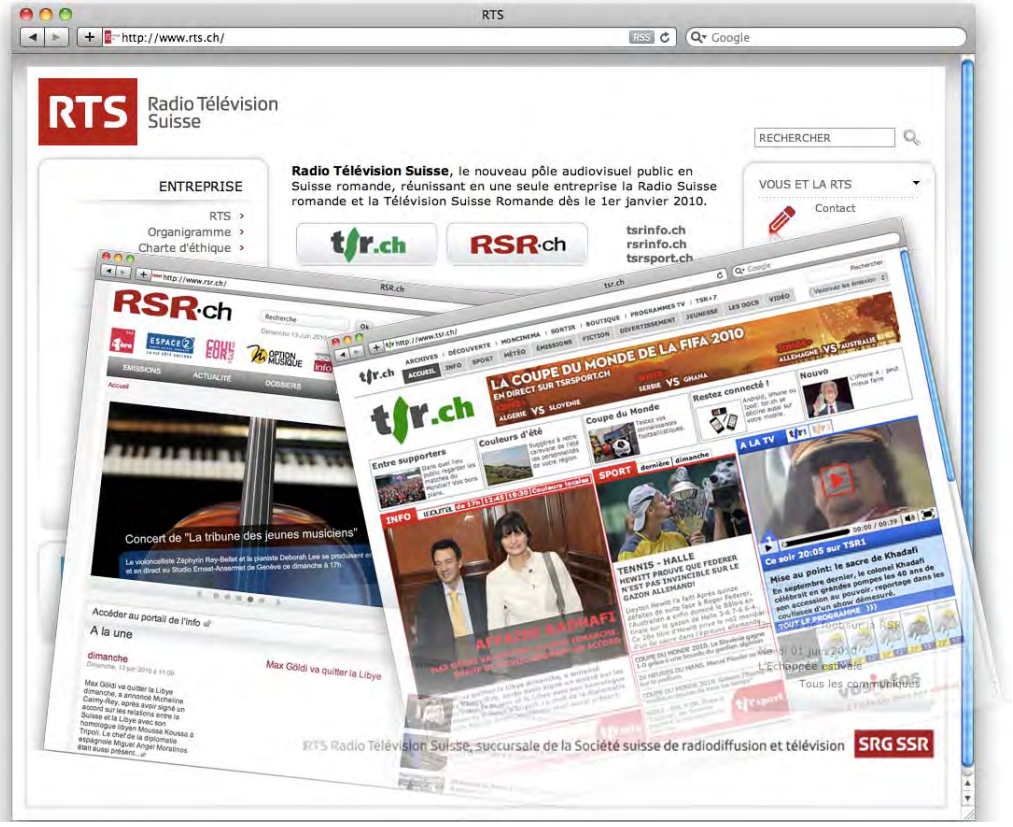

Figure 1. TSR and RSR common website

Newsroom at « Blick »

With editorial press media, we can observe the same situation. Printed newspapers are not enough for the readers. Most of them want to read the news on digital devices; they also want to be informed more precisely on a subject and at a specific time. This is the goal of the electronic media. The amount of these emergent technologies forces the publisher to be reactive on several domains, respectively, several media.

In Switzerland we have a great example with the newspaper “Blick”. It recently created a new newsroom which is totally convergent process oriented. The three editorials (SonntagsBlick, Blick am Abend and website Blick [1]), also from Ringier’s editor, where produced by individual editorial offices. From the beginning of the year 2010, it has not been the case anymore.

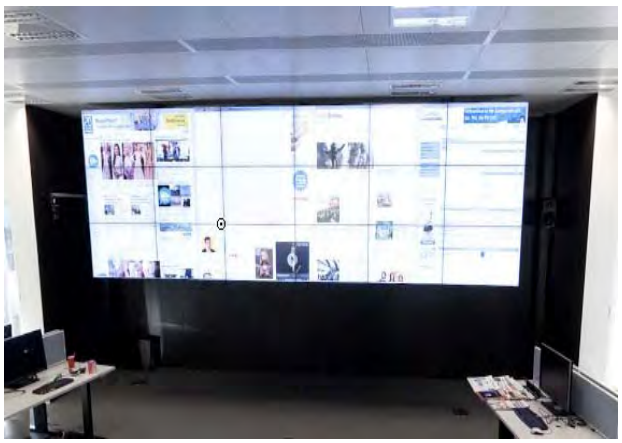

Figure 2. Blick screen wall

In the Ringier editorial, they decided therefore to build an impressive brand new Newsroom of 2500m^2. The room center is “the Bridge”, place to take the decisions. There, the four editors-in-chief display and coordinate their products in front of a 12m^2 wall full of screens (see figure 2 **Fehler! Verweisquelle konnte nicht gefunden werden.**). Each of them knows on what the other is working on and for which publication. All the news from Switzerland come at this place. 200 journalists, photographers, pages designers bring their own ideas and sell them creatively for their own publication. Each title of Blick has to keep its own particularity. As a complement, a fully furbished web/tv studio belongs to the Newsroom.

This style of new working process speaks for the development of the quadri-media with a great synergy between print, tv, radio and web. At long-term, it may become a need.

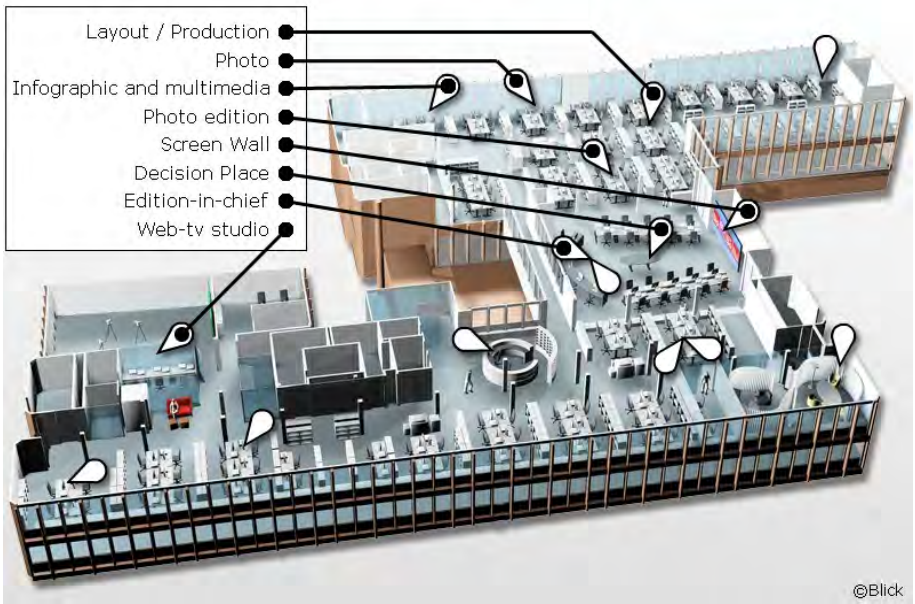

Figure 3. Blick new newsroom

Recent proof of concept at Comem+

With our students we managed a project addressing the three aspects: technical, communication and management.

One based on a communication course, one on prepress technologies and one related to Polypublishing & Crossmedia.

Communication, content production and web site

The subject proposed was “Places at comem+”. The aspect of human meeting areas was important in particular to face the students to the concept of proxemic and human exchange. The other important aspect was the relation between students. Each of them had a specific role: editor-in-chief, editor assistants, journalists, and a multimedia team composed of photographers and video producers

They had to plan editorial meetings, interviews and everything useful to produce messages (articles) using all electronic media available (text, photo, video, sound…). Then, they published these articles while respecting a story with some logical relation inside their publication. A simple web site was chosen (Wordpress Blog) as the main publication system.In this exercise, they worked in a newsroom, mixing all the roles mentioned before. The time to do this exercise was short, about six days from the working idea on the subject to the published product.

Print version

In a following lecture on prepress, groups of students with the messages produced in the first step, produce a printed version of the whole. They manage this job using Adobe InDesign. The goal was to adapt the text and image layout and pick up again the content done in the previous lecture.

Polypublishing & Crossmedia

The last step was a technical experiment: using the original messages.

The goal was to make a proof of concept for an automated crossmedia publication process. Based on the same content produced in the first step, we wanted to produce a 3 media coherent publishing tool for: a website, a pdf version for each articles as well as one containing the entire publication and an audio output for each articles, using speech synthesis and voice markup language. Students had to:

- Structure, work on the original content and store it on a standard open format (XML)
- Develop and setup publishing processes for every media

  XSL transformation for articles (xml to xhtml), XSL-FO for pdf, XML transformation to produce SSML markup and then an mp3 file for each article
- Set up a web site to hold all these media.

Convergent Media Center

As we have seen, media industry is evolving. With Internet, main media producers have taken the curve and have developed synergies between their original publication (print, radio or TV) and their presence on the Web.

But this is not over. New devices as well as new technologies on existing ones challenge over and over the communication best practices.

We are at the beginning of crossmedia publishing. This trend involves new ways of communication. From thinking the message to its delivery, the paths become more and more complex.

How should I use these new media? What combination of media is best suited for my message? Who are the providers for these new ways of publishing? What are the tools adapted to this new trend? What are the costs of going crossmedia? What will be the most popular media tomorrow?

These are only a few of the questions that came in mind when we thought about it. No actor, today, can say it has THE solution. We think that there may be NO universal solution. We have seen the difficulties and challenges that we all have to face regarding these problems.

And the technical part of the problem is not the most difficult! Human organization, costs, objective definition, adaptability are some probably more challenging other issues!

As an educational actor with applied research and development facilities, can we get the answers? Obviously, we have not them now. But we have to find the ways to get them. And that is the main objective of our new Convergent Media Center.

Our students have to be aware of these challenges and this is what we want to develop in our CMC: facing the students with the present and future reality. The idea is to immerse them through workshops implementing most of the aspects mentioned in this paper. The learning of the process, the communication, the human management, the technical aspects are important in our point of view.

Regarding these technical aspects, one of our students is working on a system which can store, index and search media produced within the CMC.

Media enterprises are not the only ones that have to deal with this convergence. Non-media enterprises (such as big companies) are facing the same challenges. This enlarges opportunities for our future engineers.

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COLOR MANAGEMENT FOR THE INTERNET - IN-DEPTH ANALYSIS AND TEST OF THE CSS COLOR MODULE

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Abstract

Compared to the printing world, color management in online media is still rather undeveloped and undescribed. This article has its focus on a new addition to the Cascading Stylesheets (CSS) standard called the *Color Module*. Sadly the current version of the color module does not include any possibility to color manage websites via CSS. This was a part of a previous working draft, but was dropped in the latest version. The color module as it is defined today has its focus on how to define colors via CSS. In this article I have tested and compared the consistency of these different color defining methods in a number of different browsers. It appears that color can not be trusted. None of the browser platforms are rendering colors with the same RGB output.

Keywords: Cascading stylesheets, World Wide Web Consortium, W3C, Internet, color profiles, browsers, standards, color consistency, color declaration, color defining, color naming conventions

1. Introduction

My previous article on Color Management for the Internet from June 2009 presented a more overall view on the topic with images as the test "substrate". The article concluded among other things that not having a standard on how to color manage images for the Internet is problematic at best [1].

From a web developers point of view this is not only problematic but also very strange. This is due to the fact hat the World Wide Web is built around standards, making it accessible for everybody. In 1994 Tim Berners-Lee founded the World Wide Web Consortium (W3C) to define and provide those exact standards. Tim Berners-Lee previously "invented" the web [2]. The W3C mission is stated below:

"The W3C mission is to lead the World Wide Web to its full potential by developing protocols and guidelines that ensure the long-term growth of the Web[2]".

Companies who develop browsers like FireFox, Safari, Chrome, Opera and Internet Explorer are basing their browsers rendering capability on the guidelines from W3C. To complete the circle, these guidelines are also used by web developers and web designers as documentation on how to build websites. As with

most other standards the outcome if implemented as intended is predictability and consistency. Two things that are much needed, considering all the different platforms a website can be rendered on.

Rome was not built in one day and it would be utopia to believe that the world wide web should be any different. Standards takes time to develop and enhance. The possibility to secure color consistency has, understandable enough, not been in the very top of the to do list. This does however not mean that W3C is completely unaware of the concept of colors or even color management. The first working draft for the color module dates back to 1999 [3].

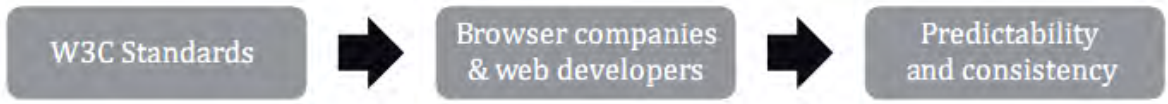

Figure 1. The flow of predictabable web sites

This article will focus on the status and the content of the newest version of that exact document. What is the color module? Is there anything remotely connected to the offline world of color management? Does the color module offer consistency across platforms as the other CSS standards? And what happens with the color consistency if the CSS colors are combined with a one-colored image?

1.1 Introduction to The Color Module

CSS beyond level 2 is divided in modules so their specifications can develop incrementally and individually. The color module is one of those modules. Basically this module describes the CSS properties which allows web designers and web developers to specify foreground color, background color and also the transparency of a given element [4]. In addition to the color related properties in CSS1 and CSS2 the color module also defines new properties and values.

The document mentions nothing about “real” color management up to section 9 (of 11 total) – *Call for Implementations of dropped features*. Apparently color management tools like ICC profiles and rendering intents was a part of the previous ver- sion of the document from 2003 [5]. . As the section heading indicates these tools and features are still considered necessary but will not be implemented at this point.

In my pursuit to find out why these features were pulled out I contacted one of the editors of the document – Chris Lilley from W3C. I asked him why the support for color management was removed from the latest document:

“Because no HTML browser had implemented that precise functionality, using that syntax.

Note that HTML browsers are starting to implement support for embedded ICC profiles in raster im- ages. Which is a start. However the realization that accurate color is important has been late among that developer community. The ability to specify a globally-effective ICC profile for colors in CSS, or to override

the embedded profile in an image (which is what the CSS3 Color module provided) had not been implemented in HTML browsers, which is what the CSS WG is primarily interested in."
Chris Lilley, W3C

Interesting though it seems that the world will have to wait a bit longer for color management ready browsers. However the last paragraph of his answer is quite interesting, as the functionality he describes is just what could provide that desired color consistency among browsers.

1.2 The test

Luckily there are other parts of the color module worth concerning about. As mentioned before the module is all about how to define colors with CSS. It would be very relevant to test if these new color definitions offer the highly valued consistency across platforms and even perform tests together with one-colored images. The next section will describe these tests in detail but will initially briefly explain the technical details of the color module.

2. Methods and experimental set-up

Today with CSS2 web developers have three different ways of defining colors. The first method is to use a hexadecimal notation for the combination of the color values (R, G, B) where each color is described by double digit values (#rrggbb). The second method is to define the values directly by RGB. According to W3C these colors are defined in the sRGB color space, but will of course vary due to the difference in end user setups (browsers, monitors e.g.)[4]. The third method is HTML4 keywords which is a set of 16 predefined colors. Naturally this is not as flexible as the other methods.

RGB values	Hexadecimal values	HTML4 keyword	Output color
color: rgb(0,0,0);	color: #000000;	color: Black;	
color: rgb(255,255,0);	color: #FFFF00;	color: Yellow;	
color: rgb(230,130,30);	color: #E6821E;	N/A	

Figure 2. Example on how to define colors with the tools of CSS2

The color module for CSS3 both details the aforementioned methods and adds new ways of declaring colors via CSS. W3C also added new functionality by including a possibility to decide on a given colors transparency value. The color module adds HSL (Hue, Saturation, Lightness) colors as a complement to RGB and hex. HSL was added in order to remedy the drawback that RGB and hex is non-intuitive. People can learn how to specify colors with RGB and hex, but HSL is much more intuitive in the way people think of colors [4].

HSL values	RGB values	Hexadecimal values	HTML4 keyword	Output color
color: hsl(0,0%,0%);	color: rgb(0,0,0);	color: #000000;	color: Black;	
color: hsl(60,100%,50%);	color: rgb(255,255,0);	color: #FFFF00;	color: Yellow;	
color: hsl(30,80%,51%);	color: rgb(230,130,30);	color: #E6821E;	N/A	

Figure 3. First column shows how to specify colors with HSL. Note that the two first values, hue and saturation, could be any numbers when drawing the black, as the lightness value is 0

The HTML4 keywords are upgraded to contain 147 predefined colors. The list of colors is from SVG [6] which is an abbreviation of Scalable Vector Graphics. SVG is an open standard that have been under development by W3C since 1999 where images and their behaviors are defined by XML.

The transparency of colors can be set by applying an extra value when defining the color. A so-called alpha value ranging from 0 to 1. Note that this is not possible to use when defining color with hexadecimals or with the keywords. Here it is necessary to add an additional attribute called opacity. The last example will demonstrate how the transparency and opacity variable works.

HSLa values	RGBa values	Hexadecimal values w. opacity	Output color
color: hsl(0,100%,100%,1.0);	color: rgb(255,0,0,1.0);	color: #FF0000; opacity: 1;	
color: hsl(0,100%,100%,0.5);	color: rgb(255,0,0,0.5);	color: #FF0000; opacity: 0.5;	
color: hsl(30,80%,51%,1.0);	color: rgb(230,130,30,1.0);	color: #E6821E; opacity: 1;	
color: hsl(30,80%,51%,0.5);	color: rgb(230,130,30,0.5);	color: #E6821E; opacity: 0.5;	

Figure 4. Example on CSS color code with the added alpha value when using transparency

2.1 Test description

There are two aspects of this test:

» **Color consistency** – *does the CSS defined colors render identical on various platforms?*

The test will consist of a set of color patches defined in CSS with RGBa, HSLa and hexadecimal values included on a website. This will make it easy to test consistency across various platforms. The test will not include colors defined with SVG/HTML keywords due to the small amount of colors available.

» **Color predictablity** – *is it possible to predict the CSS defined colors via Photoshop?*

The test will also include a possibility to view an image created in Photoshop based on the same color values as the current CSS color. The image is produced in the sRGB color space as the CSS colors are based on sRGB.

The tests will be carried out by putting together a simple website and it will be verified and measured using Photoshop's measure tool and screenshots from the different browsers. A screenshot imported into Photoshop with no color management will be an exact replica of what the browser rendered.

As a part of the test and to minimize errors the HTML and CSS code used for the test will be validated by W3C's validation tool. The image used in the test will be in the PNG-format as the colors will not suffer any artefacts due to compression as it is known from JPEG. Also PNG can contain more color information than GIF. A further comparison of the three image formats can be found in the previous article on Color Management for the Internet [1].

The browsers used for this test will be the newest versions (April 2010) of Mozilla FireFox, Apple Safari, Internet Explorer, Google Chrome and Opera. The test will also include the latest *Preview Version* of Internet Explorer 9 and the iPhone web browser (Safari for iPhone).

Please note that CSS3 is still under development and not fully implemented in all browser platforms yet – thus will the latest versions of these browsers be the best bet. Statistics on the use of these browsers can be found at *http://www.w3schools.com* [7].

Figure 5. The test composition. The colors chosen are random in order to test the versatility of these color declaration methods. The color names to the left is only to indicate the color.

Where RGB and hex are fully available in Photoshop as a standard way to define and get color, the story is somewhat different with HSL. Photoshop only supports HSB where the *B* is for *Brightness* which is different from the *Lightness*

the *L* in HSL refers to. Details about the difference can be found at *http://ian-albert.com* [8]. The HSL values in the test composition have been generated with a calculation tool I created based on generic RGB to HSL color conversion math formulas [9]. The excel- sheet can be found and tried on the test website.

Address for website: http://www.uppercase.dk/color – choose *CSS 3 Color Module* in the menu.

3. Results

3.1 Color consistency

The first test is to see whether or not all the color patches actually renders.

	Opera 10.51	FireFox 3.6.2	Chrome 4.1.2	Safari 4.0.3	IE 8.0.6	IE 9	iPhone
Renders all patches?	Yes	Yes	Yes	Yes	No	No	Yes

Figure 6. An overview of the different browsers' ability to render the color patches

All the browsers besides the two versions of Internet Explorer renders the color patches. IE8 did not support either RGBa, HSLa or the opacity setting on the hex color. IE9 rendered hex and RGBa but could not render the patches defined with HSLa. Even the iPhone renders all the patches.

The next step is to measure all the patches in all the browsers, in order to see if they correspond to eachother. This is important as it is one way of assuring color consistency on different platforms. All the results will be measured in RGB in order to have a common reference for comparison.

Patch	Opera 10.51	FireFox 3.6.2	Chrome 4.1.2	Safari 4.0.3	IE 8.0.6	IE 9	iPhone
HEX	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0
RGBa	255 0 0	255 0 0	255 0 0	255 0 0		255 0 0	255 0 0
HSLa	255 0 0	255 0 0	255 0 0	255 0 0			255 0 0
HEX	255 128 128	255 127 127	255 128 128	255 127 127		255 127 127	255 127 127
RGBa	255 126 126	255 127 127	254 127 127	255 128 128		255 127 127	255 128 128
HSLa	255 126 126	255 127 127	254 127 127	255 128 128			255 128 128
HEX	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6
RGBa	236 104 6	236 104 6	236 104 6	236 104 6		236 104 6	236 104 6
HSLa	236 104 6	233 104 5	234 105 6	234 105 6			234 105 6
HEX	247 194 155	247 195 155	247 194 155	248 195 156		247 195 155	248 195 156
RGBa	247 195 155	247 194 155	246 193 154	247 194 155		247 195 155	247 195 155
HSLa	247 195 155	246 194 155	246 194 154	247 194 155			247 195 155
HEX	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203
RGBa	29 224 203	29 224 203	29 224 203	29 224 203		29 224 203	29 224 203
HSLa	29 224 203	29 225 206	29 226 206	29 226 206			29 226 206
HEX	187 246 240	188 246 240	187 246 240	187 246 240		187 246 239	187 246 240
RGBa	188 246 240	186 245 239	186 245 239	188 246 240		187 245 239	188 246 240
HSLa	188 246 240	186 246 240	186 245 239	188 246 240			188 246 240

Figure 7. An overview of all measured RGB values of all the 18 patches in all of the browsers.

Ideally all of the rows with the same color (three rows at a time) should have the same RGB values

As the table clearly shows there are lot of inconsistencies. Ideally the three rows in each color should have the same values in all of the browser platforms. There are not even one platform that renders the patches 100 % consistently in itself. **Opera** is fairly consistent, but has problems with the combination of hex and the opacity setting. **FireFox** gets the first patches right, but has issues with HSLa and also opacity. **Chrome** renders the full-color patches correctly except in HSL and also has prob- lems with opacity. **Safari** also has issues with HSL and opacity. Except one RGBa patch **IE8** and **IE9** renders consistently in the patchers they actually render. Safari on **iPhone** is very much like its bigger brother.

The solid colors defined with hex and RGBa seems to be the most consistent. As soon as either opacity or HSL is a part of the color definition it becomes unstable.

3.2 Color predictability

The predictability is an important step in ensuring the end-users color experience. The images from Photoshop needs to match the colors defined with CSS. That could be difficult as there are some inconsistencies as mentioned above.

Patch	Photoshop	Opera 10.51	FireFox 3.6.2	Chrome 4.1.2	Safari 4.0.3	IE 8.0.6	IE 9	iPhone
	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0	255 0 0
	255 127 127	255 127 127	255 127 127	255 127 127	255 127 127	255 127 127	255 127 127	255 127 127
	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6	236 104 6
	247 195 155	247 195 155	247 195 155	247 195 155	247 195 155	247 195 155	247 195 155	247 195 155
	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203	29 224 203
	187 246 239	187 246 239	187 246 239	187 246 239	187 246 239	187 246 239	187 246 239	187 246 239

Figure 8. An overview of the RGB values of the images from Photoshop

The table shows that these values are the same from browser to browser. This means that sRGB images will render exactly the same on all platforms. Images are consistent and thus predictable.

4. Discussion

The results of the tests have been fairly consistent even though they did not correspond to my expectations on how standards should behave. The fact that this test is purely digital automatically eliminates all errors or inconsistencies that could be present in tests with more analogue aspects like a dirty lens, bad light setup etc. The monitor’s calibration does not have anything to say, as the measurement in Photoshop is what the browser renders.

The HTML code of the website has also been validated by W3C’s validation service in order to make sure that the website is up to standards. When validating the CSS code there were som errors but that was expected because the test website

uses CSS3 – W3C's CSS validation service is only checking up against CSS2. The only errors on the website was with the CSS3 attributes. Unfortunately it is not possible to validate CSS3 yet however the CSS3 attributes on the website follows the current specification from W3C [4].

4.1 Additional tests

The color module is a part of the emerging CSS3 specification. As some parts of this test unveiled, not all the browsers are ready for this yet. It would be interesting to try again in 6 months or perhaps a year to examine if there are any progress. First of all check if Internet Explorer 9 renders HSL. Secondly it would be relevant to examine if the color rendition is more consistent. Also when the color module is fully implemented it should be revalidated and tested again.

5. Conclusion

The initial question was to examine if it was possible with CSS Standards to ensure color consistency and color predictability. Given the test results it seems that we are not quite there yet!

The inconsistencies from browser to browser are too big and to illogical to try to remedy as a web designer. The test results indicates that the safest way to go if trying to match an image with a background in CSS would be with hexadecimal color declaration.

Some of the errors could be because the implementation of the color module are still in progress. That must apply to Internet Explorer 9 as the browser is still under development but could also apply to the other manufacturers as they are constantly trying to improve their browsers. Also more of the browsers has problems with the new HSL color declaration method. This could perhaps be fixed in versions to come.

The color differences are small and probably not noticeable visually. So it should be possible for a web designer to create a website with (visually) matching colors even though it is not a 100 % precise.

The relatively small inconsistencies could indicate that the difference lies in the math behind the color conversion and rendering. If all of the browsers are not using the same number of decimal places it could affect the color output slightly. It is worth hoping that the different browser manufacturers will eventually use the same algorithm so that color consistency and color predictability can be achieved.

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PROOFING PROBLEMS IN MANUFACTURING OF POSTAGE STAMPS

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Introduction, the objectives of the research

New materials, design technologies and colour rendering requirements represent great challenges for printing companies producing postage stamps. The key issue of today's printing tasks is whether colours appearing on the displays of a stamp designer and colours determined by post offices are the same on all devices of the manufacturing and the stamp paper.

In spite of using colour management for many years we realised that sometimes there was a significant difference in the highlights between the contract proof and the press-room prints. (Figure 1)

Figure 1. Proof (left) and postage stamps printed on stamp paper (right)

The reason for our problems was hidden in the materials, which we used in contract proofing and in the features of the stamp papers. The postage stamps are printed on special papers, which are glued or self-adhesive, either consist of safety fibres or not and have a low level of optical brightening.

Approval of stamp design-reproduction is implemented through digital proofs before printing like at other products of our printing company. We use the same proof paper for approval of every type of product, for the sake of economical production. However in the case of special stamp papers, the digital proof and the

substrate of print on stamp paper differ significantly from the perspective of luminescence. (Figure 2)

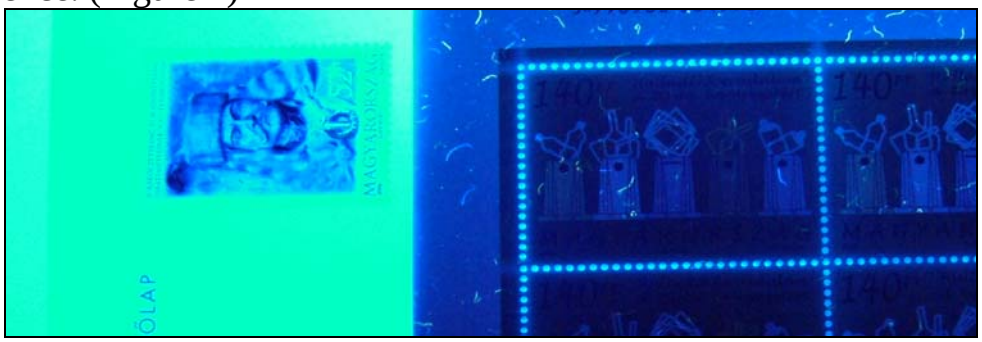

Figure 2. Proof (left) and postage stamps printed on special stamp paper (right) by UV-including radiation

Practice in digital colour management generally suggests the usage of a UV emission filter for the colorimetry of the proof's test charts. However, it is not known what level of colour modification is caused to the system by UV emission filters as regards to stamp paper, or how it will change the colour rendering and colour gamut. We had to look for an answer to this issue with our investigations.

Research methods

Firstly, we studied the influence of optical brightening because the optically brightened proof paper shows a high level of luminescent radiation while the stamps' papers have a low level. (Figure 2) We examined the reflection spectrum of some coated and uncoated stamp papers with a spectrophotometer and chose the lowest level of luminescent radiation's both types of stamp papers. (Figure 3)

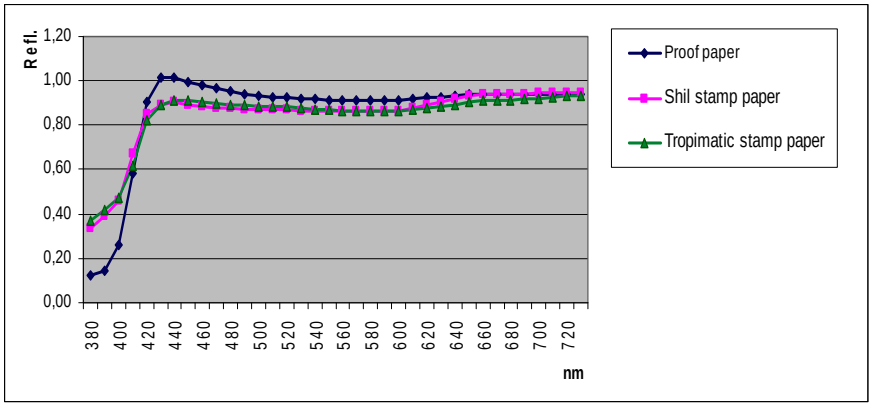

Figure 3. Reflection curves of different types papers

After that, we had made – using the Epson Stylus Pro 4000 Proof-Printer – proofs with ICC profiles of real operating conditions. The TC 6.02 CMYK test charts were printed on the chosen two types of stamp paper: Shil and Tropimatic.

The proofs were measured with the UV-emission filter, then without the filter on the SpectroScan measuring instrument. The aim of these examinations was to compare ΔE values calculated from L^*, a^*, b^* values, measured with two different ways and to evaluate the comparison. We used the ProfileMaker 3.1.5 software package for our examinations. In the case of the Shil stamp paper the highest value was ΔE^*_{max}=3.91, while the lowest was ΔE^*_{min} = 0.05. The average of the colour differences was: ΔE^*=1.41. With the Tropimatic stamp paper these values were higher; the maximum value was ΔE^*_{max}=4.17, the lowest was ΔE^*_{min} = 0.05 and the average of the colour differences was: ΔE^*=1.76. (Figure 4)

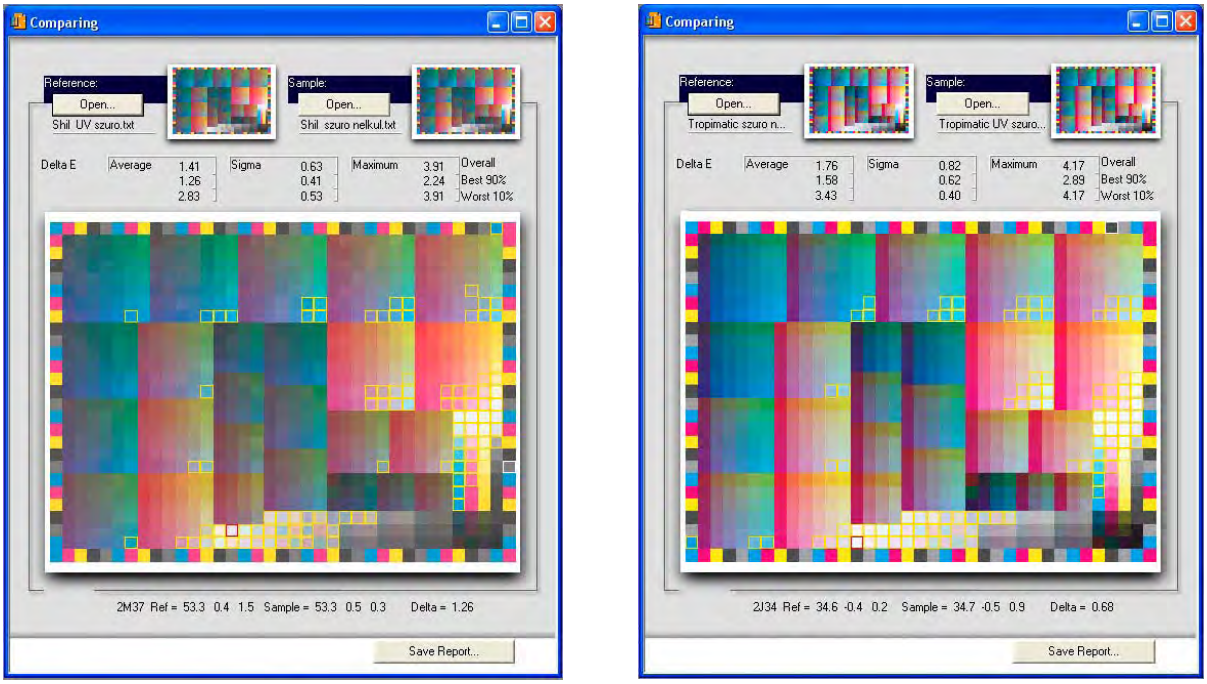

Figure 4. The greatest colour differences of proof measured with UV-emission Filter and without filter, using Shil and Tropimatic stamp paper

Digital proof evaluation and results

Firstly, we arranged our measuring results given by *ProfileMaker* software package in tables then made diagrams for digital proof evaluation. The results showed that the total ink coverage and colour difference have a strong negative relationship, colour difference values decrease exponentially where the total ink coverage is growing. (Figure 5)

This result corresponds to our initial expectations since the effect of optical brightening of the print substrate must be necessarily higher in the case of low total ink coverage. The visual optical brightening of the substrate has less effect where the total ink coverage is higher than in the case of fields with lower total ink coverage.

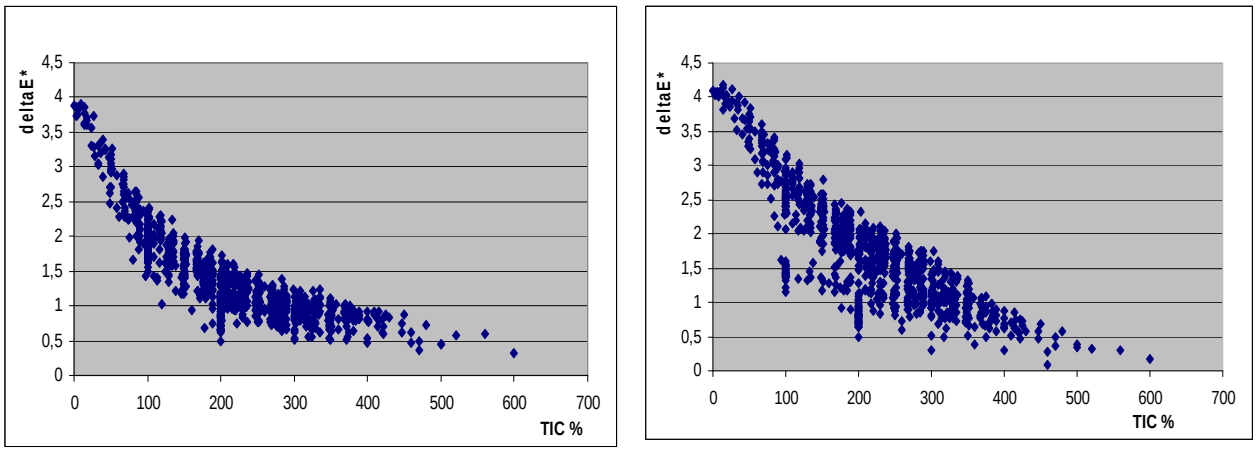

Figure 5. The colour difference dependence on the TIC (total ink coverage) using Shil stamp paper (left) and using Tropimatic stamp paper (right)

According to L*-ΔE* values the features of the results are similar for both kinds of stamp paper but the Tropimatic paper has the higher colour differences. (Figure 6) The values show that depending on the growing L^* metric value of brightness, the ΔE^* values also increase. In the case of Shil paper the values are in the interval between $L^*=35$ and $L^*=60$ with the highest density. Their value is in the interval between $\Delta E^*=0.5$ and $\Delta E^*=2.5$. Using Tropimatic paper, the values are in the interval between $L^*=35$ and $L^*=70$ with the highest density. Their value is also in the interval between $\Delta E^*=0.5$ and $\Delta E^*=2.5$.

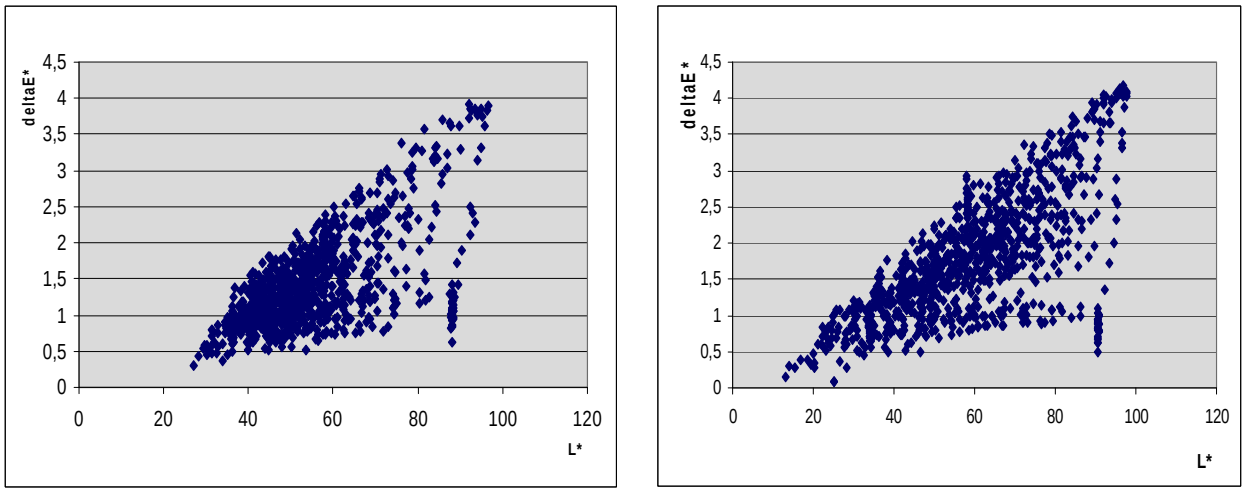

Figure 6. The colour difference dependence on the L^* metric value of brightness, using Shil stamp paper (left) and Tropimatic stamp paper (right)

The difference between the values measured with and without the UV-emission filter must be great in the case of lighter shades namely of high lightness

value, since the effect of optical brightening is stronger where lighter shades are printed to the printing substrate.

It was also important to compare the colour gamut of digital proofs measured with and without using the UV-emission filter and to check the degree of white point shifting. For a better visual comparison, all of the gamut view diagrams (xy, ab, u'v') have been examined. (Figures 7 and 8)

It was found that the white point is shifted significantly towards yellow direction in the case of using UV-emission filter, due to the colour transformation of the measurement method. The shape of the colour gamut also changed and the gamut itself shifted to yellow direction especially with blue and violet colours. It caused the altering of the colour of the pressroom-print by the highlights compared with the proof.

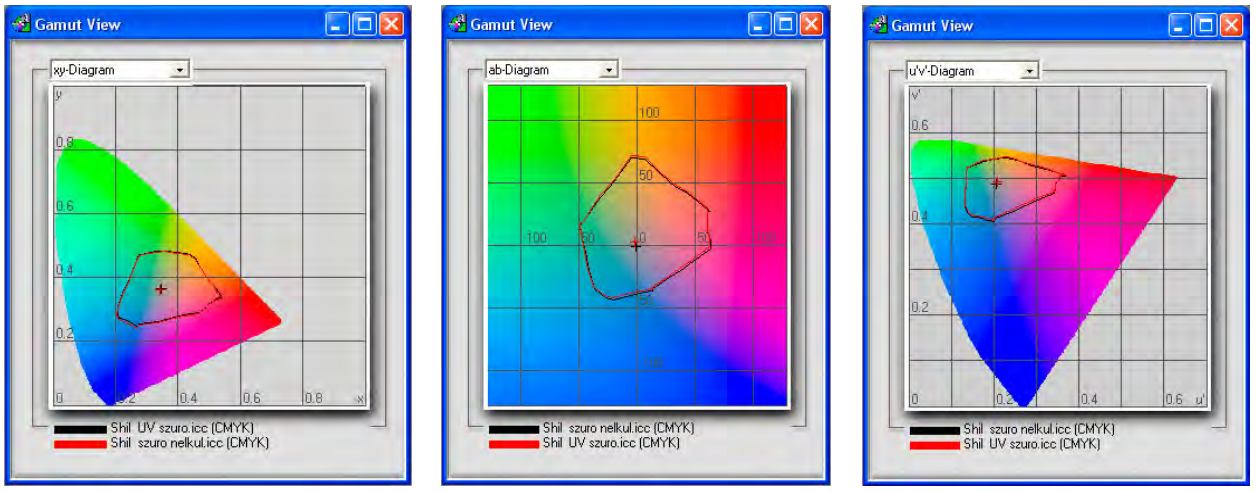

Figure 7. Colour gamuts of Shil paper's digital proof measured without UV-emission filter and with UV-emission filter

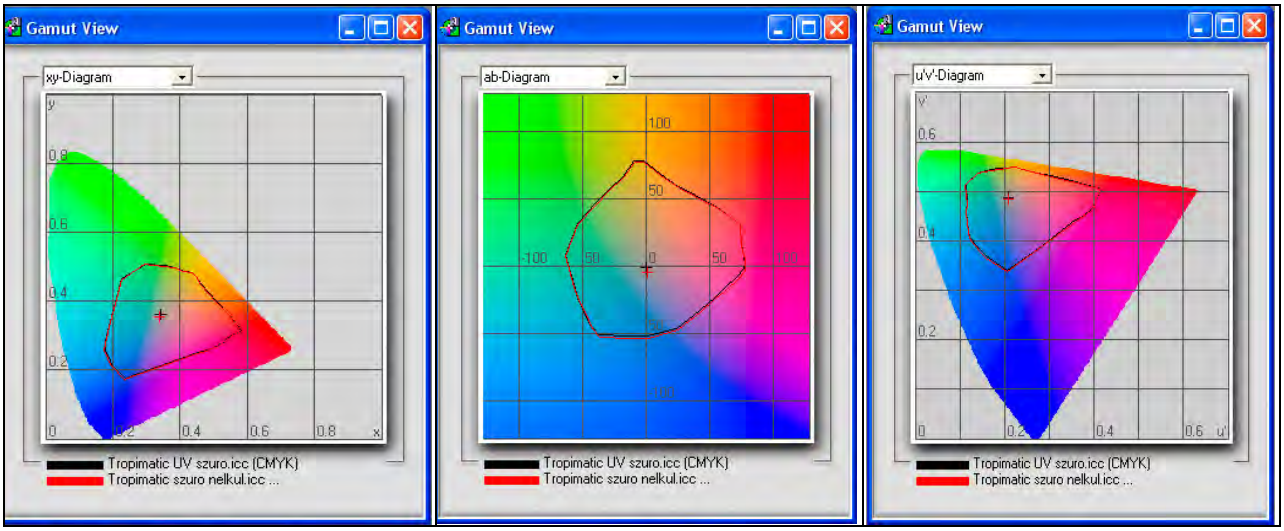

Figure 8. Colour gamuts of Tropimatic stamp paper digital proof, measured with UV-emission filter and without UV-emission filter

It has become clear from the tests that if the colour fields of a test chart are printed and measured on an optically brightened digital paper when preparing the ICC profile for the proof printer, it is worth applying the UV-emission filter in order to be able to define the required colour profile with the possible greatest accuracy for contract proofing of postage stamps which are printed on low optically brightened paper. Only in this way can we avoid the yellow shades of print compared to the contract proof.

Additionally, we have to use *ProfileEditor* software as the colour gamut shifting and shape altering was not uniform. The colour gamuts gained by using UV-emission filter were smaller and shifted unequally to the yellow shades (Figures 7 and 8). We checked the modification of the colour profile directly in the Photoshop programme then saved the appropriate ones. The pressroom prints also proved the correctness of this method later.

USING MICROSCOPIC IMAGES IN COLOR PRINT RESEARCH

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Abstract

To study properties of color prints and paper substrates in close detail, an experimental image acquisition system has been developed, allowing for microscopic imaging up to a resolution of 1.2 μm/pixel. The images can be converted into the colorimetric representations CIEXYZ and CIELAB and also into multispectral images, estimating the spectral reflectance. In this presentation, we give an overview of how microscopic images can be used in color print research, the possibilities that it provides, and some examples of previous and ongoing projects. Examples of research projects include: colorimetric and multispectral image acquisition, separation and determination of physical and optical dot gain, detailed gloss characterization and studies on how the micro-reflectance of the halftone dots and the paper varies with dot area coverage.

Introduction

To improve the quality of color prints it is of great importance to understand the printing process thoroughly, and to develop accurate models that can predict the outcome of the final print. However, modeling the color reproduction of halftone prints is difficult, mainly because of light scattering in the substrate, causing optical dot gain. Most available models are based on macroscopic color measurements, averaging the reflectance over an area that is large in relation to the size of the halftone dots. Such color measurements corresponds well to the

appearance at normal viewing distance, but do not reveal the underlying microstructure of the prints. To overcome these limitations, and to study color prints in detail, a special image acquisition system has been developed, allowing for microscopic imaging up to a resolution corresponding to 1.2 μm/pixel. Microscopic images, with a resolution that is high in relation to the resolution of the printed halftone, allow for measurements of the individual halftone dots, as well as the paper between them. Methods have been developed, allowing for the device dependent images to be converted into the colorimetric representations CIEXYZ and CIELAB, and also to reconstruct spectral reflectance data with high accuracy. By combining colorimetric and multispectral imaging with a high spatial resolution, accurate color measurements can be made in every single pixel in the microscopic images, which reveals information that can never be obtained from macroscopic measurements, and opens many new possibilities in color print research.

Figure 1 illustrates an example of microscopic images of 40% blue prints, using 100lpi AM halftoning and 600dpi FM halftoning, respectively. The two prints, which in the microscopic images appear very different, will in macroscopic color measurements produce almost identical CIEXYZ and CIELAB values, as well as spectral reflectance. This clearly illustrates the limitations of macroscopic color measurements, giving only the average reflectance.

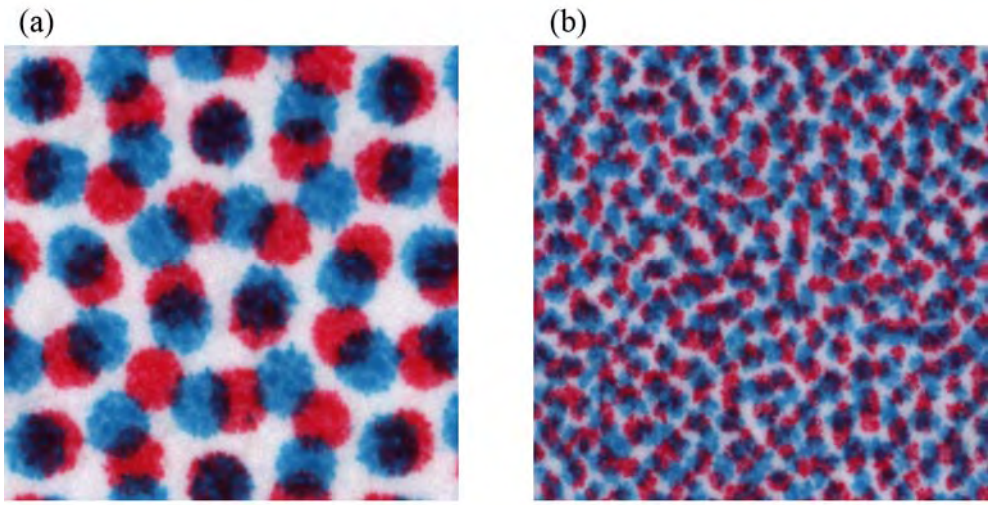

Figure 1. Microscopic images of 40% blue tints for AM (a) and FM (b) halftones.

The Image Acquisition System

The image acquisition system is an experimental system with great flexibility for the user and numerous ways to control and alter the image acquisition setup. The substrate is placed on a table, which allows for motor-driven translation in x-y directions and rotation around the optical axis. The illumination is provided using a tungsten halogen lamp through optical fibers, which offers directed light with an adjustable angle of incidence for reflectance images. By using a backlight setup, imaging with transmitting illumination is also possible.

The images are captured using a monochrome CCD camera, with a resolution of 1360 × 1024 pixels and 12 bit dynamic range. The CCD, specially designed for scientific imaging, is highly linear and uses digital temperature compensation to reduce noise. The optics used is a macro system, designed for scientific applications, allowing for images of various magnifications, up to a maximal resolution of 1.2 μm/pixel.

Color images are captured sequentially, using filters mounted in a filter wheel in front of the light source. By using this color sequential method, there is no need for any interpolation or de-mosaicing scheme, as is the case in conventional digital cameras. Besides the ordinary RGB-filters, the filter wheel also contains a set of 7 interference filters, which allows for the acquisition of multi-channel images. Figure 2 illustrates the image acquisition setup, including the xy-table, the camera and the directed light, as well as the filter wheel. Further details of the image acquisition system are given in ref. [1].

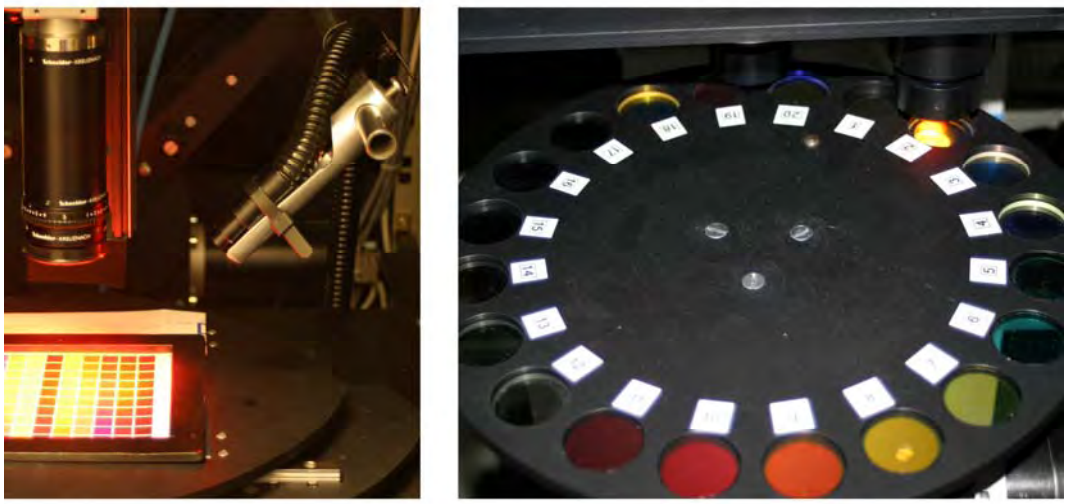

Figure 2. The image acquisition system.

Examples of Research Projects

To illustrate some of the possibilities that microscopic imaging can provide in color print research, short examples of previous projects are given. For details on the methods and the results, references to relevant publications are provided.

Colorimetric and Multispectral Image Acquisition

To achieve consistent color data, one needs to map the device dependent images to the colorimetric representations CIEXYZ and CIELAB, i.e. *colorimetric images*. In color print research, it is further of great value to be able to reconstruct the spectral reflectance of objects, i.e. to acquire *multispectral images*. A thorough calibration and characterization of all the components of the imaging system has first been carried out [1]. The spectral sensitivity for the CCD-camera, which could not be derived by direct measurements, was estimated using least squares regression techniques, relating the camera response to the reflectance of a set of carefully selected color samples [2]. To derive mappings to colorimetric and

multispectral representations, two conceptually different approaches were used: In the *model-based* approach, the physical model describing the image acquisition process is inverted to reconstruct the spectral reflectance. In the *empirical* approach, the functions are derived by relating the device response for a set of training colors to the corresponding colorimetric and spectral measurements, using least squares regression [3]. The results have shown that accurate colorimetric imaging can be achieved even from RGB-images, by using polynomial regression to CIEXYZ and CIELAB. Accurate spectral reconstructions, however, requires for multi-channel images, and using the model based device characterization [4].

Microscopic Gloss Measurements

Measurement and characterization of paper gloss is of great interest, since gloss is an important quality factor in color printing. By using the possibility to vary the angle of incidence for the light source, and to rotate the sample around the optical axis, detailed gloss measurements can be made for every single angle. Since the gloss reflections usually are concentrated in very narrow and bright peaks, the dynamic range of the 12 bit CCD sensor may not be sufficient to accurately capture the peaks. To overcome these limitations, high dynamic range (HDR) images are computed, based on multiple exposures with varying integration times. Microscopic gloss measurements on newsprint paper grades have revealed that there are two different types of gloss, originating from the paper fibers and from small facets on the surface [5]. The paper fibers give specular reflections in two directions, 180° apart, while the facets have a pronounced peak in a single angular reflection. By relating the average gloss to the orientation angle, it has been shown that the maximum gloss occurs opposite the marine direction of the paper [6].

Separation of Physical and Optical Dot Gain

The term *dot gain* commonly used in halftone printing actually encompasses two fundamentally different phenomena. *Physical dot gain* refers to the fact that the size of the printed halftone dots differs from their nominal size, due to the printing and ink-setting processes. *Optical dot gain*, on the other hand, originates from light scattering inside the substrate, causing light exchanges between different chromatic areas. The result is that the dot area appears bigger when the reflective light is perceived/measured, compared to the physical dot size, and hence a darker tone. Due to the different intrinsic-nature, these two types of dot gain have to be treated separately in order to accurately model the outcome of halftone prints. However, in reflectance measurements, physical and optical dot gains always co-exist, making the separation difficult. In transmittance measurements, however, optical dot gain is not present. By using microscopic images, captured with reflective and transmittive light, we have proposed different methods to separate physical and optical dot gain, using image analysis methods, as well as traditional models for halftone reproduction [7, 8]. We have further studied the relation

between dot gain and halftone dot size, showing that the physical dot gain is proportional to the print resolution [7].

Micro-reflectance Measurements of Halftone Dots

The traditional models predicting the outcome of halftone prints (such as Murray-Davies, Yule-Nielsen and Clapper-Yule) are based on the assumption that the reflectance values of the ink and paper are constant. Only the reflectance of the unprinted paper and the full tone ink are used in the models. By using microscopic images, the reflectance of the individual halftone dots and the paper between them can be measured, which is not possible in macroscopic measurements. The results reveal that the micro-reflectance of the ink and paper is not constant, but varies with the dot area coverage. By incorporating this varying micro-reflectance of the dots and paper into an expanded Murray-Davies model, the prediction errors are smaller, compared to the commonly used Yule-Nielsen model. However, unlike Yule-Nielsen, the expanded Murray-Davies preserves the linear additivity of reflectance, thus providing a better physical model of halftone printing [1, 9]. The results further show that the way that the micro-reflectance varies is heavily dependent on the halftone method, the print resolution and properties of the substrate [10].

Summary and Future Work

This paper has given a short overview of how microscopic images can be used in research related to color printing and paper optics, including some brief examples of our previous projects. Ongoing and future research projects include paper surface characterization by extending the concept of photometric stereo, using multiple angles. We will further continue the gloss studies and the characterization of the varying micro-reflectance of the ink and paper, relating the phenomenon to properties of the substrate and parameters in the printing process. We believe that the possibility to combine colorimetric and multispectral imaging with a high spatial resolution, will give many new possibilities for future research in color printing and paper optics. A deeper understanding of the complex process of halftone color printing on paper substrates will in term benefit the quality in color prints.

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USE OF BIOPLASTICS, BIODEGRADABLE INKS & ENVIRONMENTAL FRIENDLY CHEMICALS AS PACKAGE SUBSTRATE AND PRINT ESSENTIALS

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Abstract

In this paper it is basically discussed about the possible practical approach to adopt the biodegradable substrates, inks, plate, chemicals and other related materials in the field of Printing and Packaging. There is lot of hazardous effects of petroleum based plastic packages and chemicals used in package printing on the environment. So there is a need of rethinking, for the use of such kind of materials, which create threat to the society and environment through different kinds of print products. Here an effort is made by collecting the available data from different open sources and same is compared for initializing positive approach to replace the conventional plastics with bioplastics packaging substrates and using biodegradable inks for printing, which are bio-degradable, compostable, energy efficient and proven suitable though studies. So comparing the physical, chemical and other properties of bioplastics and its type, it is suggested that its use at the place of conventional petroleum based plastics can be a revolutionary step for environmental protective and sustainable print- packaging along with the use of biodegradable inks, adhesives and other materials. The gas barrier, water vapour transmission rate, oxygen permeability, mechanical properties, printability and compatibility with other as well as thermal properties of bioplastics are very near and in some cases better than the conventional plastic. The recent researches are making them more efficient in case of its use in packaging with cost considerations. The inks used for package printing are basically made of varnish, oil and pigment, the oil is usually mineral based and the pigments can contain heavy

metals. This means that when substrate rots and degrades in the soil the oil and pigments are left to pollute the environment. In order to get rid of these hazardous materials options of biodegradable inks based on vegetable oils such as Soya oil, sun seed oil or rapeseed oil and are naturally biodegradable needs to be explored, these are less likely to smudge, do not contain any toxic materials, do not any give any foul smell and more vivid colors can be produced. So using these kinds of materials will make our packages and printing more environmental friendly which is our essential need.
Key words: biodegradability, compostability, degradation, oxygen permeability, mechanical properties, water vapour transmission rate, Soy-based inks, Chem-free.

Introduction

The printing was started with the use of leaf (Bhojpatra) as substrate and invention of paper gave it appropriate speed which is biodegradable in real sense. In the later phase of its development the flexo and gravure printing adopted the poly based printing substrates widely for printing and packaging. The other essentials were developed / modified without any consideration of its environmental impact and hazards but in the later phase all the manufacturers stared thinking about encountering, eliminating and minimizing the both with required parameters. As the world is becoming cognizant about the hazardous effect of plastic on the environment. To support this, researchers have come up with natural option of Bioplastics. Plastics are being used all over the world. Right from drinking cups to parts for automobiles. Plastics are extremely important to the job market as well as for printing and packaging throughout the world. Since plastics are involved with peoples everyday lives. Therefore options of Green substrates other than paper to replace poly based substrates and other printing consumables has become necessary for green printing and packaging.

Green consumables

The ink industry has reformulated all inks to exclude the known toxic metals like lead, cadmium, mercury and hexavalent chromium. While there is some evidence that vegetable oils themselves are more biodegradable than petroleum oils and biodegradability of printed matter is a function of the biodegradability of the substrate, not of the dry ink film. Biodegradability and compostability for inks and coatings are complex subjects. There is little scientifically based lifecycle analysis research in these areas. But testing which indicates that mass of ink present on most packaging is so small that it does not interfere with substrates that do biodegrade or compost. Making up a very small portion of the mass of the entire package is the one of the solution. Suppose if ink will represent less than one percent of the total mass of many packages. It makes little sense to expend significant effort and resources to make changes to a material that will have a minimal overall impact on the biodegradability/compostability of the packaging.

There are many different types of printing inks like sheetfed, web, liquid, energy curable, metal decorating, and coatings are used in printing. The decision to choose an ink, and its specific performance characteristics, typically is made based

on the printer's need to balance performance, cost and environmental compliance. Often the choice comes down to performance. To meet the performance requirements a printer may have a very limited choice of ink systems. As we know all printing inks are made up of four classes of raw materials; pigments, resins, solvents, and other additives. The pigment is the color portion of the ink formula which are solid particles. The resins are also solid, and resins bind the pigments to the substrate and provide many of the end-use properties that are required as an ink printed finished good.

The solvent reduces the ink to a liquid form, allowing the ink to be printed by the various selected printing process. Additives are a wide range of raw materials which modify the physical properties of the ink to improve its use on the printing press.

Most of all of these four classes of raw materials are petroleum based products. These are highly refined and processed specialty chemical materials which deliver very unique properties to the various printing ink formulations.

There are some ink raw materials which do come from renewable resource feed stocks. There has been a long tradition of use of renewable raw materials in inks. There are a wide range of current renewable raw material components that are used in various printing inks formulations which includes: vegetable oils and esters, alkyd/rosin esters, cellulose esters/nitrocellulose, fatty acid amides, epoxy soy bean oil, vegetable waxes, and bio-ethanol. The use of renewable raw materials in various printing inks is influenced by technical considerations, customer requirements and pricing.

Ink companies are continuing to practice environmental stewardship on a global bases, fostering technical and regulatory groups to work to produce ink, coatings, pigments, fountain solutions and other products that are environmentally friendly like soy based process inks.

Ink manufacturers today are experimenting with many types of new vehicles and other non-petroleum products to produce the next generation ink systems that will continue to offer environmentally friendly "green" inks.

If we consider the consumables for any printed product it major portion is covered by the substrates and than ink and plate and other chemicals occupy very less portion even than the green chemistry like Chem-free violet CtP, Chem-free Thermal CtP, Process-freeInkjet Metal CtP, Process-freeInkjet Polyester CtP solutions and FOGRA approved Alcohol-free & Alcohol reducing founts, Aromatic-free press washes, Low hazard cleaners & deglazers launched by the "Technova" and similar products by other manufacturers are the really appreciable efforts for achieving "green" printing and packaging

Green substrate

Bioplastics are the one of the option to replace the poly based substrates in package printing other than paper because it is a form of plastic derived from renewable biomass source, such as vegetable oil, corn-starch, potato-starch or microbia, rather than fossil-fuel plastics which are derived from petroleum. In the

1850s, a British chemist created plastics from cellulose, a derivative of wood pulp. Later in the early 20th century, Henry ford experimented with soy-based plastics in his automobiles. After that, biodegradable plastics began being sparking interest during the oil-crisis in seventies. The 1980's brought items such as biodegradable films, sheets and mold-forming materials.

Bioplastics can be made from many different sources and materials. They are produced from renewable biomass sources, such as vegetable oil, corn-starch, potato-starch or microbiota, a number of fibers including those obtained from pineapple and henequen leaves and banana stems. Corn is the primary source of starch for bioplastics, although more recent global research is evaluating the potential use in bioplastics for starches from potato, wheat, rice, barley, oat and soy-sources. Also, bioplastics can be made using bacterial micro-organisms or natural fibers such as jute, hemp & Kenaf. Sometimes various nanometer-sized particles especially carbohydrate chains called polysaccharides or other biopolymers that don't dissolve in water, with clay are added to add certain properties like, low water-vapour and gas permeability, increased shelf-life with better strength. But there is a need to identify the other suitable plants available for this specific purpose.

Classification of Bioplastics

Starch based plastics: - Starch the storage polysaccharide of cereals, legumes and tubers is a renewable and widely available raw material for bioplastics. Flexibiliser and plasticizer such as sorbitol and glycerin are added so that starch can also be processed. As a packaging material starch alone does not form films with adequate and required s mechanical properties of high percentage elongation, tensile and flexural strength unless it is treated by either plasticization, blending with other materials, genetic or chemical modification or combinations of different approaches. For which corn is the primary source of starch, although considerable amounts of starch are produced from potato wheat and rice starch.

Bioplastics produced from classical chemical synthesis from biobased monomers: - Using classical chemical synthesis for the production of polymer gives a wide spectrum of possible “bio-polyesters”. Polylactic acid is the polymer with the highest potential for a commercial production of renewable packaging materials. However, a wide range of other bio polyesters can be made. Theoretically, all the conventional packaging materials derived from mineral oil today in coming future can be produced from renewable monomers gained by fermentation. Today, this approach is not feasible due to the cost of the production of the monomers has economical constraint.

Polylactic Acid (PLA) plastics: - Polylactic acid, PLA is a biodegradable, thermoplastic, aliphatic polyester derived from lactic acid. The lactic acid source of PLA is itself produced from the fermentation of agricultural by-products such as corn-starch or other starch-rich substances like maize, sugar or wheat. PLA has high potential for packaging applications. The properties of the PLA material are

highly related to the ratio between the two mesoforms of the lactic acid monomer. Using 100% L-PLA results in a material with a very high melting point and high crystallinity. A 90%/10% D/L co-polymers gives a material which can be polymerized in the melt, oriented above its Tg and is easily processable showing very high potential of meeting the requirements of bulk packaging. PLA may be formed into blown films, injection moulded objects and coatings. PLA is the first novel biobased material produced on large scale.

Bioplastics produced directly by natural or genetically modified organisms: - Poly Hydroxy alkanoates (PHA's) and Poly Hydroxy butyrate (PHB) is the most common polyester produced by certain bacteria processing glucose or starch. The properties of PHA's are dependent and relates upon the composition of monomer unit, the microorganisms used in fermentation, as well as the nature of the carbon source used during the fermentation process. It is a typical highly crystalline thermoplastic PHA are elastomers with low-milting points and a relatively lower degree of crystallinity. A very interesting property of PHA's with respect to food packaging applications is their low water-vapour permeability which is close to that of LDPE. The renewable resource-based plastic has similar properties to polystyrene. PHB resembles isotactic polypropylene (iPP) in relation to melting temperature (175-180°C) and mechanical behaviour. PHBs Tg is around 9°C and the elongation to break of the ultimate which is very important in bulk packaging application especially in flexible intermediate bulk containers and bulk shrink packaging. It has been reported in the literature that annealing can dramatically improve the mechanical properties of PHB by changing its lamellar morphology while subsequent ageing is prevented to a large extent.

Incorporation of 3HV or 4HB co-monomers produces remarkable changes in the mechanical properties. Stiffness and tensile strength decrease with increase of toughness with increasing fraction of the respective co-monomer. Medium chain length PHAs, unlike PHB or its copolymers, behave as elastomers with crystals therefore, can be regarded as a class of its own with respect to mechanical properties. Elongation to break up to 250-350% has been reported and a Young’s modulus up to 17 MPa.

Polyamides 11: - PA11 is a biopolymer derived from natural oil. It is also known under the trade name Rilson B commercialized by Arkoma. It is used in high-performance application like automotive fuel lines, pneumatic airbrake tubing and flexible goods means they too have good mechanical properties as they are used in automotive and electrical stuffs.

Polycaprolactones: - It is a biodegradable thermoplastic polymer derived from the chemical synthesis of crude oil. Polycaprolactones has good water, oil, solvent and chlorine resistance. It is mainly in thermoplastic polyurethanes, resins for surface coatings adhesives and synthetic leather and fabrics.

Properties of bioplastics and its comparison with conventional plastics for its application in printing & packaging:

Due to biological biodegradability the use of bioplastics is especially popularizing in the packaging sector. The use of bioplastics for shopping bags is very common. Certain characteristics of bioplastics- such as their aroma barrier and ease of moulding make them particularly suitable for use with cosmetics and are continually being developed to make bioplastics beter alternatives for such packaging. PLA offers good-moisture barrier properties and is able to withstand the rigors of injection-moulding and blow- or vaccum-forming processes. It is used for loose fill packaging food packaging. PLA has similar characteristics as cellophane, oriented polypropylene (OPP) or oriented polyethylene (OPE). Its performance include high clarity and gloss and high stiffness. Bottles made from PLA can show characteristics similar to PET. Its containers are rigid, strong and have high aroma barrier suitable to pack cold delis items such as fruit, pasta, salads and cheese. PHA's can be incorporated into packaging components such as coatings, laminations and biodegradable printing inks. It is currently being considered for flexible packaging. After the detail study of bioplastics's mechanical, thermal and barrier properties conclusion regarding its use in bulk packaging as an alternative for petroleum based plastics can be obtained.

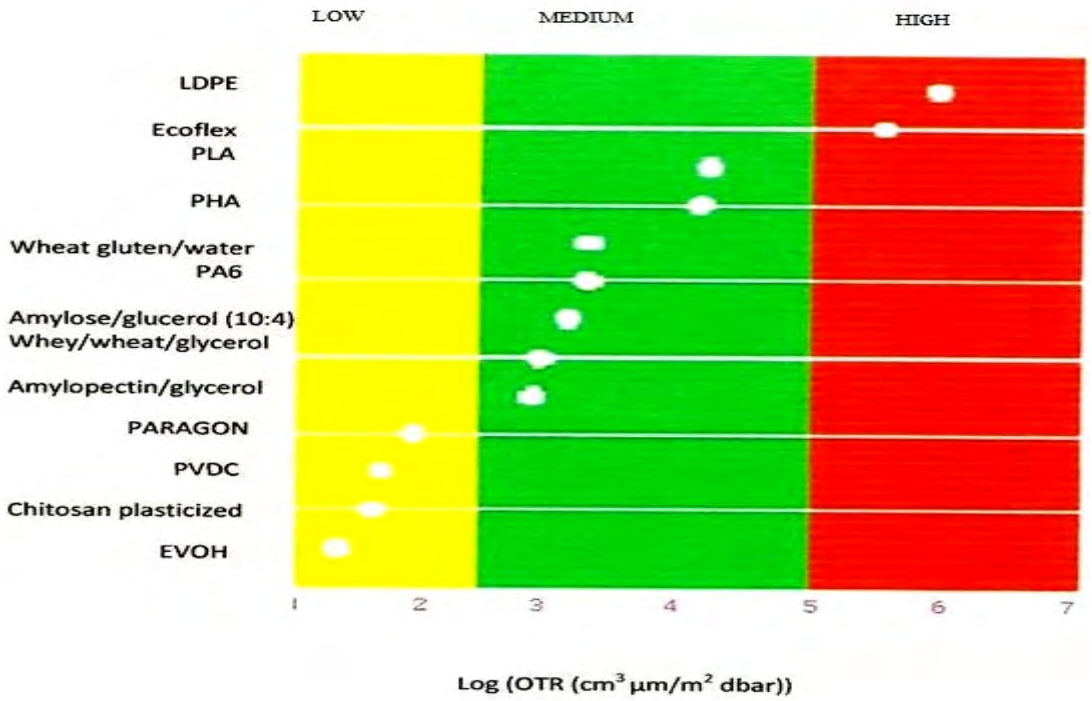
Gas barrier properties:

In most packaging applications the gas mixture inside the package consists of carbon dioxide, oxygen and nitrogen or combinations. Biobased materials have quite same oxygen permeability that of conventional mineral-oil-based materials and it is possible to select from a range of barriers among the present biobased materials. The conventional approach to introduce high-barrier films for packaging of food is to use multi-layers of different films in order to obtain the required properties. A laminate that is often used in packaging consists of an layer of EVOH or PA6 combined with LDPE for mechanical strength and the excellent sealing properties. A similar multi-layer approach for biobased materials may be used to produce materials with the required properties. Starch-based materials could provide cheap alternatives to presently available gas barrier materials like EVOH and PA6 and an equivalent biobased laminate would be an outer- layer of plasticized chitosan, a protein or starch-derived film combined with PLA or PHA. PLA and PHA will protect the moisture-sensitive-gas-barrier made of polysaccharide and protein. Developments have made it possible to improve water vapour and gas properties of biobased materials many-fold by using plasma deposition of glass-like SiOx coatings on biobased materials or the production of nano-composites out of a natural polymer.

In general, the oxygen and other gases permeability of a specific material are closely interrelated, petroleum based polymers have a fixed ratio between the oxygen and carbon dioxide permeabilities. This relation is also observed for biobased materials. However, for some biobased materials,like PLA and starch, the permeability of carbon dioxide in comparison to oxygen is much higher than for petroleum based plastics.

Gas barriers, humidity and microbial growth

As many of these biobased materials are hydrophilic in nature therefore their gas barrier properties are very much dependent on the humidity conditions for the measurements and its gas permeability may increase many times with when increase in humidity. Same is the phenomenon with conventional polymers. Gas barriers based on PLA and PHA is not expected to be more dependent on humidity. According to the study microbial contamination levels of packages made from conventional and biobased materials are relatively below the standard of 1 organism/cm^2.

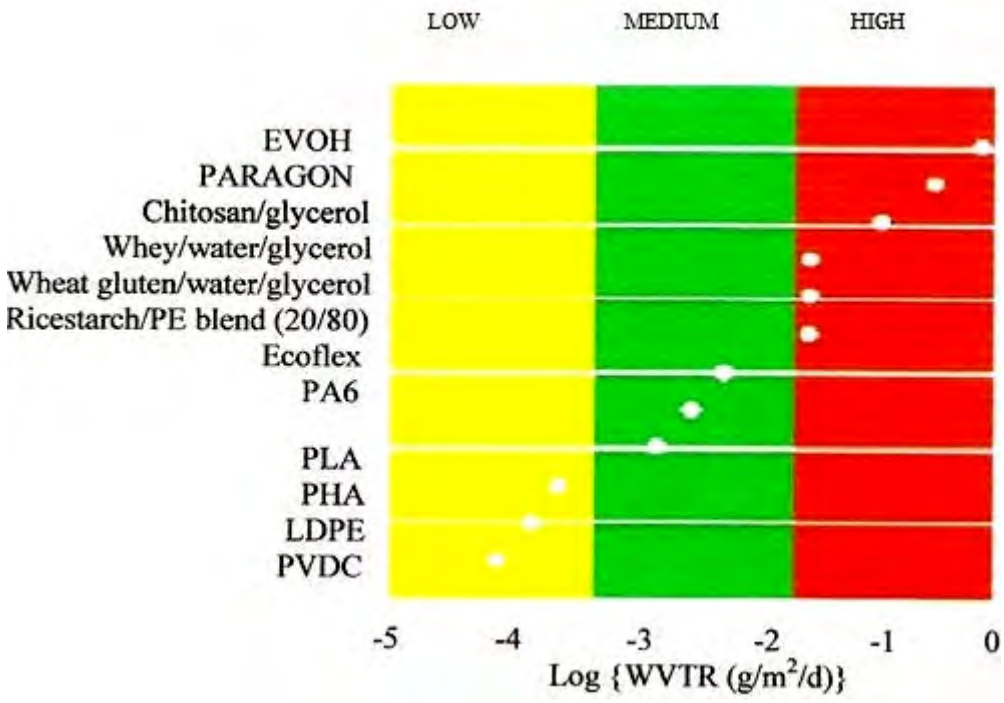


A microbial study of cellulose triacetate, a type of bioplastic shows that after years of storage under ambient conditions mostly *Pseudomonas* bacteria is found in the film. Different tests for fungal growth (ASTM G21-96, G22-76, G21-70) has been conducted on the bioplastics, after many years of storage it was found that a low growth of selected food related fungi like *Penicillium* ocured in the same.

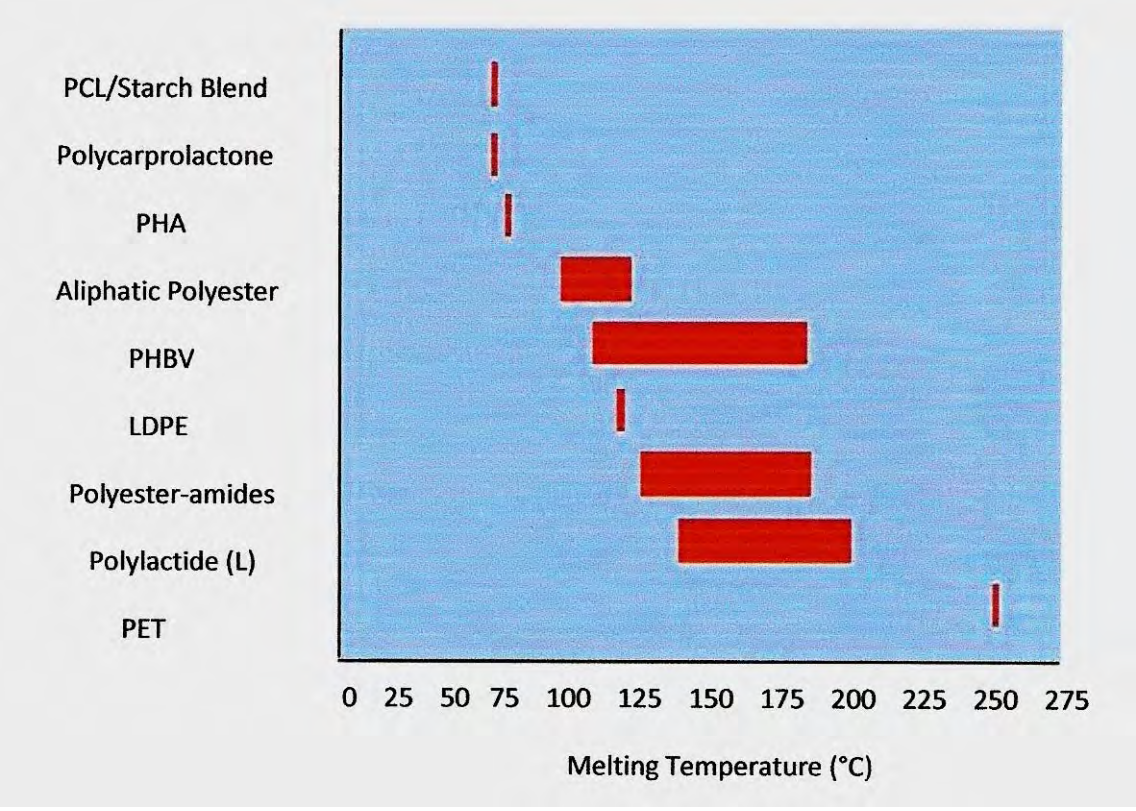
Water vapour transmittance:

While comparing the water vapour transmittance of various biobased materials to conventional plastics it comes out that it is possible to produce biobased materials with water vapour transmittance rates comparable with some conventional plastics. Research are currently focusing on this problem and future biobased materials will be compatible in terms of water vapour barriers with conventional conventional pastic materials known today.

Thermal and mechanical properties: The thermal and mechanical properties of the materials are important for processing and for use of the products derived from these materials. Most biobased polymer materials act in a similar fashion to conventional polymers. This indicates that both polystyrene, polyethylene and PET-like materials can be found among the available biobased polymers.The mechanical properties in terms of modulus and stiffness are not much different compared to conventional polymers.



The modulus of most biobased and petroleum derived polymers can be tailored to meet the required mechanical properties by plasticizing, blending, crosslinking. A polymer like bacterial cellulose could be used in materials to meet special mechanical properties.



Bioplastics also provides very good printability, without any pre-treatment. Apart from this PLA have particularly high glossiness, high transparency, and good aroma or fat barriers, high oxygen barrier properties, antistatic properties.
Now comparing with the petro-based plastic we find that bioplastics have enough potential that it can be implemented in the IBC, FIBC, Shrink wrapping, and as liners in the bulk packages.

Biological derived polymers may be used for the production bulk packages with the same technology used for conventional materials. These data proves that they are nowhere less in any physical, thermal, mechanical and barrier properties than conventional plastics.

PROPERTIES OF BIOPLASTICS (ASTM standard)

Physical properties	
Mold shrinkage	0.0125-0.0155 in/in
Density	1.4g/cm³
Apparent viscosity(180ºC, 100 sec^{-1})	950 Pa-s
Thermal properties	
Melting point	160-165ºC
Heat distortion temperature	143ºC 78ºC
Vicat softening temperature	147ºC
Mechanical properties	
Tensile strength	26 MPa(3800psi)
Shrinkage	0.93% caliper
Tensile modulus	3400 MPa(494,000psi)
Tensile elongation brake	3%
Compressive yield Stength	65MPa (approx)
Compressive Modulus	2GPa (approx)
Flexural strength	44 MPa(6390psi)
Izod impact strength	26 J/m(0.5 ft lbs/in)
Hardness	54 shore D(90ºC,2.16kg)
Bending module	387 MPa
Moisture absorption	0.16% (23ºC, 50% RH)
Transparency	High
Oxygen barrier	Medium-high
Other Properties	

Stackability	Fair
Puncture Resistance	Excellent
Crystallinity	60

Advantages of Bioplastics over conventional plastics

Compost derived in part from bioplastics increases the soil organic content as well as water and nutrient retention, with reducing chemical inputs and suppressing plant diseases.

Starch-based bioplastics have been shown to degrade 10 to 20 times quicker than conventional plastics.

On burning traditional plastics, create toxic fumes which can be harmful to people's health and the environment. If any biodegradable films are burned, there is little, if any, toxic chemicals or fumes released into the air.

Safe Biodegradability: In degradation test it was found that more than 90% of samples degrade in 10 months, according to the measurements of weight loss and CO_2 production. There are water soluble biocomposites with solubility depending on the amount and the molecular weight and its crystallinity. Bioplastics like PHBV, PHB are biodegradable in soil, river, water, sea-water aerobic and anaerobic sewer sludge and compost.

Compared to conventional plastics derived from petroleum, bio-based polymers have more diverse stereochemistry and architecture of side chains which enables research scientists a great number of opportunities to customize the properties of the final packaging material.

Thus with this added advantages and almost similar properties of LDPE, PVC, Nylon, HDPE, PP we can implement bioplastics in the packaging industry at the places of these petroleum based plastics which are creating environmental pollution by its non degradability and harmful gas emission.

Conclusion

Biodegradable plastics are one of the most innovative materials being developed in the printing & packaging industry. How widespread bioplastics will be used all depends on how strong society embraces and believes in environmental preservation. It is important to recognize that although past and recent efforts have thus for yielded significant strides in the field of bioplastics. To establish themselves, these materials have to be well performing in order to be able to compete with highly developed and sophisticated materials/substrates used today in printing & packaging. Comparing the properties of biobased polymeric materials with the conventional synthetic petroleum derived polymers shows a major potential of these polymers for the production of well-performing packages. The biobased materials have an inherent potential of being compostable which may help the commercialization of these materials. As with any emerging technology,

continued innovation and global support is essential in order for bioplastics to fully demonstrate its socio-economic benefits and further challenge the status of traditional petroleum based plastics.

After a long period of latency biodegradable plastics are now credible. Many polymers manufacturers are entering the market, material costs are falling fast, performance and process ability is increasing significantly. Among the different categories of bioplastics both synthetic and biotechnological biodegradable plastics satisfied the majority of requirements of plastic printing & packaging industries.

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PAPERS' ANALYSIS IN REAL CSWO TECHNOLOGY

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Introduction

Traditional newspapers print technology is called CSWO (Cold Set Web Offset) on standard newsprint (NP). This technology requires high capital investments, but the most important restriction is that coldset printing process normally is not carried out on another type of paper besides NP. Quality achieved with this classical print process is known as newspaper's quality, means CSWO + NP.

Generally relationship between paper, ink type and drying system determine the type of papers that can be printed, achieving proper quality and operating costs as well.[1] Quality is a combination of paper's characteristic (structure, physical grade, optical properties) and reproduction processes. The higher the value of these attributes, the higher the total newspapers quality and cover price without loss of readership.

Today the market demands high quality full-colored newspapers and they really have lots of colors and high print quality that makes newspaper stand out from the competition.[2] If the advertisers see that it is well printed on good paper, they are ready to pay more and customers do pay for better quality as well. In many cases advertisings are printed on better sort of paper than NP, however by different print process, which brings much more quality and higher expenses respectively.

Variety in newsprint quality has spelt the end for many brands, but has also given new print media papers. Paper-makers were forced to bring many tailored specialties to the market-place, particularly in the upper newsprint field. They launched new standards of NP: improved (INP), recycled NP, colored NP, bulky NP etc. All this enables us to choose the best possible base paper which forms a solid foundation for everything involved in this range.

Total process optimization including printed paper is the fundamental key to success for both, print quality and production efficiency.[3] Nowadays already there is developed a significantly higher coldset print quality for commercial customers and for publications accordingly. It has been achieved by optimization

of the production process along with by printing on different types of papers.

Problem Definition

Quality of different papers is evaluated according to runnability and printability, which means to inspect the papers' behavior and interaction of paper/ink in general.[4] These are those properties that have an effect on the running and speed at which the web runs through the press when printing the job. These targets are included in our study. We have been inspected a wealth of papers, printing with regard to their behavior patterns according to such criteria as breaking events and wastages (makulatures) (tabl.1, fig.1). These criteria emphasize the importance of paper's type in CSWO printing process. They are significant for productivity because of utmost importance is that paper runs well. This allows to maintain and even increase the time by moving deadlines to the last moment (editorial schedules have not allocated any extra time for frequent breaks). The purpose is to evaluate different kind of NP: NP of virgin fibres and NP of fully or partially recycled fibres. In addition have been identified the most frequent web breaks, according to different factors (fig.1) and prevention possibilities. In this report are represented results of different papers quality - standard NP, NP of virgin fibre, supplied by different producers, fully recycled NP, INP and MFS (machine finished specialty) (tabl.,2,3,5). We have inspected numerous print performances of variable papers in this print method, using proper inks type.

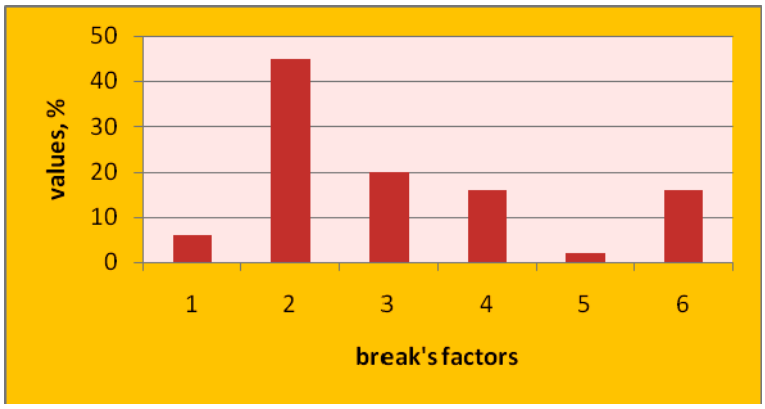

Figure 1. Newsprint breaks, defined in real CSWO, according to different factors:
1-start; 2- autopasting; 3- during print; 4- technical reasons; 5 – fabrics labels; 6 – others

Table 1.

Most important process's quality criteria, defined in real CSWO

№	Process criteria	Sachsen	Solikamsk	Norske Skog	Kondopoga	Volga	Rhein
1.	Breaks, [%]	4,4	15,2	7,9	9,6	7,7	3,9
2.	Makulatures, [%]	1,57	3,51	2,24	2,50	2,15	1,61

Newsprint is very cautious about the influence of ink's consumption when there are different grades, origin (mills) and print quality (tabl.4). In principal ink's consumption can be minimized essentially through optimization of prepress. Our previous experience has shown that ink's setting on recycled NP in CSWO was too poor, causing smearing, set off and marking, so the total print quality was not satisfied. For our case drying is controlled by visual and manual inspection carried out by the operator. (There have been no satisfactory solutions found yet for practical online measurement of the drying).[4]

Problem solution

This article is a trial to present different papers in real CSWO printing, using GEOMAN web offset printing press. This typical coldset web press is a 8-couple tower, offers the highest inking with the shortest web path for double-sided process colors.[5] Our GEOMAN contains four towers each of them of 8-couple printing units. These units involve two H-type printing sections arranged on top of each other. It is set of the horizontal blanket-to-blanket cylinder groups with vertical web lead, permitting for multi-web production, favored for large number of pages involved. This is the simplest and most compact configuration for producing a 4/4 job with one single tower (cut-off 578mm). Each printing unit has its own drive, allowing work independently. All inking units operate with pre-dampening. Reduction of the expected fan-out effect by adjustable register pins and motorized buzzle wheels (the web is laterally extended under the influence of dampening solution). Dampening system is a non-contact, turbo-dampening unit with a kind of oscillator roller, resulted of no reverse transfer of soiling dampening solution to the water fountain. This machine runs a range of different papers from 40 to 60 gsm that do not require any additional drying on press.

Operating conditions include:

- euro scale coldset inks (Newsking TOP, Flint Group),
- sequence: cyan-magenta-yellow-black;
- alcohol free dampening solution, with 3,5% additive (Hydrofast), suitable for soft to medium total water hardness (hydro-carbonates~170 mg/l);
- current dampening solution parameters: pH= 4,8-5,2; conductivity ~ 1500 µS/cm; t°= 10 - 12°C;
- Rollin-Reporter offset blankets - thickness 1,95 mm, underlay 0,16 mm;
- negative conventional printing plates, 0,3 mm (Agfa);
- printing speed ~ 28 - 30 thousands rph (max is 35 thousands rph, 11 m/s)

CSWO on standard NP is the base against which other operating variations are compared. The operating scenarious was the variable coldset production with NP of fully virgin fibres, NP of 100% recycled, and NP of combination (70/30% virgin+recycled), supplied by different mills. The sample of print job is a real newspaper products, consisted of 32-pages (289 x 420 mm), printed of run min 80 000 copies and more. Print quality has been evaluated by printing tests and measuring of solid inks density (SID) in selected solid areas of flat tone and

spectral color parameters, using SpectroEye (X-Rite). All results are shown in 5 tables and 1 graph.

Table 2.

Quality properties of used NP, delivered by different paper's mills

№	Quality properties	Sachsen recycled	Solikamsk virgin		Norske Skog	Kondopoga virgin		Volga virgin
	Reel's width, cm	*168*	*168*	*84*	*126*	*168*	*126*	*168*
1.	Grade, [g/m²], ISO 536	44,9	45,1	45,2	45,5	46,0	45,0	45,0
2.	Thickness, [μm], ISO 534	60	72	71	71	70	69	67
2.	Density, [g/cm³], ISO 534	0,75	0,63	0,64	0,64	0,66	0,65	0,67
3.	Bulk, [cm³/g], ISO 534	1,34	1,59	1,57	1,56	1,52	1,53	1,48
4.	Breaking length, [m], ISO 1924-2	5100	4300	4900	4600	4500	4100	4250
5.	Tear resistance, [mN], ISO 1974	363	216	255	284	294	353	345
6.	Smoothness Bekk, [s]	>60	56	46	50	58	52	55
7.	Brightness, [%], ISO 2470	59	62,3	61,6	61,4	62,5	62	61
8.	Opacity, [%], ISO 2471	93,7	95,4	96,2	94,5	95,5	96,5	95
9.	Humidity, [%], ISO 287	8,2	7,4	6,2	8,6	8,2	9,8	8,1

Table 3.

Quality properties of different samples of 100% recycled NP, StoraEnso

	Characteristics	Newsprint	SACHSEN	SACHSEN	SACHSEN	SACHSEN
№	samples	(virgin)	1	2	3	4
1.	Grade, [g/m²], ISO 536	45,0	44,9	45,0	45,0	45,0
2.	Humidity, [%]	8,0	8,0	8,0	8,0	8,0
3.	Thickness, [μm]	70	63,2	62,5	63,4	64,2
4.	Density, [g/cm³]	0,643	0,710	0,720	0,709	0,701
5.	Bulk, [cm3/g] ISO 534	1,56	1,41	1,39	1,41	1,43
6.	Roughness, [ml/min] Bendtsen	169	162	163	165	164
8.	Air permeability, [ml/min]	215	192	212	222	212
9.	Elongation, [%]	1,5	1,4	1,4	1,3	1,2
10.	Breaking length, [m]	>3500	4900	5200	5150	5290
11.	Tear strength, [mN]	206	310	290	288	288
12.	Brightness [%], ISO (D65)	60	58,4	59,1	58,9	59.0
13.	Opacity, [%]	95	93,5	93,5	93,4	93,5
14.	Ash, [%]	~ 3,0	5,0	5,6	6,3	5,2

Table 4.

Solid Inks Densities on different papers types, used in CSWO

Inks	NP *virgin, 45gsm*	NP *recycled, 45gsm*	MFS *Brite C, 52gsm*	MFC *Matt, 60gsm*
Cyan	0,79	0,78	1,25	1,42
Magenta	0,85	0,85	1,15	1,18
Yellow	0,76	0,79	0,95	1,09
Black	0,96	0,95	1,40	1,47

Table 5.

Characteristics of different types of papers, possibly to be used in CSWO printing

Properties	NP standard	INP improved	NP recycled	MFS UPM Brite	MFS UPMOpalite	MFC matt	WFU fine
Grade, [gsm]	42, 42,5, 45, 48,8	45 - 55	42,5, 45, 48,8	42, 45, 48,8, 52, 55, 60	36 - 45	48, 54, 60	60
Furnish	100% virgin fibre	mechanical bleached, virgin fibre	50-100% recycled fibres	100% mechanical or recycled	mechanical and recycled fibres	mechanical,chemical fibres	wood free, sulphate pulp
Surface description	machine finished newsprint	improved, soft calendered newsprint	machine finished newsprint	Uncoated, machine finished, specialties	machine finished directory paper	machine finished, coated, satin	uncoated, machine finished
Brightness [%] ISO (D65)	58-60	65, 67, 69	57 - 59	63 – 76; 80	55 - 60, 63	70 - 80	>85
Calliper, [µm] ISO 534	65 - 70	68 - 90	60-64	65 - 100	55 - 75	66 - 87	-
Bulk [cm³/g]	1,53	1,45 - 1,60	1,34– 1,43	1,55 – 1,82	1,53- 1,67	1,38– 1,45	-
Opacity, [%]	95- 96	93 - 95	93-94	91 - 96	87 - 93	91- 95	86 - 99
End uses	newspapers advertising	newspapers inserts, advertisings	newspapers inserts, advertising	inserts, week newspapers, catalogues	week newspapers inserts, tel directories	supplement special newspaper advertising	advertisings, comics, newspaper supplement

Results and discussion

Printing on used NP shows an acceptable quality process for CSWO. The usage of coldset web inks requires papers to be designed accordingly, which means open, flat surface, provided good absorption of oils, contained in the inks. Printing these types of inks on uncoated paper tends to increase ink consumption so ink transfer has to be of high attention. Practically the comparison of papers was carried out on the base of printability and runnability. Their printability refers to the properties which the substrate must have to reproduce the text and illustrations in optimal quality.[4] Such parameters as absorption and ink's drying time, picking resistance, two-sidedness (wire mark), longitudinal and cross profiles under the

influence of moisture, thickness and grade, dusting (linting has effect), color density and mottling (uneven solid density) are essential. According to tests and everyday printing results, the printability and runnability of recycled NP equals the properties of virgin NP. This relates particularly to partially recycled NP (Norske Skog, Rhein). The influence of recycled fibre on the physical paper's properties depends on the constituent part in the paper. Permanent grow of recycled fibre involved in NP (up to 100%) is an alternative for the print production. But fully recycled NP (Sachsen) is not competitive with virgin NP, particularly towards optical properties and drying time (tabl.1,2,3). Recycled NP has a specific surface - more flat topography, with closed porosity and better smoothness, which makes oils absorption difficult (Sachsen). But advantage in print process without problems (low breaks) is valued predominantly (tabl.1). This means better pressroom runnability, without frequent breaks and wastages respectively. 100% recycled NP (Sachsen) has first-class runnability together with overall cost efficiency. Reduction of grade makes possible to use substrates up to 42,5gsm (Rhein).

Printability is influenced by all optical properties as brightness, opacity, color and gloss.[4] Physical properties, primarily compressibility, elasticity, humidity, absorption capacity and bulk, also have an influence on the printed reproduction and on runnability (tabl.2,3). Some of physical properties like strength, paper thickness and bulk (specific volume) depend on the grade. Now the basis weight of NP is mostly 45gsm. The higher the basis weight the greater the opacity. Most types of NP are produced according to basis weight, but some of them like bulky NP and MFS as well, are produced strictly according to thickness (tabl.5). Thickness has a major impact on bending stiffness. The specific volume is a ratio of thickness to grade. Greater paper thickness gives a more volume and stiffness of print product while keeping the same grade. Natural NP is more bulky than recycled NP. To ensure smooth production process NP has to meet the high requirements related mainly to strength, an important factor in web offset printing and in CSWO as well. It is influenced by the type of fibres and their alignment in the microstructure of the paper. Chemical pulp naturally has greater strength than mechanical pulp. NP of fully recycled fibre has better breaking length compared to natural NP (tabl.2,3).

Surface characteristics, determined the visual impression and texture of the paper are roughness, topography, gloss, opacity. Opacity depends on the number of fibres, air and pigment in the paper. The greater the light resistance and reflectivity of the paper, the higher the opacity. Improved NP is characterized by higher brightness, better opacity and bulk, important for achieving max CSWO quality. This means better ink's coverage and reduced dot gain. The business trends of INP are similar to those of standard NP.

In tabl.5 are shown the results of these different types of papers, which can be used in CSWO. Along with NP is favorable wide range of MFS grades, distinctive and designed for many fine uses, with a special touch. The brightness of this family (UPM Brite) is very high. To brightness and good printability

recognition has come from the matt surface and high bulk, resulting in good readability. Her matt surface with high rigidity is unique and so versatile, suited for many products, like weekend newspapers, comics, direct mails, telephone directories (Opalite). MFS provide a bright clear image for newspapers or separate different supplements, flyers, multicolored catalogues etc. Towards mechanical coated papers (MFC) additional benefit is that several grades (48, 54, 60) are suitable for CSWO. Due to their surface treatment it is possible to keep their form even, when the weight is light. Easy readability of the matt coating and better advertisings' quality make these grades niche product for newspapers market. That is why very often MFC papers have been selected for newspapers publications with excellent full-color printability. But the main reason, given great advantage of mechanical papers is expensive chemical pulp contained in WFU (wood free uncoated) papers. In the same time we have WFU paper with high brightness, suitable for multi-purpose uses, sometimes for special newspapers (UPM Fine100, 60gsm).

Ink coverage was evaluated by representative solid ink density (SID) values for comparison of print quality and economic modelling (tabl.4). SID values depend on fibre composition and surface quality. There is a direct correlation between visual color assessment and SID. Different papers have different levels of maximum SID and sometimes differences within a single paper grade vary over 15%. Visual effect of density and the adverse properties of ink weight on NP is linear. Average results for black on NP are accepted as a normal with ink consumption of about 1gsm. The most important conclusion is that solid ink densities for CSWO on newsprint are a compromise between visual perception and adverse effects as, smearing, print-through, set-off, marking.

Conclusion

There is a direct link between the perceived newspaper's quality and its flexibility of used papers. The higher the number of different types of papers, the higher the possibilities for newspapers production. Newspapers is the only medium that offers an endless combination of papers types, substrates, surfaces, shapes, colors, smells and tastes and all these appeal to our senses and create emotional value to suit a specific audience.

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COMPARISON OF OPTIMAL INKING OBTAINED BY USING THE METHOD OF MAXIMUM PRINT CONTRAST AND INKING OBTAINED BY ACHIEVING THE COLOUR VALUES IN CIE LAB

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Abstract

Defining of optimal inking in the offset printing process is one of the most important conditions for achieving of high quality and predictable results. Besides defining the exact values of optimal inking, expressed by D_v, applying the method of maximum print contrast for the different combinations of printing substrate-offset printing press-ink, it is also necessary to check whether these values can result in correct colour characteristics, expressed by CIE Lab of the main ink types – C, M, Y and K. In order to achieve the goals of the experiment, a number of measurements have been performed (from underinking to overinking) for defining the optimal inking by the method of maximum print contrast. Also, the colour coordinates CIE Lab have been defined and the respective corresponding density of the fields, at which the smallest colour difference is achieved between the measured fields and the colour values in CIE Lab included in the ISO Standards for colour characteristics of inks for offset printing. A comparison has been made between the optimal inking results obtained by the two methods. The analysis of the Dv results achieved by the two methods also compares the values of the print contrast, the tone value increasing (dot gain), etc. It also gives some recommendations of practical importance.

Key words: Print Quality, Offset Print, Optimization of printing processes, Optimal Inking Values, Print Contrast

Introduction

One of the most important factors, influencing the offset image quality is the ink quantity onto the printed sheet. This ink quantity depends on the specific combination printing substrate-printing machine-ink.

The major methods exist on determination and control of inking:

1. Method for determination of optimal inking density – D_v, based on maximal print contrast [1]. Its main purpose is to produce as deep as possible colours with the highest ink quantity, while keeping the dot gain in the admissible limits and it is characterized by good quality of the prints' dark tones.

2. Method based on colourimetry, aiming at gaining of color levels for C, M, Y and Black as defined in the ISO standards [2,3,4]. These standards provide the following interpretation. Density values can be very valuable for process control during a print run, where the instrument, the ink and the print substrate remain the same (see ISO 13656 [3]). However, in a general situation, density values do not define a colour to the required degree. Therefore, for the purpose of ISO 12647-2, reflection density values are only recommended for the determination of tone values. Following ISO 13656, the production press operator first achieves the

correct colour of the solids on the press, then reads the densities with the instrument from the OK print. The densities are then used as target values for process control during the production run. According to the ISO 12647-2 [2], the leading method for inking determination is the colourimetry, while the densitometric measurements appear to be informative only.

Experimental

The major goal of this experiment was to determine and compare the inking for CMYK, for two various treatments - the maximal print contrast method expressed as D_v, and the colourimetric method defined as per the ISO standards [2,3,4] for LWC paper, printed on Heatset printing press.

Results and Discussion

The test form that have been used contains different control strips and elements: solid patches for C, M, Y, K, two color overprint patches, 40% and 80% dot gain patches [5,6], slur/doubling control elements and etc. All measuring components are with screen value 150 lines per inch. During the experiments were used printing plates FUJI LH-PCe Brilia 1005x680mm, obtained via calibrated and linearised CtPlate device Kodak Trendsetter Quantum II have been used. The paper that has been used is Galerie Brite 60 g/m^2, SAPPI, Inks - Maxink Phantom HD OHD 9300. The printing machine, which has been used is web offset heatset press KOMORY SYSTEM 40.

The printing process was performed at standardized conditions.

A densitometer D19C and spectrophotometer of type SpectroEye of GretagMacbeth have been used for measuring of optical density, print contrast, dot gain and the colour characteristics in the CIE Lab color system. All measurements are in accordance with ISO 12647-1[7]: D50 illuminant, 2° observer, 0/45 or 45/0 geometry, black backing and in accordance with [8,9,10].

Colour characteristics of used paper (print substrate color) are in accordance with ISO 12647-2 [2] tolerances (L±3, a±2, b±2).

In the above-mentioned conditions, were printed series of samples characterized by gradual smooth changes in ink quantity - from underinking to overinking.

In order to achieve the goals of the experiment, series of measurements of Dv and Print Contrast have been performed (from underinking to overinking) for defining the optimal inking by the method of maximum print contrast for Cyan, Magenta, Yellow and Black. A statistical analysis of the results was performed.

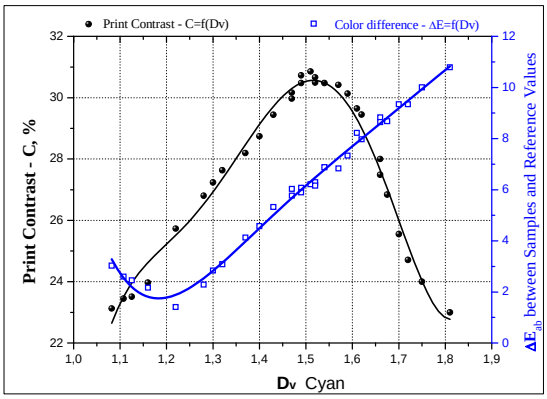

Figure 1. C=f(Dv), ΔE=f(Dv) for Cyan

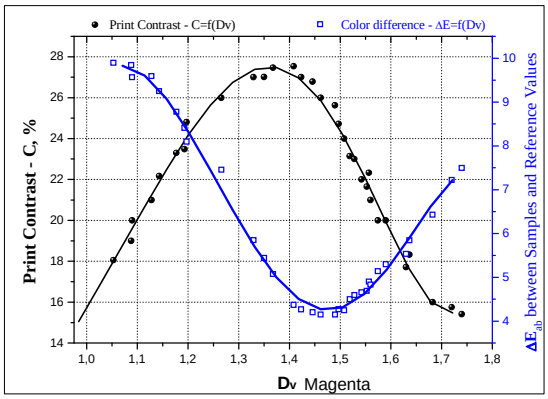

Figure 2. C=f(Dv), ΔE=f(Dv) for Magenta

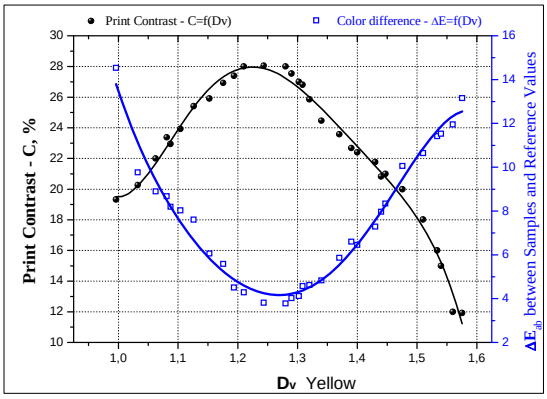

Figure 3. C=f(Dv), ΔE=f(Dv) for Yellow

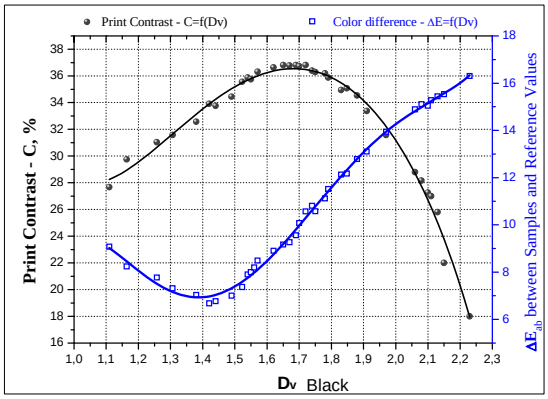

Figure 4. C=f(Dv), ΔE=f(Dv) for Black

The experimental data, representing the changes in the print contrast – C (the ordinate axis on the left side on figures), depending on the Dv for the process colors, are given in Figures 1, 2, 3 and 4.

The graphs show clearly visible peaks, visualizing the maximal value of the print contrast and its corresponding D_v. The optimal inking has been defined through the optical density of 100% solid patch - D_v. Experimentally defined values for optimal quantity of printing ink for the LWC paper are shown in Table 1.

Table 1.

Experimentally defined values for optimal quantity of printing ink by the Print Contrast Method

Type of paper	**Dv** (Optimal density defined by maximal print contrast method)			
	Cyan	Magenta	Yellow	Black
LWC	1.50	1.40	1.25	1.65

In order to determine the inking via the second methods, series of colourimetric measurements were performed on printing sheets with different ink quantity (from underinking to overinking). The major goal was to determine the ink quantity, which provides the smallest colour difference (ΔE) according to the reference values defined in ISO [2,4].

Figures 1, 2, 3 and 4 represent graphically the dependence of ΔE (colour difference between measured values in CIE Lab for solid patches for C, M, Y, K with varying ink quantity and the reference colour values from ISO) to D_v. To achieve better visualization of the experimental data, at the figures 1, 2, 3 and 4, the colour differences - ΔE are presented on second ordinate (the ordinate axis on the right side on figures).

The curve that connects the values of the measurements shows the changes in ΔE from reference values, depending on the printing ink quantity. All graphics show that the curve lies at a determined distance close to the reference value. This distance represents the smallest ΔE between the experimental data and the standard values as per ISO. According to [2,4], the printing process must be performed with ink quantity, which corresponds to the colour in the CIELab system characterized with this smallest ΔE.

Table 2 presents the relevant (corresponding) optical densities $–D_v$ to the smallest values of ΔE, obtained from the experiment.

Table 2

Experimentally defined values for smallest colour differences - ΔEmin and relevant ink quantity defined by Dv

Paper	Cyan		Magenta		Yellow		Black	
LWC	ΔE_{min}	**Corresponing D_v**	ΔE_{min}	**Corresponing D_v**	ΔE_{min}	**Corresponing D_v**	ΔE_{min}	**Corresponing D_v**
	1.44	1.22	4.10	1.46	3.8	1.25	6.6	1.42

Analyses of the achieved results shows:

It is clearly visible from the graphs that for some of the colours exist relatively big differences between the values of D_v, where K has highest levels, and D_v where ΔE has lowest levels.

The experimental results and the comparison of the data in Tables 1 and Table 2 shows that the optimal inking, determined by the two methods differ substantially for Cyan and Black. A relatively big difference in D_v is observed – about 0.3 units for Cyan, and 0.23 units for Black.

While for others colours the difference is smaller - 0.06 units for Magenta and for Yellow it has no difference for obtained ink quantity defined by D_v.

Conclusions

The results achieved are important from practical point of view. They lead to the conclusion that it is necessarily not only to achieve the maximal accuracy of reference colours from ISO standards, but also taking into strict consideration the

concrete printing conditions - as dot gain, print contrast, screen frequency, type of printing press, ink properties (viscosity, adhesion to substrate) etc.

It is clearly visible from the experimental results and graphs that exist relatively big differences between the values of Dv, where print contrast has highest levels, and Dv where ΔE has lowest levels. This means that the implemented two different methods for inking determination result in different levels for D_v.

According to the recommendations of the ISO standards, the leading issue is to achieve of the reference colour values for C, M, Y, K, while the concrete technological printing process conditions are not taken into consideration, for example - dot gain, type of printing plates, ink types, printing paper specificity, printing press, screen frequency etc.

The inking process, as determined by the maximal contrast method takes into account all above mentioned technological conditions, except for the ink color characteristics.

Both methods for inking determination have their advantages and disadvantages. The advantages of one of the methods appear to be disadvantages of the another one.

In order to reach the level of maximal accurate colour reproduction, the condition to achieve colour characteristics C, M, Y, K is not sufficient, without taking into consideration the concrete technological conditions. Taking into account the concrete printing conditions for determination of the inking, but without considering ink colour characteristics would not lead us to predictable results too.

From the point of view of the human perception, it is very important to achieve maximal accurate reproduction of key tones that could be fulfilled only if the Print Contrast method is implemented.

The experimental results lead to the idea that it is necessarily to take into consideration both methods for inking determination, while the best performance from the viewpoint of accuracy of colour reproduction is the generation of ICC colour profiles. The experience has shown that during the ICC profile application, both concrete technological conditions and ink color characteristics are taken into consideration.

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DETERMINATION OF THE DEVIATIONS TOLERANCES OF THE PROCESS-COLOUR SOLIDS FROM THE OK PRINT IN OFFSET PRINTING METHOD

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Abstract

The goal of the present study is to define the correlation between the optical density and colour difference of the main ink colours cyan, magenta, yellow and black in printing on different types of paper, printed on four-colour sheet-feed offset printing machines. A test form has been used that contains different control strips for densitometric and colourimetric measurings.

By the methods of Regression analysis it has been ascertained that the correlation between the optical density deviations - ΔD from the optimal values and colour difference - ΔEab, can be presented by the following regression model (equation): $\Delta Eab = a.\Delta D^2 + b.\Delta D + c$ ($y=ax^2 + bx + c$). The coefficients received are not equal for the different paper-ink combinations, which suppose different limits for ΔD. By using of the allowed limits for colour difference ΔEab (defined in ISO standards), it is graphically defined which ΔD limit values correspond to every colour and every paper-ink combination.

The results achieved are important from scientific and practical point of view. For the first time in an experimental way a well-grounded proof has been achieved with regard to the limits of the optical density deviation from the optimal values for various ink-paper combinations, by provision of colour differences in compliance with the international standards.

Key words: Print Quality, Offset Print, Optical Density, Colour Difference

Introduction

The offset printing method has a leader position in graphic arts technology. The quality of printing production is the most important factor, which determines the market position of the printing houses. Quality parameters are accounted in the European standards. In printing processes we operate with parameters like ink quantity, registration of colours, dampening process, pressure in printing zone and so on. Quality of printing image is function of supporting of printing process parameters in precise boundaries. The valuation of quality of printing image can be finished by the human eye and by colourimetric methods.

In the practice we use two methods to measure the quantity of printing ink [1,2,3,4,5]:

Densitometric methods – used for control and management of printing processes. The measurement of the optical density refers to solid and raster images, which are printed by the basic colours – cyan, magenta, yellow and black. The measurement results cannot used to estimate the visual perception of colour. When we measure the optical density we ensure control of reproduction and printing processes with two ways:

measuring of quantity of printing inks in way of generant of form cylinder in narrow borders for each of main colours;

measuring of dot area, based on optical density of solid field.

Colourimetric methods – based on colour difference ΔEab, needed to estimate the first approved printing sheet of paper related to the printing proof, to compare real printing process to first approved printing sheet of paper, for digital printing.

All the two methods have advantages and disadvantages.

Experimental

The main goals of this research is to define the correlation between optical density and colour difference of basic inks colours – cyan, magenta, yellow and black in printing on two types of paper – glossy coated paper and uncoated paper, on four colour sheet feed offset printing machines.

Results and Discussion

A test form that have been used contains control and measuring components: registration marks, solid patches for cyan, magenta, yellow and black – for control of optical density and colour difference, patches for estimating of dot gain and grey balance, strip which contains raster lines in different slope for doubling and slur control. All measuring components are with screen value 150 lines per inch.

All four printing plates are positive working and exposed on CtPlate system Lüscher XPose 130. The offset printing machine, which has been used, is five colour sheet feed “Heidelberg 74”. The paper, which has been used, is 150 g/m2 coated glossy paper (Neo gloss), and 80 g/m2 uncoated paper (Amber offset). The printing inks, which have been used, are “Europe” scale. The optimal quantity of

printing ink has been determined by method of maximum printing contrast [1] for each combination of paper-ink.

A spectrophotometer/densitometer of type SpectroEye of GretagMacbeth has been used for measuring of optical density and the colour characteristics in the CIE Lab colour system. All measurements are in accordance with ISO 12647-1[5]: D50 illuminant, 2° observer, 0/45 or 45/0 geometry, black backing and in accordance with [6,7,8]

Colour characteristics of used papers (print substrate colour) are in accordance with ISO 12647-2 [2] tolerances (L±3, a±2, b±2).

When the test samples are printed, we use the optimal quantity of printing ink that has been determined by method of maximum printing contrast. We used for operating conditions the limits [9,10], which have considerable difference and it have no evidence for their determination. In table 1 are shown experimental defined values for optimal quantity of printing ink (presented by Dv) for the two types of paper.

Table 1

Experimental defined values for optimal quantity of printing ink for the two types of paper

Type of paper	**Dv**, (optical density of 100% solids)			
	Cyan	**Magenta**	**Yellow**	**Black**
Glossy coated	1,57	1,59	1,46	1,85
Uncoated white paper	1,07	1,07	0,95	1,25

From the already printed paper fortuitously are taken printed sheets, which have not a slur defect. For the each type of paper are measured the four process colours in solid fields, which are parallel to the generant, the deviation of optical density from optimal value and the difference in colour co-ordinates related to the reference. The reference colour is a field, which have an optimal density (table 1). The numbers of measurements are different for four colours and it is determined from the variety of colour differences – from minimum up to in excess of determinate limits [2].

The main goal of this research is formulated on the base of the advantages and disadvantages of the densitometry and colourimetry, as follows: to determine the dependence between the optical densities and the colour differences of the basic ink colours.

The previous version of the ISO 12647-2:1996 standard has defined the following admissible deviations from the reference colours: ΔE cyan - 2,5; ΔE magenta – 4; ΔE yellow – 3; ΔE black – 2. The last version of ISO 12647-2 [2] defines admissible deviation tolerances as follows: ΔE cyan - 4; ΔE magenta – 4; ΔE yellow – 5; ΔE black – 4. From the data available it is obvious that the

deviation tolerance for magenta has remained unchanged, but the values for C, Y and K have increased. During previous researches [11], the relation between ΔD and ΔEab was investigated in accordance with reference values, as set by the previous ISO standard version.

In order to express the analytical dependence between ΔD and ΔEab, it is needed to apply mathematical modeling. It is recommendable to use regression analyses for data processing and to determine the deviation tolerances Dv for the process colours, taking into consideration the optical perception for various paper types.

That's why we do a Mathematical modeling of the data, describing the correlation between ΔE and ΔD and determination of deviation tolerances from optimal inking for C, M, Y, K, considering the human perception specificity.

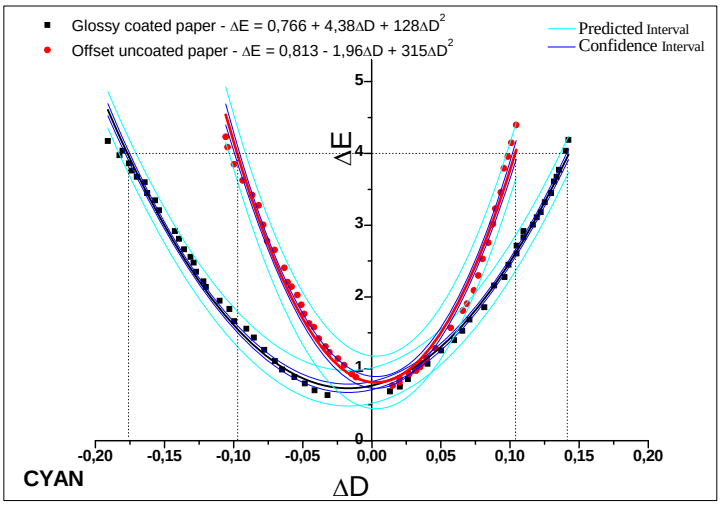

Figure 1. **Δ**D – **Δ**E function for Cyan

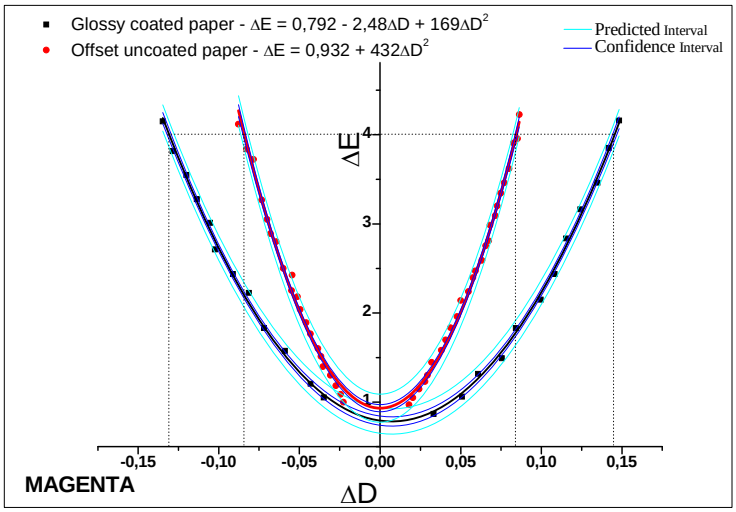

Figure 2. **Δ**D – **Δ**E function for Magenta

It was determined, that the experimental curve is a square function – parabola, described with the formula: $y=ax^2+bx+c$ (in this concrete case - $\Delta E= a.\Delta D^2+b.\Delta D+c$). After experimental data analyzes, for some of the cases the coefficient b was omitted. Therefore the function type was transformed to: $y=ax^2+c$ (in this concrete case - $\Delta E= a.\Delta D^2+c$).

Results of measurements are shown in following graphics. On "x" axis is projected deviations **Δ**D from the optimal ink quantity and on "y" axis – colour difference $\mathbf{\Delta}E_{ab}$ from the reference value.

One of the most important conditions, that guarantee formulation of realistic and practically applicable model - $\Delta E= f(\Delta D)$, is the statistical analyses of the regression model. This analyzes consists of several steps: 1. Dispersion analyzes; 2. Examination of the hypothesis for coefficient significance; 3. Examination of the significance of determination coefficient - R^2; 4. Examination of the adequacy hypothesis of regression model through repetitive trials. The regression models obtained by experimental data are presented in table 2.

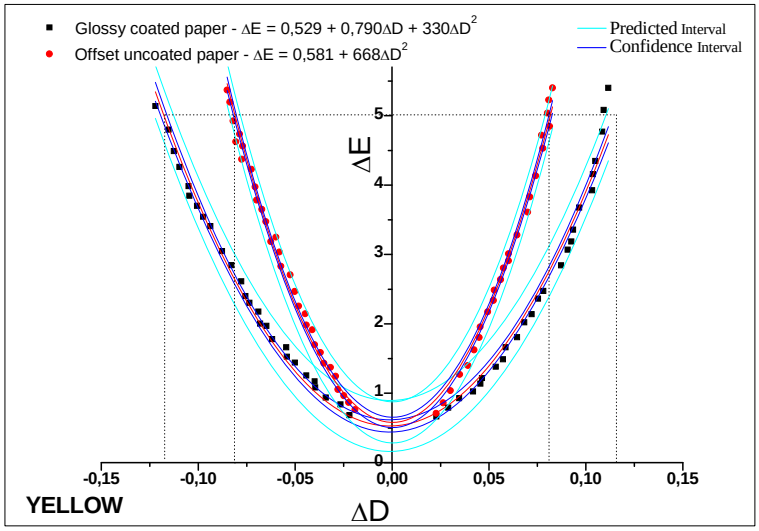

Figure 3. **Δ**D – **Δ**E function for Yellow

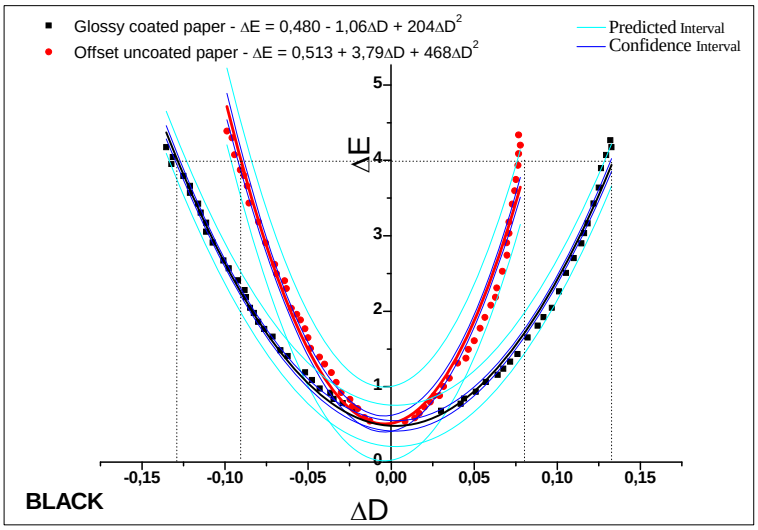

Figure 4. **ΔD – ΔE** function for Black

Table 2

Regression models ΔE=f(ΔD) obtained by experimental data for C, M, Y, K and two types of paper

Paper Type	**$\Delta E = a.\Delta D^2 + b.\Delta D + c$ ($y=ax^2 + bx + c$)**			
	Cyan	**Magenta**	**Yellow**	**Black**
Glossy coated	$\Delta E = 0,766 + 4,38 \Delta D + 128 \Delta D^2$	$\Delta E = 0,792 - 2,48 \Delta D + 169 \Delta d^2$	$\Delta E = 0,529 + 0,790 \Delta D + 330 \Delta D^2$	$\Delta E = 0,480 - 1,06 \Delta D + 204 \Delta D^2$
Offset uncoated	$\Delta E = 0,813 - 1,96 \Delta D + 315 \Delta D^2$	$\Delta E = 0,932 + 432 \Delta D^2$	$\Delta E = 0,581 + 668 \Delta D^2$	$\Delta E = 0,513 + 3,79 \Delta D + 468 \Delta D^2$

Figures 1-4 represent the experimental data and the graphics of the regression models ΔE=f(ΔD). In addition to the models obtained (in this case - parabola), the confidence and the predicted intervals are visualized also.

When ΔE_{ab} is restricted with accepted limits, graphical and analytical can be determined for which values of ΔD limitations are executed for each colour and for each combination paper-ink. The results are in Table 3.

Table 3

Density difference limitations (deviation tolerances) for plus (+) and minus (-) direction for two types of paper

Paper	ΔD			
	Cyan	Magenta	Yellow	Black
Glossy coated	+ 0.143 - 0.177	+ 0.130 - 0.145	+ 0.115 - 0.118	+ 0.128 - 0.134
Uncoated white paper	+ 0.097 - 0.104	+ 0.084 - 0.084	+ 0.081 -0.081	+ 0.082 - 0.090

Analyses of the achieved results shows:

1. For glossy coated and for uncoated papers, the coefficients for main ink colours are different, "**a"** have a biggest value for yellow, and lowest value for cyan (fig.1-4). Therefore for yellow we have smaller limits, and for cyan more wide limits. Coefficient "**b**" shift the parabola for 5 of equations - $\Delta E=f(\Delta D)$ in right hand direction, and for 3 cases in left hand direction. Therefore for 5 cases the limits in plus (+) will be higher, and for 3 cases in negative (-).

2. The parabola in not a one case does not cross zero point. Coefficient "**c**" is smaller than 1, which show us that are possible little colour differences in the references, but they can not be seen by human eyes.

3. When we compare the main colours in the different type of papers we determine that the coefficient "**a**" is from 2 to 3 times bigger for the uncoated paper. Therefore for uncoated paper we have lowest limits. The reason is in optimal ink quantity for uncoated papers.

Conclusions

For first time via experimental research in real production conditions, the deviation tolerances for optimal inking were determined, taking into consideration the human optical perception and the specific production conditions – print substrate – ink – printing machine. It is unallowable to use equal limits for deviations of optical density from optimal inking value for different types of paper. The obtained results can be used in practice for preparing for print for sheet feed offset machines and for quality control of printing process, if we in advance are determined the optimal ink quantity by maximum print contrast method. The limits for different types of paper, does not depend of used equipment. If the print house have only a densitometer, by the black and white drawings can be approximately determined the colour differences, which are result of measured deviations of optical density.

The obtained from the regression models, deviation tolerances for optimal inking relevant to different paper types, differ between each other.

The obtained from the regression models, deviation tolerances for optimal inking for different colors relevant to specific paper type, differ between each other.

For most of the paper types and colors, deviations in different directions – positive or negative, were observed. From the total of 8 developed models, 6 of them are characterized by different tolerances in positive or negative direction. The deviation tolerances' values for 2 models are similar.

The results achieved are important from scientific and practical point of view. For the first time in an experimental way a well-grounded proof has been achieved with regard to the limits of the optical density deviation from the optimal values for various ink-paper combinations, by provision of colour differences in compliance with the international standards.

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EVALUATION OF SURFACE MICROGEOMETRY AND QUALITY PROVISION OF PRINTED MATERIALS

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1. Introduction

The quality of printed materials depends on the number of factors, one of which is microgeometry of polygraph material surface. At present actual problem is an exact evaluation of polygraph materials printability.

The purpose of the work is a development of the methods based on micro technologies of the evaluation polygraph materials printability and determination of the correlation dependencies between them. For the first time in printability evaluation following methods: 3D noncontact profilometry, tribology applied.

The cardboards analyzed are Alaska GC-2 (230 g/m^2), Ladoga (220 g/m^2), Ladoga (260 g/m^2) magnesium and brass embossing stamp, combined materials produced by companies «POLIPAKS «OZLB» (70 g/m^2) and «HOUPAK» (70 g/m^2):

- aluminum annealed foil GOST 745-2003 / melt RE / moisture and oil resistant paper;

- aluminum annealed foil GOST 745-2003 / polyurethane adhesive / moisture and oil resistant paper.

2. Methods

Estimation procedure of surface's microgeometry of polygraph materials by means of contactless 3D- polygraph STIL's Micro Measure 3D Station consist of method is to measure the 3D profile of a polygraph material surface by the light ray 2 micrometer over illumination (30 Hz, 100 Hz, 300 Hz, 1000 Hz) of a sample surface. 3D profilograph software records measuring and then makes its static handling getting different sample surface data (depression and embossment areas, maximum height and depth etc.).

As a result the following surface microgeometry parameters: R_a, R_z, R_q, R_p, R_v, R_t, R_{sk} , R_{ru} , RT_p, RHT_p were estimated. The 2D scanning of surface areas shows a surface inhomogeneity and allows quantitatively estimating its value with a color scale. 3D visualizations of sample surface microgeometry were made as well as sample surface microphotography. An objective surface inhomogeneity appraisal on the ground of surface material volume quantity data and surface inhomogeneity volume was carried out. A surface layer represented it as a parallelepiped. Its height equals the length from the deepest sample surface cavity to the highest peak. The average line value was chosen to build an obvious picture of surface inhomogeneity. Volume values of emptiness and sample material were counted to describe surface layer inhomogeneity. The Abbot-Firestone's curve, allowing estimating surface roughness value percentage, was built (fig.3).

An abrasion resistance of ink layer surface and packaging coated board surface detect the face and the quality of printed matters.

Estimation procedure of abrasion resistance of polygraph material's surface by means of "HighTemperature Tribometer" equipment of company CSM Instruments consist of method is to move a metal ball on a sample surface in a desired path in the static and dynamic load mode in temperature environment, in atmosphere and fluids. A force transducer with an elastic arm gets sample behavior data under test. The length of the way passed by the ball till the surface destruction is the description of sample surface strength.

As the result for samples were detected the following parameters: time, the number of path and the ball way length, friction ratio, frictional torque, surface temperature etc. Graphs of the sample surface destruction process were built, allowing estimating the surface abrasion resistance (fig.1, fig.2).

3. Results

There are set out results in table 1. Carried out research showed close connections microgeometry of surface with strengthening characteristic of pulp-and-paper materials are not constant, it's explained wide range breakup of half-stuff. Pattern of celluloses with similar length of fiber can have distinguish abundance separated fraction, it leads to considerable fluctuation of strength characteristics.

It means cellulose paperboard from primary filaments Alaska have the most suitable abrasion characteristics. At the same time it has homogeneous enough surface structure (Ra=0,411 μm). Roughness parameter Ra of chipboard's pattern of Ladoga has variation from 4 to 5 μm. There are increase of fluctuation strength of inking layers of cardboard Ladoga.

Analysis of research results of combined materials show that fluctuation strength of inking layers depends on characteristics of surface's microgeometry.

Strength of inking layer increase then inhomogeneity surface of combined materials are reduction. Combined material of company "HOUPAK" consist, by way of adhesive for combining layers of aluminum foil and paper, polyurcthane adhesive. It has more uniform surface structure (Ra=0,474 μm) and more suitable indices of fluctuation strength of inking layers in comparison by combined material of "POLYPAKS "OZLB" (Ra=0,709 μm), which consist, by way of adhesive for combining layers of aluminum foil and paper, dissolving RE. It's explained different physicochemical properties of using adhesive and technique of manufacturing combined materials.

In case of using adhesive lamination for manufacturing combined materials are noticed more uniform distribution of adhesive layer, it influences on structure of the surface material. Estimate of microgeometry of embossing stamp detects magnesium stamp has more uniform surface. It is explained more microcrystalline structure compared of brass one.

Table 1

Research result of microgeometry and surface deterioration of print matters

Sample's number	Mark	Density,g/m^2	Characteristics of the surface microrelief										Characteristics abrasion resistance			
			Ra, µm	Rq, µm	Rp, µm	Rv, µm	Rt, µm	Rsk, µm	Rku	Rz, µm	RTp, %	RHTp, µm	Friction coefficient	Number of Tracks	The length of the path to destruction, м	Time, c
1	Alaska GC-2	230	0,411	0,512	1,29	1,36	2,75	-0,02	2,6	2,64	23,4	0,85	0,39	54	1,53	7,5
2	Ladoga	220	5,110	6,86	10,8	28,7	43,6	-1,89	7,70	39,5	1,2	9,64	0,21	35	0,99	5,0
3	Ladoga	260	4,010	4,89	8,42	12,7	23,7	-0,60	2,66	21,2	0,9	8,75	0,23	46	1,3	6,5
4	Combination material of company "POLYPAKS "OZLB"	70	0,709	0,885	2,49	2,28	5,22	-0,06	2,9	4,77	1,7	1,37	0,24	135	3,8	34
5	Combination material of company "HOUPAK"	70	0,474	0,596	1,28	1,65	3,48	-0,42	3,7	2,93	10,8	0,93	0,23	253	7,2	64
6	Brass stamp	-	0,637	0,808	2,31	2,14	5,91	-0,19	3,3	4,45	1,31	1,25				
7	Embossing stamp	-	0,258	0,330	1,1	0,79	3,45	0,08	3,3	1,90	0,6	0,55				

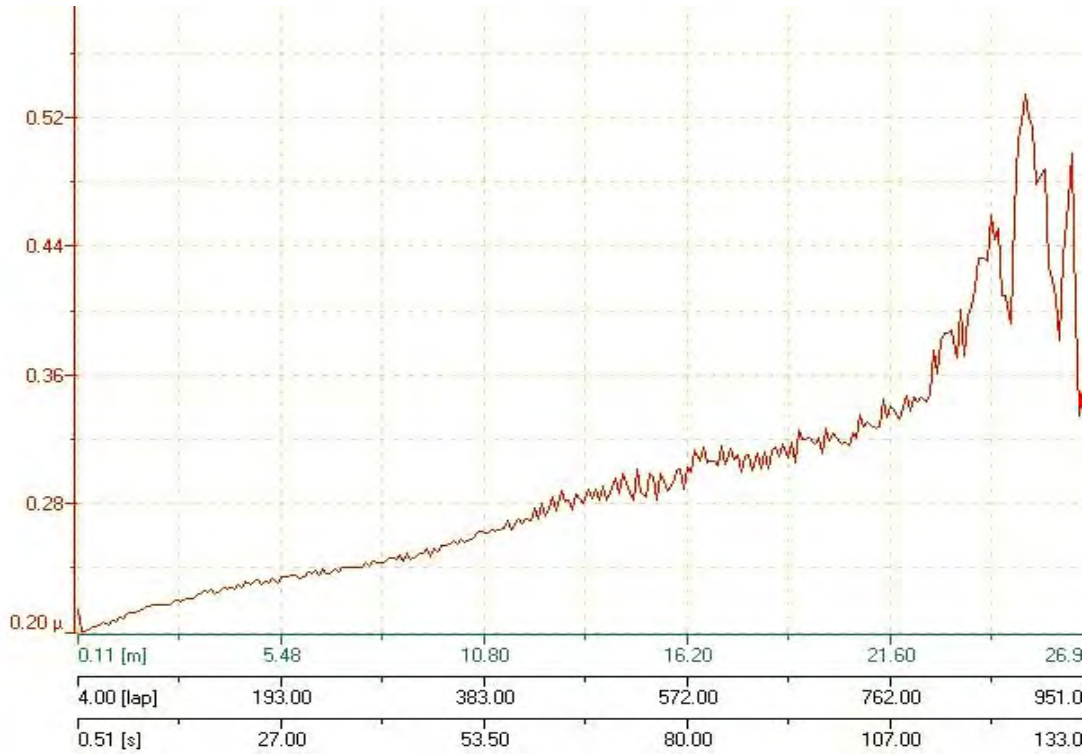

Fig.1. Curve of surface's destruction of printed pattern of coated board Alaska GC-2, 230 g/m^2

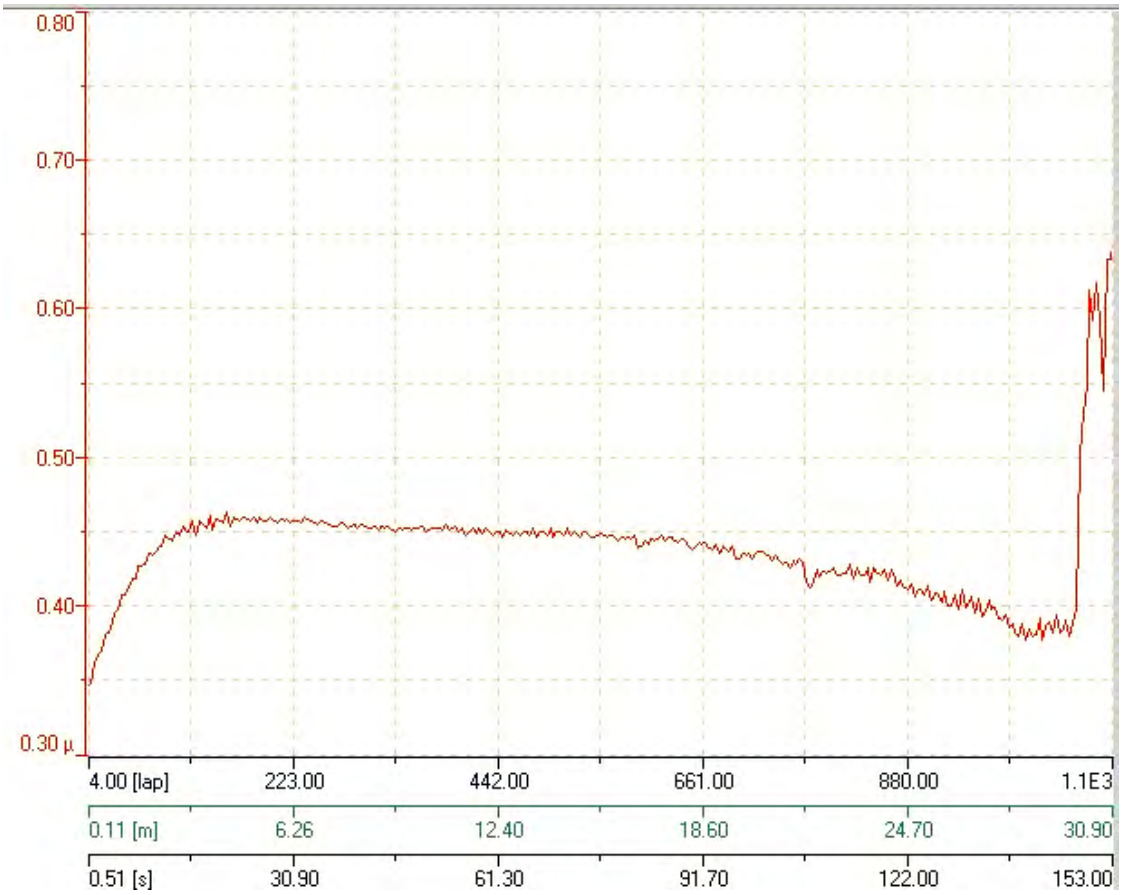

Fig.2. Curve of surface's destruction of printed pattern of combined materials of company coated "HOUPAK", 70 g/m^2

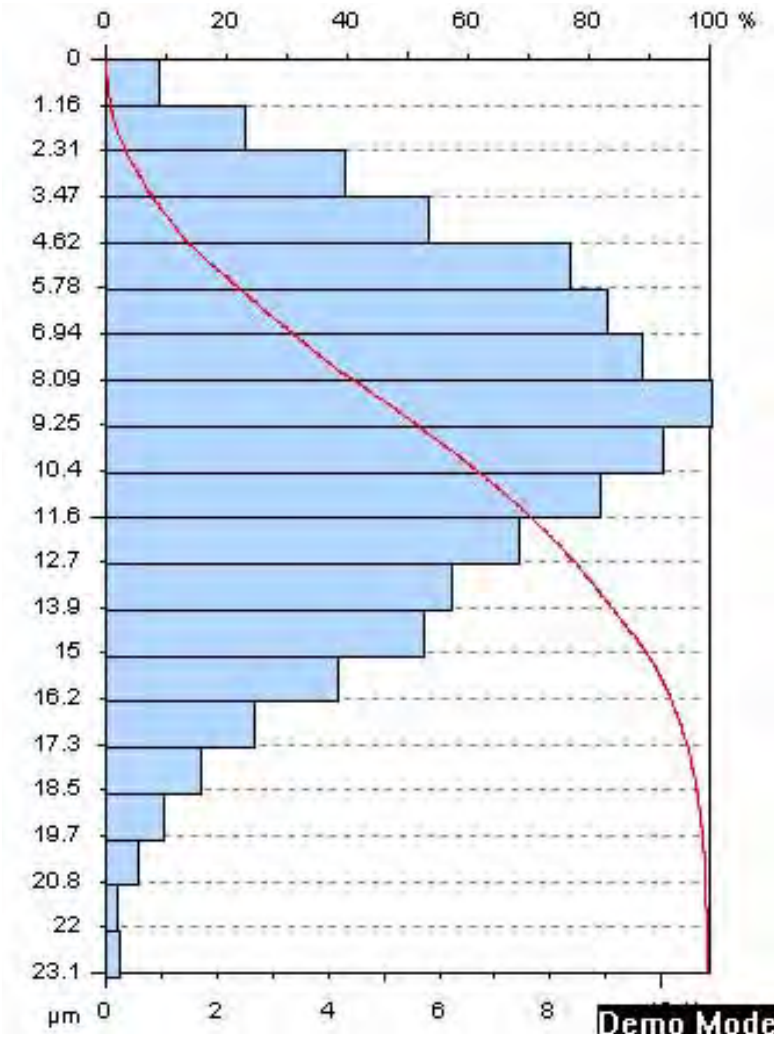

Fig.3. The Abbot-Firestone's curve to pattern of Ladoga's cardboard, 220 g/m^2

4. Conclusions

1. The surface microgeometry estimation method has been developed. With this method it is possible to represent surface heterogeneity and accurately register microgeometry parameters.
2. The polygraph material surface abrasion resistance estimation method has been developed and the surface destruction process graphs have been presented.
3. There are showed connection between fluctuation strength of inking layers of printed matters and options of surface microrelief. Dependence has a reverse linear character. The less surface's inhomogeneity of printed matters, the more strength of inking layer.
4. The kaschiered aluminum foil substrate microgeometry dependence on the received complex material strength has been detected. The dependence has a reverse linear character. The lower substrate roughness, the smoother surface material and the higher binding adhesion strength.

STADY ON ALGORITHM OF OVERPRINT ERROR IN AUTO-DETECTION*

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Abstract

According to template matching theory and statistics method, a new method named "New Template Matching Algorithm" was processed in this paper. which can be used in automatically detecting Overprint Error due to register difference of sequence of colors in sheet multi-color offset press. The position was obtained with inherent character of register mark by summing up difference image data. All of these jobs not only established a theory foundation for achieving automatic detecting of multi-color offset press, but also brought forward a new idea. The experiment results indicate that this algorithm was effective and feasible.

Key words: Printing Engineering; Overprint Error; New Template Matching Algorithm; multi-color offset.

The overprint was a kind of working procedure in print that different primary colors overlap according to different screening angle so that high quality print product can be got. The error in overprint was named overprint error. The exact overprint was that the error was controlled in the certain scope. In multi-color print, the exact print was the most basic request.

At present, the template matching method was widely applied in print product quality control technology. According to the different basic units, the template matching method can be divided into pixel matching one by one and pixel matching in different regions. Pixel matching one by one had some characteristic that were high precision and low speed. Pixel matching in different regions had some characteristic that were high speed and low precision. In view of the above situation, the literature [1] proposed a kind of matching method by the pyramid construction of data to the image lamination in different regions. But there were some shortages that the tolerance function was decided difficultly and the method's serviceability was bad. The literature [2] adopted the genetic algorithm to match which overcame the lamination matching method's shortcoming. But it was not suitable for the high precision automatic detection overprint system. The literature [3] introduced the

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combinative method of template matching method and subtracting image method that was suitable for automatic detection print shortage. But it was not fitful to overprint detection.

This article mainly studied the application in automatic detection overprint error according to the literature [3]. The New Template Matching Algorithm (as NTM algorithm) was proposed with statistics theory and programmed by VC. The experiment results showed that the method could detect ±0.5mm overprint error. Its detection precision was 0.05mm that satisfied the overprint demand of offset print products.

1. The theory elements

1.1 Template Matching

In the process of machine recognise tings, we need to match the two or many images which obtain from different sensor or under the different time, the different condition. Sometimes we need to search another image according to the known pattrern. This method was named template matching. The image information of specific region which appled in template matching was named template. The template matching was appled in image matching, quality detecting, movement detecting and so on. The commonly measure was correlation method. As Figure 1 shows:

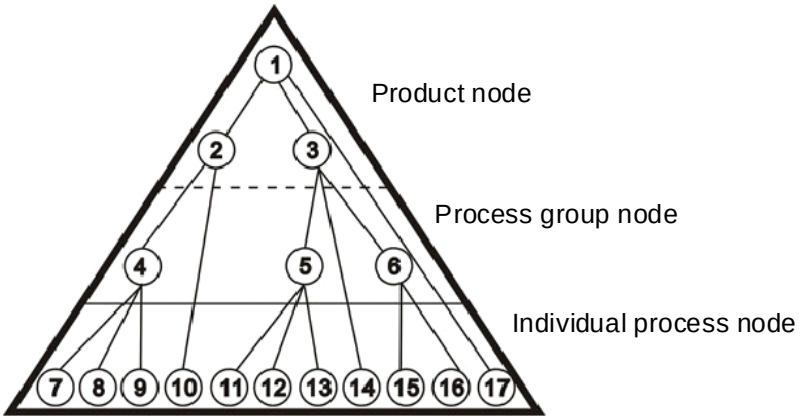

Figure 2. JDF Node Tree

Supposes the template T moved on the search image S, the image of search image S which under the template was called sub-search image $S^{i,j}$. We can named the point which in the left top corner in the sub-search image reference point P. The reference point coordinate was P(i,j), then the range of i,j value was $1 < i, j < N - M + 1$

Compared with T and $S^{i,j}$. If two images were similarly, the difference didn't exit. We could use the following expressions to weigh T and $S^{i,j}$:

$$D(i,j)=\sum_{m=1}^{M}\sum_{n=1}^{M}[S^{i,j}(m,n)-T(m,n)]^2 \quad (1)$$

$$D(i,j)=\sum_{m=1}^{M}\sum_{n=1}^{M}[S^{i,j}(m,n)]^2-2\sum_{m=1}^{M}\sum_{n=1}^{M}S^{i,j}(m,n)\times T(m,n)+\sum_{m=1}^{M}\sum_{n=1}^{M}[T(m,n)]^2 \quad (2)$$

In the expression (2), the third item expressed the template total energy. It was a constant. It had not correlation with (i,j). The first item was the energy of the sub-search image which under the template. It had correlation with (i,j). It would changed slowly according to the position of (i,j). The second item was the correlation of sub-search image and template. It would changed according to the position of (i,j). When T and $S^{i,j}$ matched accurate, this value was the biggest. The expressions (3) was correlation function:

$$R(i,j)=\frac{\sum_{m=1}^{M}\sum_{n=1}^{M}S^{i,j}(m,n)\times T(m,n)}{\sum_{m=1}^{M}\sum_{n=1}^{M}[S^{i,j}(m,n)]^2} \qquad (0<R(i,j)<1) \qquad (3)$$

1.2 New Templte Matching algorithm（NTMA）

The New Template Matching algorithm was put forward with the technology of presswork quality auto-detecting. The object was “+” cross line in the algorithm.

1.2.1 Algorithm Principle

The NTM algorithm was a process to calculate the different image(the search image and the template image’s difference). When the number of the black pixels was least, the reference dots of different image were “+” cross line coordinate. The zero dot was definited. The Overprint Error was calculated. The program of algorithm as chart 2 show:

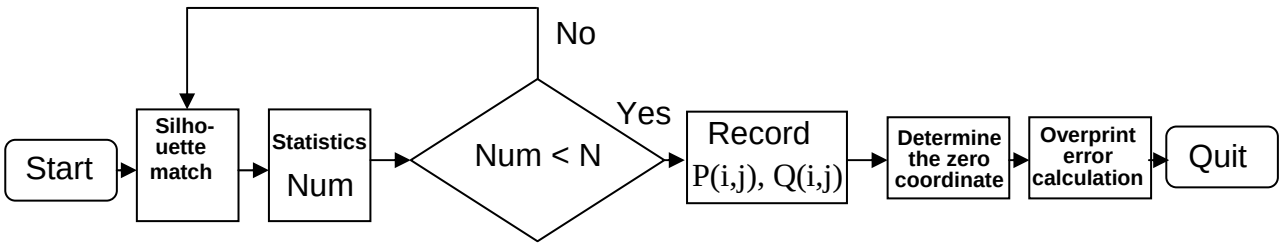

Figure 2. The program of algorithm

Main difference between the NTM algorithm and presswork quality auto-detecting: the statistical values were different. The subtraction operation was done in the program of NTM algorithm, the different image was calculated. The relevant operation was done in the program of presswork quality auto-detecting algorithm, the correlated coefficient was calculated. The matching precisions were different. There was not matching step in the program of NTM algorithm. But in the program of the presswork quality auto-detecting, it needed the accurate matching.

1.2.2 Algorithm Step

In the program of NTM algorithm, gathers the first color "+" line image as template T, the first color and the second color "+" line image as search image S. The image which under the template was called sub-search image $S^{i,j}$. The different image between sub-search image $S^{i,j}$ and template T was named the difference images D. We can named the point which in the left top corner in the sub-search image reference point P. NTM algorithm principle: calculate the black pixel number Num of the difference images D. The reference point coordinates were two "+" line coordinates which obtain the smallest black pixel number Num. The NTM algorithm was a process of statistics of the black pixel number Num of the difference image. Algorithm elements as chart 3 shows:

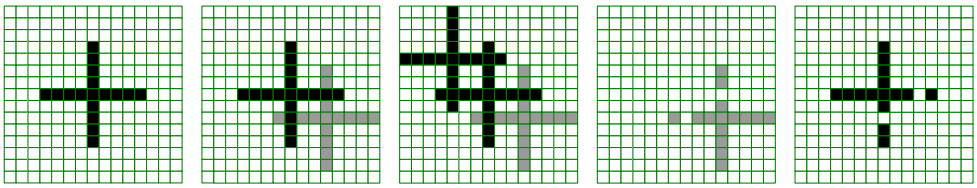

Fig.3 The algorithm elements

In the Fig.3, the Fig.(a) was template T; the Fig.(b) was search image S; the Fig.(c),(d),(e) expressed the situation which attempt to match the template T and the search image St; the Fig.(c) was the situation which the "+" cross lines didn't superposition between the template T and the search image S; the Fig.(d) was the situation which the first color "+" cross lines superposited between the template T and the search image S; the Fig.(e) was the situation which the second "+" cross lines superposited between the template T and the search image S. Obviously, when the the "+" cross lines were superposited between the template T and the search image S, the number of black pixels were the smallest in the difference image D.

The main steps of NTM algorithm includes: (1) Calculate the difference images; (2) Record the reference points; (3) Confirm the zero spot, compute the chromatography error.

(1) Calculate the difference images

The image search was based on the pixel. When the template T moved on the search image S by the line and row translation, we calculated the difference image according one pixel, recorded the difference image D. The template T and the search image S were two values images through threshold processing. Supposed T(i,j) and S(i,j) were corresponding points in template T and the search image S, then the D(i,j) was:

$$D(i, j) = T(i, j) \oplus S(i, j) \tag{4}$$

When image size for M×M pixels, the first subtration operation obtains D(i,j) value. When $D(i, j) = 1$, included Num. In the NTM algorithm program, the Num was the number of the black pixels which obtained in the difference images D actually.

(2) Record the reference points

In the step (1), we had completed all interpolations chart black picture element number Num statistics. In all Num, had or two minimum values min Num inevitably. If min Num only, indicated the existence only interpolation attempts D and the template T difference smallest, namely two hairlines positions superposition, the output "the chromatography was accurate", withdrawal; If had two min Num, indicated had two interpolations to attempt D and the template T difference was smallest, namely two hairlines had the position deviation, records two min Num the correspondence reference point coordinates P(i,j) and Q(i,j), continued the step (3);

In the NTM algorithm program, we need to count Num, searches min Num. The concrete method was: Establishes threshold N which satisfied $Num < N$ named the min Num for searching. Obviously, how to defined the threshold N was the key of NTM algorithm.

Supposes the "+" line to be composed by the N_0 picture element, attempts the template T cover in the search on S to do the translation sketch operation, when the template T "+" line and the search attempts S the free "+" line completely heavy to be fashionable, the sketch obtains the interpolation to attempt D, there interpolation attempts D correspondence Num namely for min Num which must search, min$Num=N_0$-2u. In ideal does not had under the noise condition, threshold $N=minNum=N_0-2$; In actual image gathering the noise was inevitable, even if passes through smooth processing, after also was unable to guarantee processing the image does not contain the noise completely. Therefore, in actual examination, threshold $N \geq N_0 - 2$. Threshold N upper limit determination that, Counts all

interpolations chart Num, after removes min Num, other Num in minimum value definition was max Num, obviously, max Num namely for threshold N upper limit max$Num=2N_0-4$, then $N<maxNum$, namely $N<2N_0-4$. This time, the template T hairline and the search attempts on S some hairline in the level or the vertical direction line superposition. The threshold *N* value scope was:

$$N_0 - 2 \le N < 2N_0 - 4 \tag{5}$$

This article discussed the value scope of threshold *N*. In the actual examination, according to the total information of image content percentaged and the different noise, named threshold value *N* the different values. The reasonable threshold *N* was guarantees for the examination accuracy and the accurate premise.

(3) Confirm the zero spot, compute the chromatography error

After completed the step (1) and (2), two groups of reference points P(i,j) and Q(i,j) were obtained, which corresponds two colors hairlines point of intersection coordinates separately.

The NTM algorithm processing images were two values images, which lost the color information. The list from the image angle, two reference points coordinates P(i,j) and Q(i,j) were unable differentiation,and which expressed color printing hairline separately, does need to judged further.

When machine vibration and paper distortion were controlled in the allowable error scope, two-time photographs in the image, the first color printing hairline position was invariable basically. Thus, during two groups of reference points P(i,j) and Q(i,j) must exist one coordinate was close to (0,0) inevitably, which was the first color hairline coordinate, and define that was the zero $O_1(x_1,y_1)$, the second color cross line coordinate was definited the $O_2(x_2,y_2)$. The Overprint Error was:

$$\begin{cases} D_x = x_2 - x_1 \\ D_y = y_2 - y_1 \end{cases} \tag{6}$$

The Dx and Dy in the formula (6) expressed axial and contour chromatography error separately, and the unit was a picture element. According to the actual of the image, converted the picture prime about Dx and the Dy into distance value, and the actual chromatography value was obtained.

2. Experiment and Result

The experiment was designed for validating of NTM algorithm. To prove the algorithm’s accuracy. The experimental condition as table 1 shows:

The expreiment steps:

(1) The "+" cross line scanning

The resolution of image was 200p/cm (508dpi). The image size was 2×2 cm(400×400 pixel). The "+" cross line was about 7mm long. The range of auto-detecting was ±0.5mm. And the precision was 0.05mm.

Table 1

Properties of effect pigments.

PC 机	AGFA Scanners	Support Software
CPU:Pentium III 450; Memory: Modern SDR512M	Model: Duo SCAN T2500 Resolution: 508dpi	Photoshop7.0; VC7.0 FotoLook 32 V3.600

(2) To select the smoothing algorithm

The average smoothing, Gauss smoothing, 3×1, 1×3, 3×3 median filter were used in the smooth processing of scanning images. The correlated coefficient and PSNR were used for judging of the smooth processing result. At least, 3×1and1×3 median filter were choosed.

(3) Programme

Compiles the auto-detect Overprint Error programme according to the NTM algorithm with VC.

(4) Auto-detect the Overprint Error

The image information would losed possibly in the process of image scaning. The length of "+" cross line was define L=7±1mm. When L=6, the threshold value N was $237 < N \le 474$. The unit was a pixel. When L=8, the threshold value N was $317 < N \le 634$. Therefore, the threshold value N was $317 < N \le 474$. Considered the allowable the noise, chose the threshold value N=400 pixel finally in the auto-detecte Overprint Errorv process. The detection elements as chart 4 shows.

(5) Adjust the Overprint Error

Transform the Overprint Error to practical distance value. According to electromotor which would choose, transform the practical distance value to rotation pulse number of electromotor. Then the controling signal was output, and the register was adjusted.

Below the experiment draws the conclusion: The threshold value N value scope was reasonable, it may satisfied register demands. The NTM algorithm's detecting exactness was 0.01mm and was effectived for the Overprint Error in ±0.5mm . Compared with the presswork quality detecting technology algorithm, the strongpoints of NTM algorithm: replace the average of D(i,j) which applied in compareing the difference between images. And the operation was simply. The matching precisions were different. There was not matching step in the program of

NTM algorithm. The NTM algorithm had a high reliability. This algorithm was simply and prone to actualized. The NTM algorithm may be extension.

3. Conclusion

This article proposed a kind of new template match algorithm (the NTM algorithm)using to the automatic detection chromatography error. The core of this method was the interpolation chart statistical process. It had 3 mainly steps: Statistical interpolation chart; Recording reference point; confirming zero spot, and computing the chromatography error. The experimental result indicated that the NTM algorithm was corrective and accuracy in a certain distance. It might be used to the exploiture of the automatic detection chromatography error procedure, and had laid the rationale for the research of the single sheet paper multicolor offset printing press automatic wrap accurate system. What question worth further studying and discussion was: To exploit a smooth processing algorithm which could better suit for the printing crossline image; Optimiz the scope of threshold value *N*.

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AMAZON KINDLE TYPEFACE LEGIBILITY

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1. Introduction

Amazon.com is an American-based multinational e-commerce company known as one of the largest online retailers worldwide. It started as an online bookstore, however, soon DVDs, music CDs and MP3s, video games etc complemented Amazon's daily offer. One of their latest additions is Amazon Kindle DX – the newest technological achievement in the area of e-books launched recently. Amazon Kindle DX is the 'bigger' brother of Amazon Kindle 2, released in February 2009, merely one year after the first Kindle generation [1].

The device enables content presentation in a specific way with no colours present (only a 16-level greyscale) and five buttons for navigation. Amazon Kindle is based on an electrophoretic display, which forms visible images by rearranging the charged pigment particles using an applied electric field. Each particle comprises the negatively charged black plastic on one side and positively charged white plastic on the other. The spheres are embedded in a transparent silicone sheet, each sphere being suspended in an oil bubble enabling free rotation. The voltage polarity applied to each pair of electrodes then determines whether the white or the black side is face-up, giving the pixel white or black appearance.

On Amazon Kindle, the contents can be shown in different file formats (.pdf, .txt, .html and .mobi), however, the default format is .azw (Amazon Whispernet), which is at the same time the format of more than 400,000 e-books, e-magazines etc available at Amazon.com [2, 3]. This format includes information that enables Amazon Kindle to show contents as text (or graphics) in a predefined typeface, six different font sizes and three possible line adjustments.

2. Anti-aliasing

Anti-aliasing enables the user or reader to get the same feeling by looking at a screen as they would by looking at a printed page. This method is based on the description of the font outline, considering repeated colour shades that appear against background colour. The parts where the font outline united with the background were joined using middle hue values. In this way, we can create more smooth-looking fonts, especially when using bigger font sizes [4, 5]. When working with smaller font sizes, anti-aliasing influences the entire letter, which makes the letter appear soft and blurred.

When the horizontal and vertical lines align with the pixel frame, the font looks sharp and solid; however, if the deviation from the pixel frame occurs and the font stretches over two or more lines, it seems foggy. In practice, a larger amount of text rarely aligns with the pixel frame in more than just a few parts, therefore, the rest of the text looks blurred. The quality of anti-aliasing depends on numerous factors. Software developers use various technologies, techniques and algorithms to calculate the optimal hue values for middle colour values of anti-aliased font outlines [6].

Due to the conformity with the pixel frame, the pixel fonts adjust to the screen, and there are no anomalies or worse readability of the text, respectively. With other fonts, such as Prelo Slab, it is just the opposite. The letters are made

also of lines which are different from the angles 0°, 45° or 90°, which requires additional adjustment [7].

The letters the parts of which do not align with the pixel frame require additional time for processing and additional capacity of the device. Prelo Slab is a part of the so-called 'smartly designed fonts' as its lines mostly stick or adjust to the frame, which consequently makes its display satisfactory. The adjustment is mostly made with the use of colour and shade that make the edges appear smooth. Therefore, from 16 to 20 intermediate shades of grey colour are used for such smoothing for a black letter on white background, which gives the letter the right image to be viewed from a normal distance. The process is the same for colour versions of font and background. This is possible only if the screen of the device supports 16-byte colour display. If the screen shows 8-byte display or only 256 colours [4, 5, 8], all intermediate shades are lost and replaced with colours that correspond to the so-called web palette.

The suggested solution is completely acceptable for larger fonts and bold versions; the problem between the pixel frame and font appears when decreasing the font size. However, Prelo Slab avoids this problem in two ways. Firstly, the basic line is levelled with the pixel frame (on account of the sign proportionality), which is called 'hinting'. And secondly, the actual position of the basic line is simulated, where again a shade illusion is used for edge smoothing. To achieve the impression of a line positioned precisely between two pixels, brighter shades of colours used in neighbouring pixel lines are applied. To show smaller font sizes, it is thus better to use well designed screen fonts or pixel fonts, respectively.

3. Experimental

The purpose of the research was to analyze Prelo Slab as the default typeface of .azw file formats, describe its advantages and weaknesses, and compare Prelo Slab with the typeface Blaznic.

3.1 Typeface Blaznic

The design of the typeface Blaznic is based on the typography used in the 19th century by one of the most prominent Slovenian printers, Jožef Blaznik [9, 10]. From his time, no movable metal types have been preserved, and since today only printed books and newspapers from that period can be found in libraries, the motivation to digitalize the typography used in 1854, when Blaznik’s career as a printer was at its peak, was even greater. The digital version of the original typography, we titled it Blaznic, was subsequently adjusted to modern electronic devices. Thereby, we are reviving the history to serve present needs and take care of the cultural heritage. In other words, we are to recycle the past.

3.2 Methods

In the research, we decided to check the suitability of an individual font with regard to the device, screen and contents displayed. Special attention was devoted to the screen and legibility of fonts regarding the position of Amazon Kindle (horizontal or vertical screen rotation). The purpose of the research was to establish

whether Blaznic can replace Prelo Slab and what factors might influence such a decision. The research was conducted through an anonymous questionnaire, testing legibility and comprehension of a text.

The questionnaire referred to the Amazon Kindle display, which showed different texts with the same contents in two different typefaces, i.e. Prelo Slab and Blaznic. The comparison of typefaces on screens was performed with two Amazon Kindle devices placed next to each other (cf. Figure 1), the distance between the interviewees' eyes and the screen remaining approximately the same as when holding the device in hands (on average that is 30–35 cm). The device dimensions are 203 × 135 mm with a 6" display, which is equivalent to 91 × 122 mm with the resolution of 600 × 800 pixels.

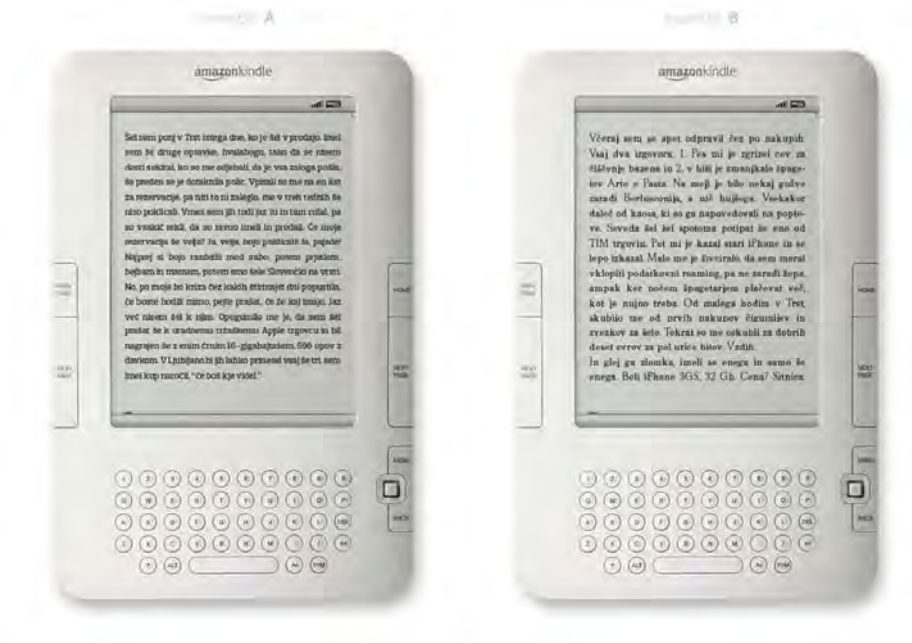

Figure 1. Example of Amazon Kindle screen showing different texts with same contents with help of two different fonts: Prelo Slab (example A) and Blaznic (example B)

The research was undertaken among a group of people (*n = 53*), male and female, aged 15–65 with different knowledge of technology, typography and various reading habits. A diverse group of people allowed us to draw conclusions that are more representative.

The first stage of the research was the pilot study. No problems occurred during the pilot testing; moreover, very interesting results emerged; therefore, we could proceed with the experiment. The collected data were analyzed and statistics were elaborated with the interpretation of the gathered data. A combination of suitable scientific methods was used, including the most important, e.g. the inductive method, the analysis and synthesis method, and the static method. The static analysis was performed with questionnaire program tools.

4. Results and discussion

The survey was conducted among a group of people, almost equally represented by both genders (53% male, 47% female). 24% of interviewees were

aged 26–30, 19% 31–35, 14% 36–40, 9% 41–45 and 9% 56–60 years. The remaining 25% was equally distributed into groups aged 15–20, 21–25, 46–50, 51–55 and 61–65 years, each representing 5%.

In accordance with our expectations, the results revealed that the majority of interviewees are familiar with the Amazon Kindle device, which was confirmed by 53% of them. The following set of questions was related to the device functions. The most frequent answers what Amazon Kindle is used for (cf. Figure 2) were reading e-books (64%), reading e-magazines (42%), e-newspapers (29%), listening to music (29%), Text-to-Speech function (14%) and Wi-Fi connection (29%). Nevertheless, 50% of respondents were not familiar with any of the Amazon Kindle functions.

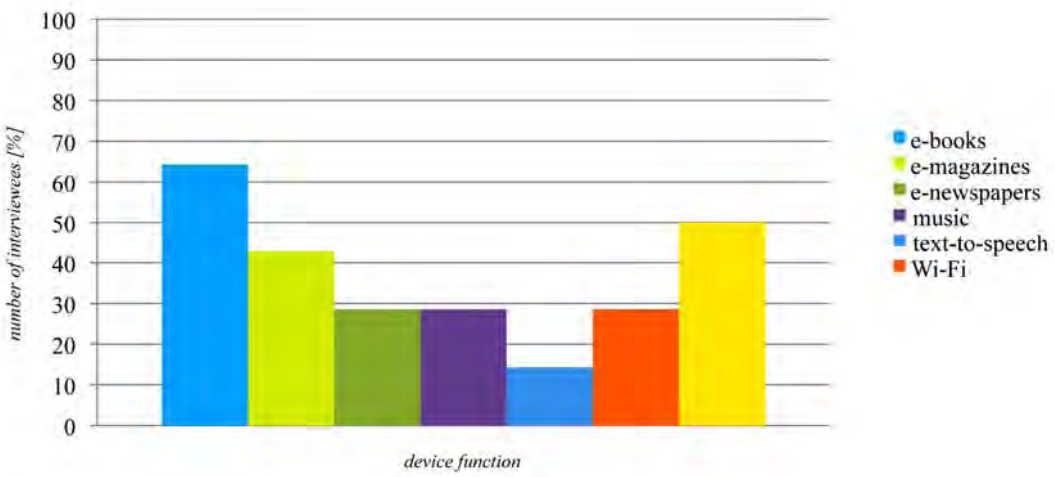

Figure 2. Familiarity with Amazon Kindle functions

The next set of questions examined the opinion on the used typefaces. The results revealed that the selection of typefaces for electronic devices is a well thought-out decision, based on many trials and research. While all interviewees believed that the selection of typeface matters, only 57% of them were satisfied with the default typeface used on Amazon Kindle (cf. Figure 3). In contrast (cf. Figure 4), 15% thought the combination of the typeface and background to be excellent, 50% good and 35% decent, which leads to the conclusion that the combination of the typeface and background is appropriate and considerably influences the text legibility.

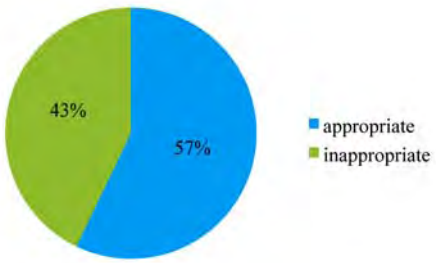

Figure 3. Satisfaction with Amazon Kindle default typeface

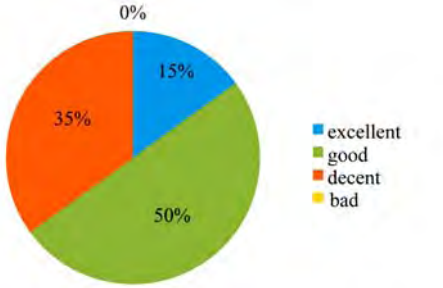

Figure 4. Combination of the typeface and background

The following six questions referred to the comparison between example A with the Amazon Kindle default typeface Prelo Slab and example B with the typeface Blaznic (cf. Figure 5). The results showed that the decision to choose Prelo Slab was suitable, which was supported by 64% of interviewees who preferred the typeface in example A over the one in example B. The latter was also verified with a *t*-test, which proved that the relation between examples A and B can be confirmed statistically.

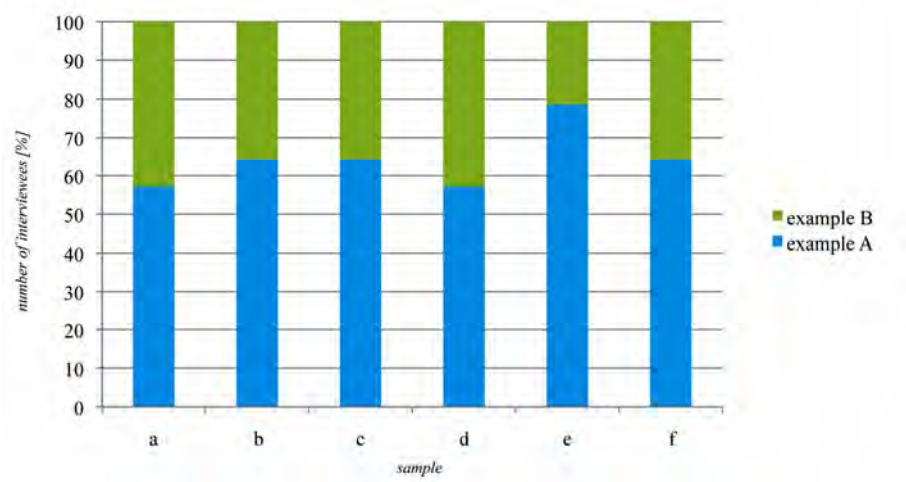

Figure 5. Comparison between two different fonts (Prelo Slab and Blaznic) showing contents

This research is even further supported by the results referring to the contents and used typefaces regarding the positioning of Amazon Kindle, i.e. vertical (example A) or horizontal (example B). 57% of interviewees preferred the vertical positioning over the horizontal one (cf. Figure 6).

Furthermore, the text legibility and reading comprehension were tested with time measuring and questions regarding the contents (cf. Figure 7). The text in Prelo Slab (example A) was read in 16–20 seconds by 29% of interviewees, while the same percentage of interviewees read the contents in 36–40 seconds.

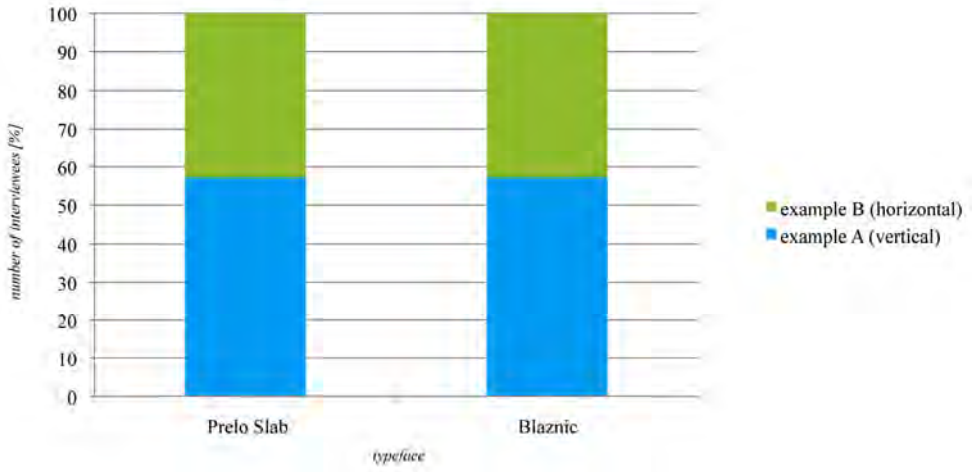

Figure 6. Preference to vertical or horizontal positioning of Amazon Kindle regarding the typeface

The rest read the content in 21–25 and 26–30 seconds (14% each) and in 6–10 and 31–35 seconds (7% each). Generally, the contents in Blaznic (example B) were read slightly faster than the example A, as 36% of respondents read it in 21–25 seconds, 29% in 26–30 and 14% in 31–35 seconds. The rest read the content in 6–10, 16–20 and 36–40 seconds.

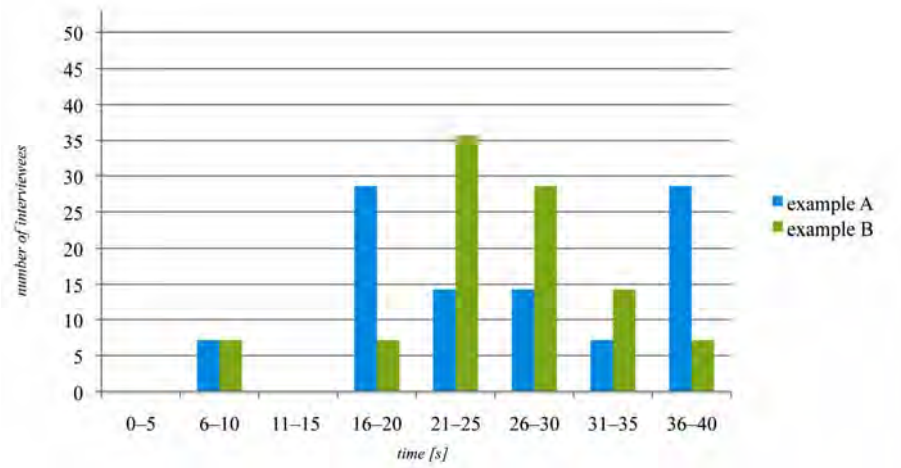

Figure 7. Text legibility and reading comprehension tested with time measuring

The results of text comprehension were rather surprising. In example A, 46% of interviewees did not answer the question or provided a false answer. In example B, the results were the opposite, since 64% of interviewees offered the correct answer. The reason could be sought after in the text contents; however, this factor was minimised by choosing popular and easily understandable texts.

The final question regarded the identification of the typeface. Only 7% of interviewees recognized the typeface used in example A, while the typeface in example B was not recognized at all. The reasons might be the relatively unknown and rarely used typeface Prelo Slab and of course, only recently designed typeface Blaznic.

5. Conclusion

This research presents not only the analysis of the current situation, but also of the future situation and subsequent events by dealing with concrete questions and answers.

The results show that despite Amazon decided to use Prelo Slab as the default typeface, our proposition (i.e. typeface Blaznic) could improve legibility or even reading comprehension. Blaznic is not a slab-serif typeface [10, 11] like Prelo Slab; nevertheless, it comprises properties of typefaces easily readable on screen. Probably only a touch of perfection and aesthetics distinguishes one from another. This and the fact that the popularity of Amazon Kindle is on the increase are well-founded reasons to continue with the research. The goal is to make Blaznic one of the most suitable typefaces for different electronic devices and thereby help develop eco-friendly technology and future products which could be (e-)recycled.

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GOING GREEN: EFFECTIVE SOLUTIONS to MITIGATE ENVIRONMENTAL IMPACT in TRADITIONAL PRINTING TECHNOLOGIES

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To drive sustainable development in printed media and strengthen their market positions, it is becoming a crucial issue how the society and consumers can be convinced that the applied technologies have no negative impacts on the environment, but are rather in line with the general endeavours of societies to preserve and conserve the natural environment.

Relying on scientific methods, the authors analyze the environmental implications of offset and flexo printing, and propose effective solutions for the mitigation of negative impacts.

In view of air cleanliness, they recommend innovative and energy-efficient solution for the reduction of VOC emissions, and demonstrate them in a practical example.

Key-words: VOC-emission, heat-set printing, energy-efficiency

1. Air quality protection solution in the heat-set offset printing

In Alföldi Printing House, large-capacity web offset machines use “heat-set” technology for printing. The incorporated print dryers are powered with natural gas for hot-air drying. Coming from the print dryers and containing certain exhaust products, the air carries primarily VOC contaminants (2–4 g/nm³). Alföldi Printing

House has deployed recuperative thermal reheating equipment for the cleaning and treatment of final gases.

The company has implemented the project within the framework of a complex program with the fundamental purpose to cut back air and noise pollution caused to the environmental with its operations considerably so that the printing house could sustain its 443-year-old activities in compliance with the relevant environmental requirements, as necessitated by the associated demands of the new millennium, with the least possible disturbances caused to the residents neighbouring its century-old business site.

This uniform approach and clean-cut corporate intent has given way to a very efficient energetic solution in several respects.

Alföldi Printing House has seen the justification for the preference of the recuperative thermal reheating procedure, which is today the most wide-spread technique in the world, in the utilization of energy and the related, additional opportunities for environmental protection, as well as the smaller investment costs. The future parts of the project will be based on this foundation.

The recuperative thermal reheating equipment is of compact design, and can be installed outdoors with the connected heat-recuperation unit.

When designating the site of installation, a condition precedent to energetic aspects has been the avoidance of further environmental loading by the operation of the equipment. For this reason, it has been installed among the plant buildings (Figure 1). Due to the high walls here and the accessory elements for noise reduction, the operation of the equipment has no negative impacts on the noise emission of Alföldi Printing House. The equipment is located approximately centrally relative to the pipelines connecting the gas dryers and the reheating unit, as well as the heat transfer station.

Figure 1. WK TNV 65 reheating equipment in Alföldi Printing House

2. Complex solution for energy utilization

As the company’s energy management has been significantly influenced by the project, such a solution has been sought and found that allows the utilization of heat energy generated during the reheating process continuously.

The concept was borrowed from the current expansion of the municipal district heating system. Near the central site of Alföldi Printing House, the construction works of a new circuit line for the enhancement of supply safety was started, and it seemed to be a reasonable option to connect to the project. The heating system of the entire printing house was converted, modernized and connected to the municipal district heating system in a reversible manner. Jointly with the district heating supplier, such a heat transfer station was built that integrated a heat exchanger for the proper utilization of the heat released during the operation of the reheating equipment.

As a result, the generated heat has become continuously utilizable, primarily for heating and hot water supply at the company. On the other hand, the redundant heat can be fed to the municipal district heating network. It is particularly important for the company in the summer period, when considerable quantities of heat are still needed to supply Debrecen with hot water.

Obviously, due to the reversible design, Alföldi Printing House can as well purchase heat whenever the reheating equipment is not operated, or supplies less heat energy than needed.

The employed technical solution is very simple. The heating water arriving at the heat transfer stations from the primary mains line of the municipal district heating network first enters the heat exchanger of the network serving the internal heating and hot water supply of the central site of Alföldi Printing House. Here, after delivering the necessary heat quantities, it cools down and flows over to the heat-utilizing heat exchanger of the reheating equipment, where it becomes hot again by absorbing the heat generated there. Thereafter, it returns to the secondary mains line of the city. The process is clearly shown in the system layout of Figure 2. The difference between the heat flows entering and leaving is measured by 2 heat consumption meters at the heat transfer station with respect to the direction of the heat flow. If the difference is positive (more heat flows in), heat energy is purchased, whereas if it is negative, heat energy is supplied. The two companies settle their accounts with each other on a monthly basis in view of the agreed purchase and supply prices. The operation of the system is supervised by state-of-the-art automated controls.

Earned during four years of cooperation, our experience shows that this special solution has been beneficial and cost-efficient for both parties. Apart from in-house utilization, Alföldi Printing House has been given an opportunity to sell its redundant heat energy, whereas the municipal district heating supplier has found a cheap source of energy near a focal point of residential consumption.

A specific outcome of the project is that Alföldi Printing House could close down its own, separate boiler house to reduce its noise emission to the environment.

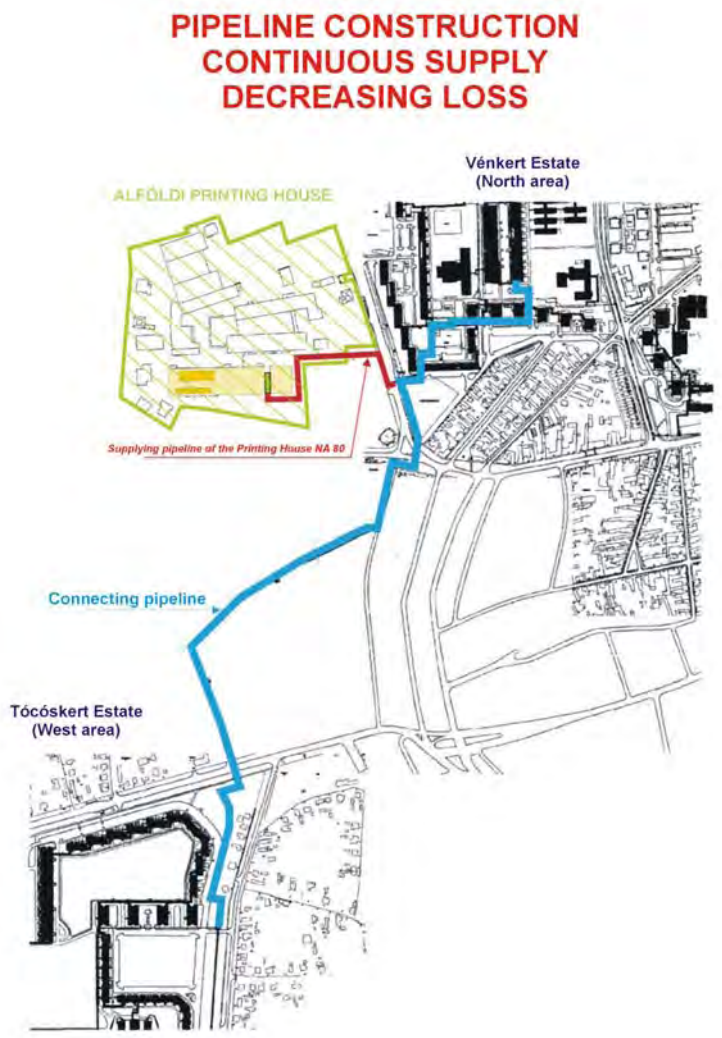

Figure 2. The planned expansion of the municipal district heating system

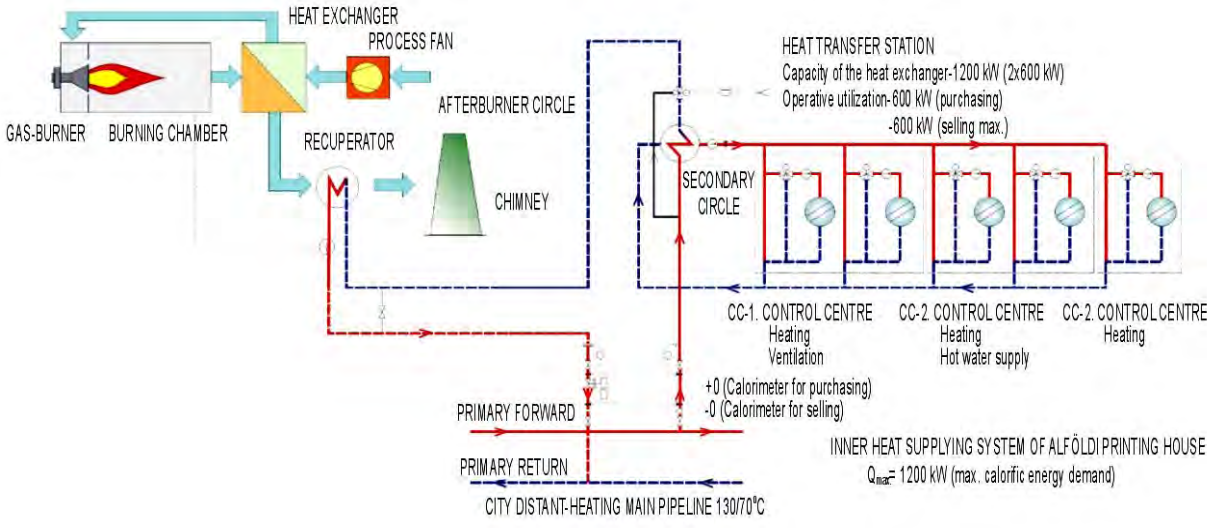

Figure 3. Energy utilization via the reheating equipment, system layout of the heating network and its connection to the municipal district heating system

3. Environmental gains

This solution has several benefits in addition to Alföldi Printing House's saving approx. one-third of its former annual heating energy costs.

A general environmental benefit is – though it is still not covered in any legal regulation – that the company's heat loading on the environment has decreased substantially (cc. 10,000 GJ p.a.). With any other solution, the redundant heat should have been released to the environment, at least in the summer period.

At the same time, the boiler house having supplying heat energy so far could be stopped with all its detrimental impacts (noise and air pollution). Its decommissioning, disassembly has been one of the most positive developments – also "psychologically" – for the residential environment apart from the elimination of cc. 5.5 t air pollutants and the 6 dB noise level.

4. Energetic gains

During the 50 months since the start-up of the system, the heat balance shown in Figure 3 has had a positive outcome. Alföldi Printing House has purchased 21,256 GJ heat from the Debrecen District Heating Company, and sold 21,852 GJ.

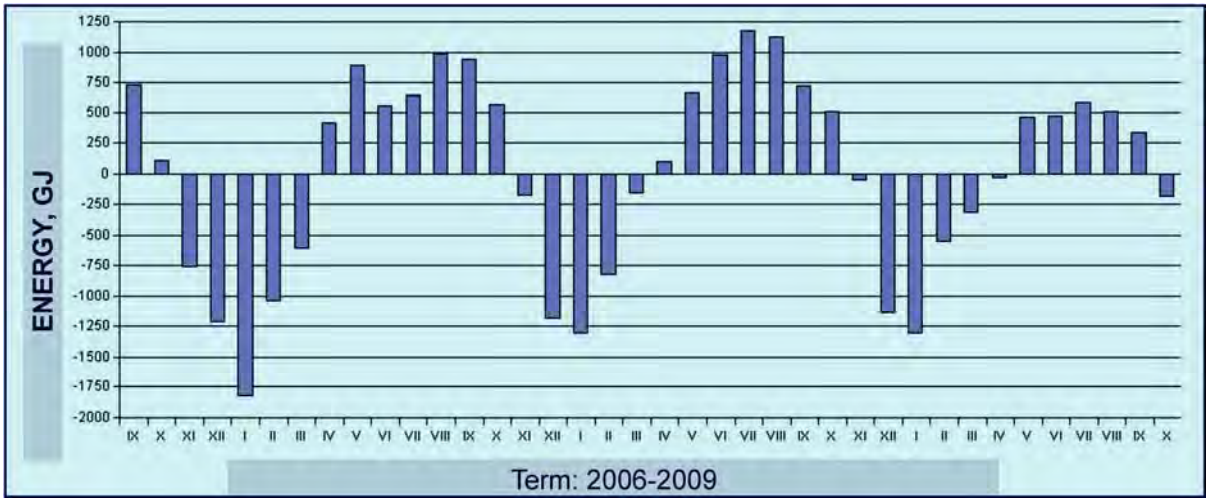

Figure 4. Alföldi Printing House's heat energy balance with the district heating supplier in the operating period of the reheating equipment

Naturally, a full-scaling and comparable conclusion of energy management can be drawn from the annual operating cycles. When analyzing the periods from the beginning of September to the end of August, the maximum difference between the purchased and sold heat quantities was 5%, an equivalent of the heat demand of 4–5 average heating days. If it is considered that at the central site of Alföldi Printing House the annual heating and hot water service demand used to be cc. 12,000 GJ, the efficiency of secondary energy utilization becomes evident. In practice, the company has become self-sustaining in terms of heating energy.

Equipped with appropriate automated controls, the operation of the system has proved to be safe and reliable.

5. Co-operant approach

The positive achievements of the project have been largely supported by the fact that in the planning and construction period the manufacturer of the reheating and heat utilization installations, the designer and adviser, as well as the investor and heating company were acting in close cooperation with each other to find and implement the best solutions.

APPLICATION FORMULA OF KOLRAUCHA FOR ESTIMATION RELAXATIONS OF PROPERTIES NATURAL SKIN

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The genuine leather possesses unique properties which allow to use it for manufacturing of the most different things. But what exactly defines such wide spectrum of possibilities of this material? Why and now process of transformation of a skin of an animal in a skin, and skin in a product not always is clear also isn't up to the end studied? The reason, probably, that the skin of an animal is a difficult biological system.

In process of religion and art development as a whole, developed and art skin processing, including in publishing. The skin is used as an integument binding material at the edition of prestigious expensive books with various stampings.

At a stamping are shown to the full relaxations of properties of skin. Influence on a punch skin is accompanied by creep at compression. After the stamping termination it is observed elastic after-action which essence consists in aspiration of a skin to restore the initial sizes.

Under relaxations understand such properties of a material, when there is a change in time of any parameter, material characterizing this or that property, at the termination of external influence or if this influence doesn't change in time.

Speed relaxations of processes depends on material structure on which mobility of the elementary structural in turn depends formations.

Change of the parameters characterizing relaxations of process, are described exponential by dependences:

for creep at compression:

$$\varepsilon_t = -\varepsilon_o \cdot e^{\frac{t}{\tau}} \quad , \qquad (1)$$

where ε_t – relative deformation of a material at the right time t ;

ε_o – initial (elastic) relative deformation;

τ –. relaxation of time

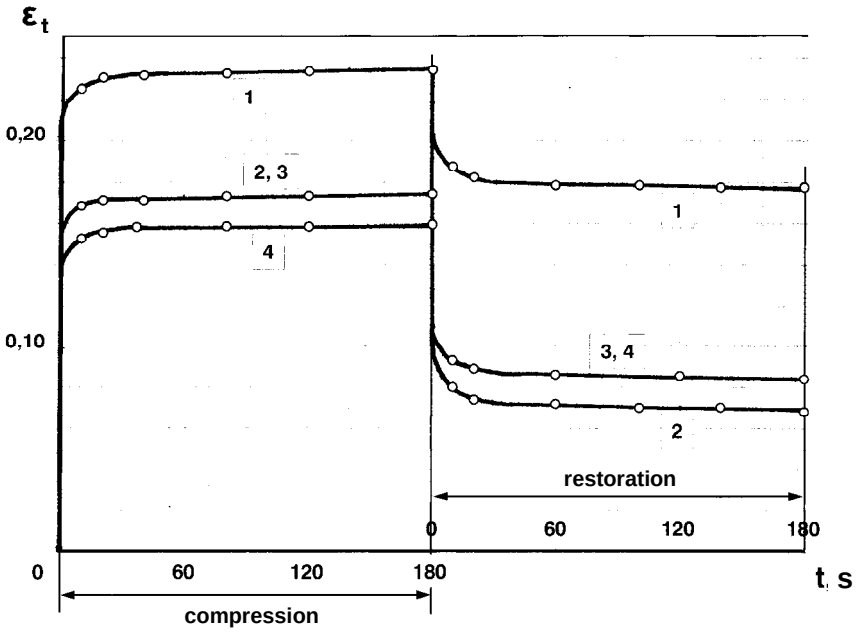
For elastic after-action after a stamping:

$$\varepsilon_t = -\varepsilon_o \cdot e^{-\frac{t}{\tau}}, \qquad (2)$$

Relaxation time characterizes mobility of structure of a material, reflects speed of aspiration of a material to an equilibrium state and on to physical sense it is equal to time, after which relaxation the parameter changes in “e” time.

In article results of the executed researches relaxations of properties of skin of the various biological nature are discussed. For their designation firm names of the processed skin are used: the sample of "Vega" – a pigskin, the sample of "Softi" – the sheep skin, the sample "Madras" – a skin horned cattle, samples of "Indius" and "Fiolet" – the veal skin

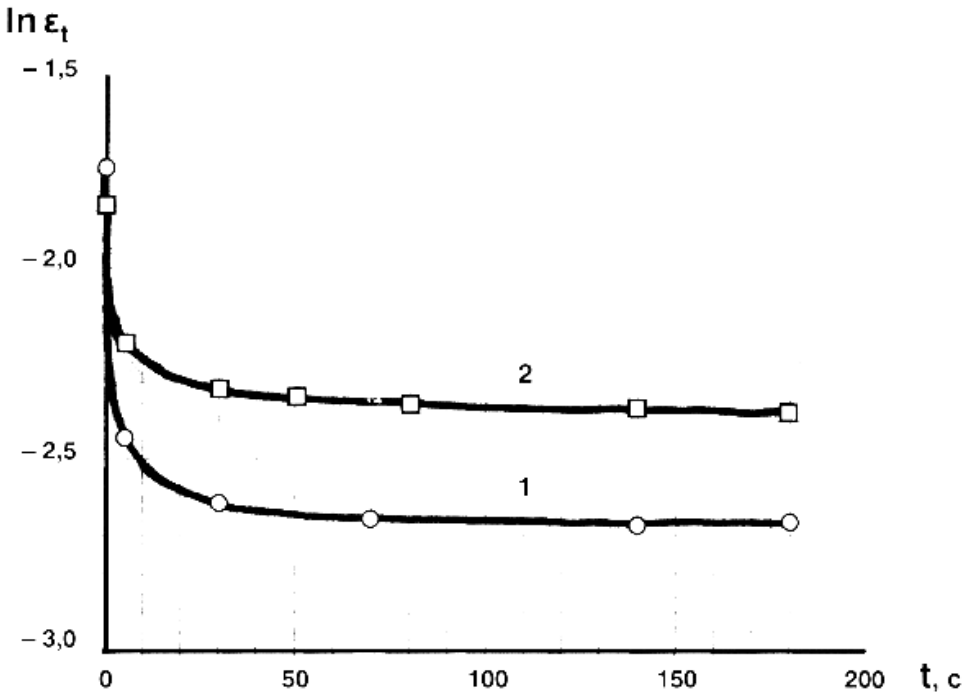
In drawing 1 results of definition of creep are resulted at compression at influence of pressure 60 Н/см^2 and results of definition elastic after-action for three skin. For convenience of calculations and the analysis of results to absolute and relative deformations for compression and after-action positive values are accepted. In a greater degree distinctions in relaxations the-stvah are shown at a stage elastic after-action. The skin of "Vega" possesses the greatest mobility of structure, and a skin of "Indius" – the least. For them the reversible part of deformation makes accordingly 10,9 % and 6,5 %.



Drawing 1. Relative deformations at compression (σ = 60 Н/см^2) and after removal of loading for skin: 1 – Indius (veal); 2 – Vega (pork); 3 – Softi (sheep); 4 – Madras (cow)

Proceeding from simple exponential the equations describing relaxation of processes, it is possible to assume that time of a relaxation of a material can be found as return size of a tangent of angle Inclination of the straight line representing dependence of deformation from time in half-logarithmic coordinates: ln ε_t = f (t).

However representation in half-logarithmic coordinates of results of definition after-action (drawing 2) confirms the general for polymeric materials the law which essence consists that a relaxation process can't be described with the help only one value of time of a relaxation. Whether-nijami dependences ln ε_t from time are straight lines. Real relaxation of process can be described by means of a set (spectrum) of times of the relaxation which finding represents an uneasy, labor-consuming problem.



Drawing 2. After-action after compression energized σ = 60 Н/см^2 for two skin:
1 – Vega (pork); 2 – Indius (veal).

It is known that with sufficient degree of accuracy relaxation of process in polymeric materials is described by the formula of Kolrausha. For process, in which the investigated parameter decreases, the formula of Kolrausha looks like:

$$\varepsilon_t = (\varepsilon_o - \varepsilon_\infty) \cdot e^{-a \cdot t^k} + \varepsilon_{,\infty} \qquad (3)$$

where ε_t – current value of parameter;
ε_o – initial value of parameter (at t = 0);
ε_∞ – equilibrium value of parameter (at t = ∞);
t – current time;
a, k – empirical constants.

Represents certain interest an estimation of applicability of the formula of Kolrausha for the description relaxation of process in such natural material which the skin is.

In our case the difference formulas of Kolrausha represents the reversible deformation disappearing in a course relaxation of process.

The difference $\varepsilon_t - \varepsilon_\infty$ is equal to the rest of reversible deformation at the right time t. Relation Q = $(\varepsilon_t - \varepsilon_\infty) / (\varepsilon_o - \varepsilon_\infty)$ reflects degree of approach of a material to an equilibrium state, i.e. incompleteness degree relaxation process.

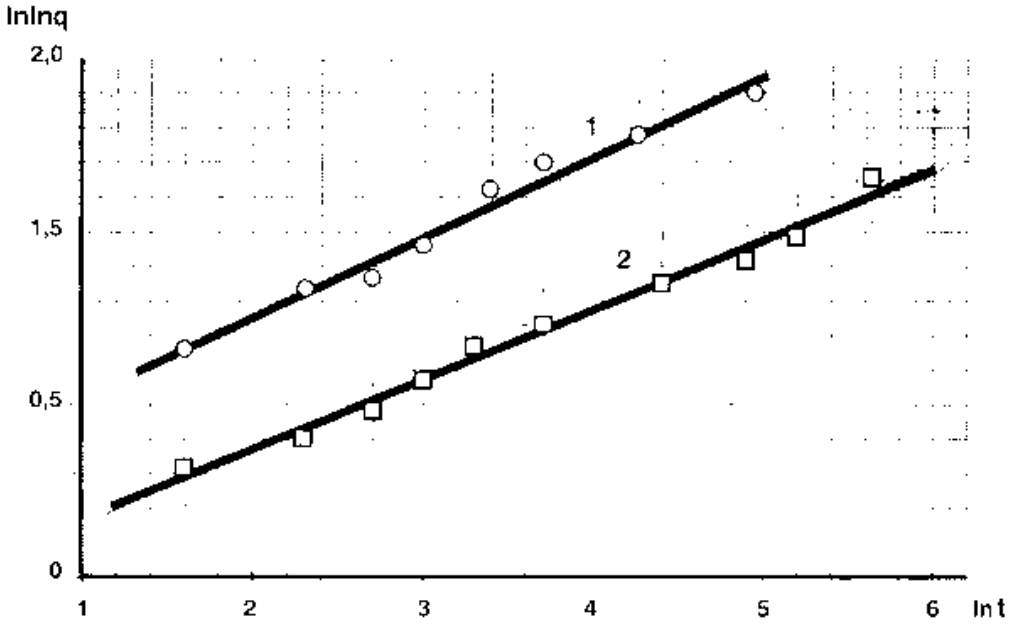
Constants of the formula of Kolrausha can be found after following transformations of the formula (3):

$$q = \frac{1}{Q} = \frac{\varepsilon_0 - \varepsilon_\infty}{\varepsilon_t - \varepsilon_\infty} = e^{at^k} \quad , \tag{4}$$

$$\ln q = a \cdot t^k \quad , \tag{5}$$

$$\ln \ln q = \ln a + k \cdot \ln t \quad . \tag{6}$$

Thus, dependence schedules lnlnq from lnt should represent straight lines. Relaxations of dependences in coordinates lnlnq = f (lnt) for two skin are resulted in drawing 3.



Drawing 3. Kinetika approach of structure of a skin to an equilibrium state after loading removal (after-action) in logarithmic coordinates: 1 – Vega (pork); 2 – Indius (veal).

The results received in work allow to draw a conclusion that relaxations of processes in skin can be described by means of the formula of Kolrausha. Constants of this equation for the investigated skin are resulted in table 2.

Table 2

Values of constants of the equation of Kolrausha
For the investigated skin

Mark of a skin	Basis	a	k
Vega	Pigskin	1,22	0,260
Softi	The sheep skin	1,49	0,290
Madrasc	Horned cattle skin	1,22	0,250
Indius	The veal skin	1,00	0,185
Fiolet	The veal skin	1,05	0,195

Smaller values of constants of the formula of Kolrausha for skin of "Indius" and "Fiolet", possibly, are connected with their differences in the nature and structure.

It is represented expedient in the further researches to try to open physical sense of constants of the equations of Kolrausha and to establish connection of these constants with the nature and properties of various skin.

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RHEOLOGICAL INVESTIGATION of the OLIGOMER-MONOMER COMPOSITIONS of the VEHICLES for UV-CURING INKS

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It is known that the most important printing and technical properties of screen printing inks, such as:

- ability not to spread spontaneously on the form;
- good fluidity under the action of squeegee;
- ability to penetrate through a form on substrate at the time of the squeegee impact;
- capacity to maximum and easy release of mesh, without the formation of filaments;
- capacity to maximum transfer of all elements of the plate on the substrate with necessary clarity of contour lines, flatness and smoothness of the colorful surface,

are determined by a number of adhesive-cohesive and rheological properties. Moreover, a number of works in this area found that the rheological properties have a predominant influence on the behavior of inks in the printing process. Such properties as ink viscosity in case of limit destruction of the structure (η_{min}), the ink viscosity in conditions of high deformations corresponding to the real shear stress in the printing process, the yield stress P_k and the anomaly of viscosity (η_{max} / η_{min}) must have well-defined values for each type of ink.

The inks for screen printing must have explicit thixotropy, low yield stress (up to 150 N/m^2) and relatively high rate of destruction of the ink dispersion structure. Achieving certain rheological properties is the most important task for scientists and manufacturers in development and production of screen printing inks.

We have studied the rheological behavior of model vehicles, which have included oligomer E-220 (polyurethanediacrylate, molar mass = 1000). Molecules of this oligomer are polyfunctional and have a tendency to dipole-dipole interaction, also they have “acid” hydrogen atoms, that are capable to generate hydrogen bonds, so it is obvious, that used oligomer may form quite strong structures as a result of interaction between oligomer and monomer molecules.

We used TPGDA (tripropyleneglycoldiacrylat) as a reactive monomer in pair with oligomer E-220.

So based on the theoretical consideration it is obvious, that oligomer-monomer system should protect quite significant structuring in vehicle. We have used model vehicles in our investigation. The first model vehicle consists of 40% of polyurethanediacrylate oligomer and 60% of monomer, the second model vehicle consists of 60% of oligomer and 40% of monomer. The third model vehicle represents the composition of 40% TPGDA (monomer) and 60% bisphenylpolyepoxyacrylate (oligomer) with molar mass = 900, which also should generate strong structures. This oligomer, as it is known, significantly accelerates UV-curing of printing inks. We also have studied rheological characteristics of monomers and oligomers, which form parts of model vehicles, and this information of course was very important for creating vehicles composition.

Rheological investigations were conducted on the rotary viscosimeter “Rotovisco” with measuring system cone-plate.

Deformation in all cases was realized with strict temperature conditions (25ºC). For oligomer and monomer and all samples of model vehicles, we obtained viscosity curves $\eta = f(D)$ and yield curves $D = f(P)$.

The results of rheological research of monomer, oligomer and model vehicles presented in table 1.

Table 1

The results of rheological research of photopolimerized composition components

Monomer/Oligomer	anomaly of viscosity $\frac{\eta_{max}}{\eta_{min}}$	the yield stress P_k, N/m^2, dyn/cm^2
TPGDA	9,48/1,2=7,9	6500
E-220	408,6/263=1,6	7000
bisphenylpolyepoxyacrylate	243,6/108,4=2,2	10000

All the studied samples of oligomers and monomers represented a non-Newtonian fluids. Oligomers, according to the obtained values of viscosity anomaly, represented a system with a low degree of structuring, but with a relatively high structure strength. Observed structuring in monomer TPGDA is probably connected with the formation of volume associates of high molecular weight.

Study of the rheological curves of the model vehicles revealed that all the studied systems are structured liquids with a characteristic for these fluids form of the yield curves and viscosity curves, with parts of the highest (η_{max}) and of the lowest (η_{min}) Newtonian viscosity and the area between them with the effective structural viscosity (η_{eff}). The results of model vehicles rheological studies are represented in table 2.

Table 2

The results of model vehicles rheological studies

Vehicles	anomaly viscosity	the yield stress P_k
Vehicle №1	40,6/1,8=22,5	3600
Vehicle №2	40,6/13,0=3,12	5500
Vehicle №3	52,1/14,2=3,7	4200

Viscosity of non-destroyed structure (η_{max}) was identical in the first two samples of model vehicles ($\eta_{max\ 1,2}$=40,6 Poise), but viscosity of destroyed structure (η_{min}) in case of model vehicle №2, as one would expect, was much higher (η_{min2}=13 Poise), than in case of vehicle №1 (η_{min}=1,8 Poise). Anomaly viscosity of the sample №1 is much higher (γ_1=22,6) than the viscosity anomaly of sample №2 (γ_1=3,4), which we believe is connected with the much higher viscosity of the oligomer destroyed structure (content of oligomer in the sample №2 is 20%

more, than in the sample №1) and with low value of the monomer minimum viscosity (η_{min}). A significant decrease of viscosity in non-destroyed structures of model vehicles (η_{max}) compared with η_{max} of the oligomers and monomers is attributed apparently firstly to the decrease of intermolecular interaction of oligomer molecules, secondly to a specific degree of oligomer ball deploying with it dissolution in TPGDA monomer, which has a linear structure and thirdly to high dilution capacity of monomer. This has led to a significant decrease of vehicle viscosity.

Structuring in the model vehicles, the presence of anomaly viscosity in them, that indicates on structure in model systems, driven by the characteristics of polyfunctional molecules of oligomer E-220, polyepoxydiacrylate and polar bifunctional monomer molecules, in case of high concentration of oligomer (concentration is 40% in the sample №1 and 60% in the sample №2).

Swollen molecules of oligomer are oriented in the direction of flow under the influence of an external deformation effect, also upsets an associated interaction of oligomer and monomer. As a result the structure is destroyed and resistance to external impact falls.

Thus, we obtained for all model vehicles typical for structured systems rheological curves $\eta = f(D)$ and $D = f(P)$. Obtained curves are fully consistent with reasoning above. The yield stress is 5500 dyn/cm^2 in case of the sample №2, where concentration of oligomer is higher. Anomaly viscosity is γ_2=3,12 in this case. It was found that yield stress is slightly lower for the sample №1, where concentration of monomer is higher, so for the sample №1 P_k=3600 dyn/cm^2 and appropriate value of anomaly viscosity is much higher (nearly 7 times higher) than this value for model vehicle №2 (γ_2=22,5). This allowed us to make a conclusion about great contribution of monomer and oligomer molecules to the structuring and strength of intermolecular interaction. As one would expect the strength of the structure decreased and the degree of structuring increased with the increasing concentration of the monomer. The degree of structuring was significantly higher, and the strength of the structure was significantly lower in case of increasing concentration of the monomer by 20% in the sample №1 compared with the sample №2.

It should be noted that even at relatively small values of the velocity gradient D = 70–140 s^{-1} fast decrease in viscosity is happening in all cases. This shows the ease of destruction of all model vehicles, which is quite close to the requirements for the structuring of the vehicle systems for standard screen printing inks.

The sample №3 based on bisphenylpolyepoxydiacrylate was similar to the rheological properties of the sample №2 based on the oligomer E-220.

Further, we have prepared model UV-curing inks for screen printing, taking into account the rheological studies of the vehicles. As the vehicles we used model vehicle №2, that represented composition of oligomer E-220 + monomer TPGDA, and model vehicle №3, that represented composition of oligomer

bisphenylpolyepoxydiacrylate + monomer TPGDA. These vehicles, as we have found, have similar rheological characteristics

Thus we conducted a study of rheological properties of vehicles for UV-curing screen printing inks and inks compositions based on them, with different type of pigments and this allows us to make the following conclusions:

1) It was found that tripropyleneglycoldiacrylat is an effective thinner for vehicle system.

2) The investigation of oligomers, monomers and vehicles based on them was conducted. It was found that model systems are non-Newtonian structured fluids, that have an influence on rheological characteristics of the inks.

3) 1) Measurement of yield and viscosity in a wide range of speeds showed that the model UV-curing compositions are liquid structured systems with variable effective viscosity, decreases from the highest value of the dispersion structure η_{max} to at least limit of the destruction η_{min}.

4) On the basis of these results the optimal composition and rheological properties of the vehicles for UV-curing screen printing inks could be estimated.

EXPERIENCE OF POLYGRAPH EQUIPMENT GROOVING CAMS DETERIORATION DIAGNOSTICS BY USING ARTIFICIAL NEURAL NETWORKS

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Abstract

Results of research of deterioration of a shaking table drive grooving cam of a thread-sewing automatic device are submitted. The opportunity of diagnosing the technical status of the researched mechanisms is shown by methods of vibro-acoustic diagnostics based on the theory of pattern recognition with use of artificial neural networks. Experimental researches are executed on specially made breadboard model with attraction of modern computational technologies, methods of digital spectral analysis of signals.

During researches it is established, that a backlash in a cam-roller pair might be determined on modification of vibration spectral component amplitudes. This allows drawing the conclusion on deterioration degree of the researched mechanism. Influence of a backlash in the cam-roller pair on quality of sewing was investigated too. The nominal variable “quality of sewing” was used as a diagnostic attribute at construction of a multivariate vector of diagnostic characteristics.

The recognition algorithm of a technical status of the grooving cam mechanism of a shaking table drive of a thread-sewing automatic device is offered, which allows correctly determining a deterioration degree of the researched mechanism. The technique of in-place diagnostics of polygraph machines drives is developed on the basis of the carried out researches and recommendations for its application are given.

Introduction

Cam mechanisms are widely used in the polygraphic equipment, their product range includes more than 500 standard sizes.

Cam mechanisms are featured by an explicit cycle of operation and a rigid sequence of contact of kinematic pairs. Vibration of such mechanisms represents a sequence of impulses, which are characterized by significant amplitude, short impulse duration, and high-frequency filling. The shock and slugged loads are the disturbing forces, which loads are stipulated by the law of periodic movement, jagging of a cam contour and oscillation of the technological load.

Oscillation of the cam mechanism details under impacts occurs on self-frequencies that are typical for each unit of the mechanism and that allows to select them from the general vibrations' spectrum.

The article shows the outcomes of the research aimed at the selection of the diagnostic factors and the development of techniques to diagnose the wear of the grooving cams of the book sewer BNSH-6 oscillating table drive gear. Oscillating table is actuated by the pair of grooving cams. Cams have the technological gaps to move the cam rollers along the slot. During the operational process these gaps are widening due to the cam and roller wear. Operating experience has shown that the wear of the working part (i.e. a spot relevant to a table being in a sewing position) of the oscillating table drive cams could reach 0,15 - 0,75 mm within the year. The wear of remaining spots is 0,04 - 0,06 mm.

Results

For the research the experimental mockup including an oscillating table drive, the piercing mechanism, and a bed with the electric motor was used. Remaining mechanisms were remote in order to eliminate interference.

To investigate the influence of the cam-roller wear on the mechanism vibroactivity, there were 8 rollers pairs manufactured with diameters starting from standard 50,0 mm up to 49,36 mm (see tab. 1). The standard gap size for a roller diameter of 50,00 mm is 0,03 - 0,04 mm.

Table 1.

Rollers parameters

Number of pair rollers	1	2	3	4	5	6	7	8
External diameter of rollers	50,00	49,92	49,86	49,67	49,55	49,50	49,45	49,36

Rollers were installed in the mockup and the vibrations readings were taken from the accelerometer positioned on a side cradle of the oscillating table. The mockup operation velocity was 82 cycles / minutes. The digitized signal from an accelerometer was written to a hard disk of the personal computer as a text file. Forty one entries of vibration acceleration for two cam turnovers were made for each of the eight pairs of rollers. From each implementation one cam cycle operation involving 30000 counts was allocated. The analysis of the obtained

vibration acceleration data showed that increase in a cam-roller pair gap results in the respectful increase of the vibration amplitude.

Digitization of the obtained vibrations was made by the analog-digital converter LA-20 USB with sampling rate 41000 Hz, the output signal of the analog-digital converter is evaluated in мV. As we were interested in a qualitative picture of the relation between the vibroactivity and the mechanism gap only, count of мV into m/s2 or dB was not carried out.

Spectra of the vibration acceleration were obtained with help Statistica. Fig. 1 - 3 shows the spectra of a cam mechanism operation cycle with roller' diameters from 50,00 mm up to 49,36 mm. Whereas the spectral component amplitudes vary from 12 мV for low frequencies up to 0,005 мV for high frequencies, it is not possible to represent all spectrum range 0-20000 Hz in one graph. For this reason spectra in the Fig. are constructed for the ranges of 0-70 Hz, 100-1000 Hz, and 1000-16000 Hz. On all graphs on axis Z amplitudes spectral component in мV are postponed.

The analysis of the graphs provides for a number of conclusions. Firstly, researched spectra of vibrations contain a number of strongly pronounced resonance frequencies. Secondly, in some of them the tendency of the amplitude magnification of resonance peaks is well distinguished while the roller diameter is decreasing, i.e. frequency data contain information.

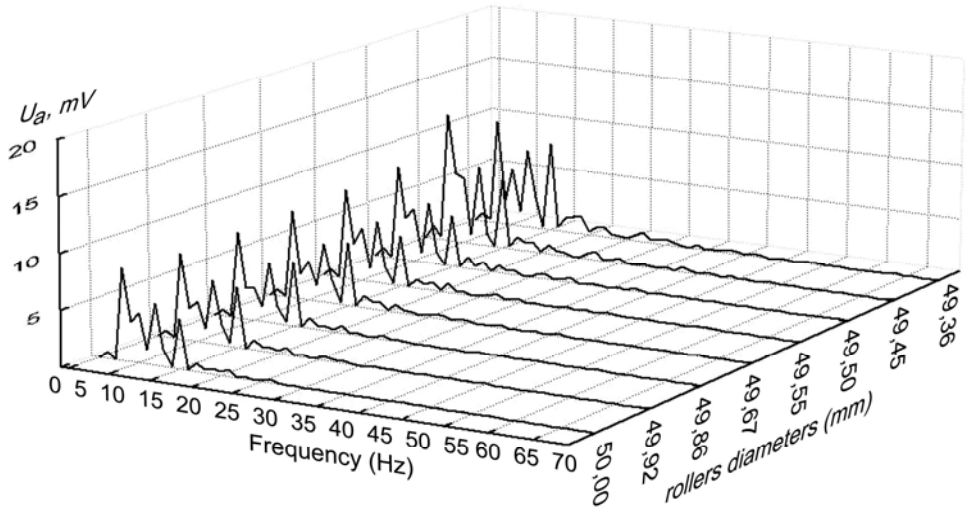

Figure 1. The spectrum of the cam mechanism vibration acceleration within the range 0 - 70 Hz

Statistical handling of the obtained data by the regression analysis methods has provided for the reveal of a number of information frequencies (3,75, 6,26, 8,75, 12,5, 98,5, 249, 289, 2437, 4876, 7165, 9600, 12050, 14450, 16900 Hz), which demonstrate the linear increase of the spectrum amplitude subject to a cam-roller gap increase.

The further experiments were devoted to the development of a diagnostic technique of a cam-roller wear with the usage of artificial neuron networks.

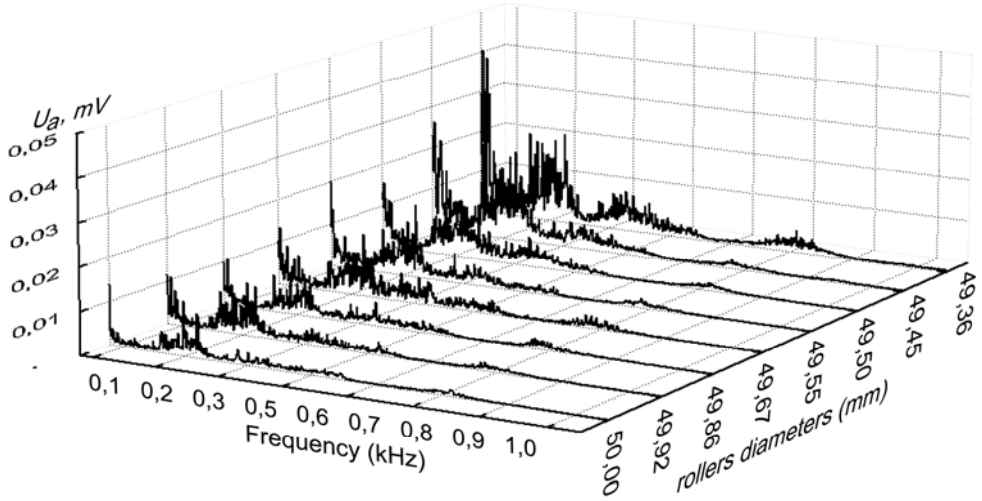

Figure 2. The spectrum of the cam mechanism vibration acceleration within the range 100 - 1000 Hz

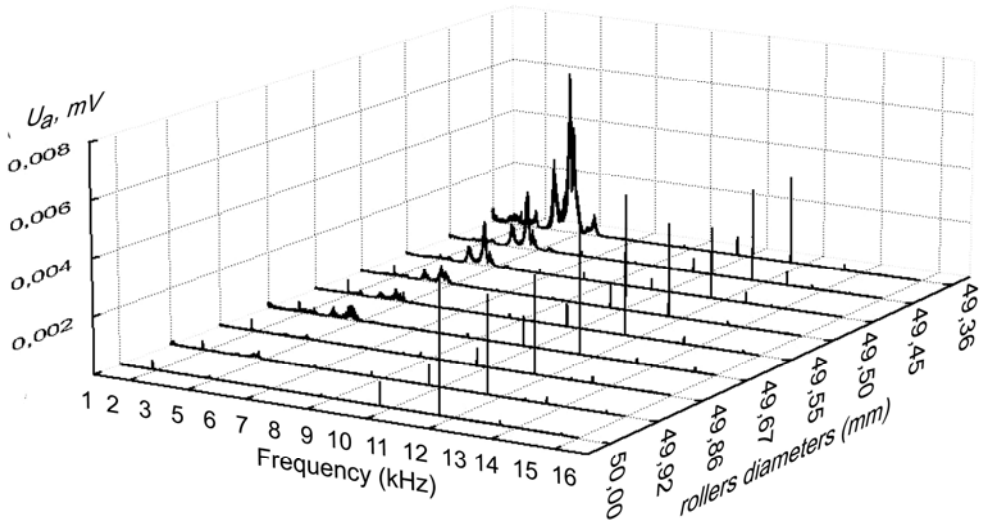

Figure 3. The spectrum of the cam mechanism vibration acceleration within the range 1000-16000 Hz

The further experiments were devoted to the development of a diagnostic technique of a cam-roller wear with the usage of artificial neuron networks.

From 41-st spectrum vibration acceleration of each roller, learning, test, and check samplings were generated. Then in STATISTICA Neural Networks program with the usage of the solutions wizard (Automatic Network Designer) there were generated 5 networks of classification, their main performances represented in tab. 2.

Table 2.

Main performances of the first group of networks (the analysis of a spectrum of vibration)

The profile of network	Efficiency of tutoring	the Test. Efficiency	the Error of tutoring	the Test error	Inputs	Hidden
MP 14:14-13-7:1	0,930556	0,845070	0,352732	1,377594	14	13
Linear 13:13-7:1	0,750000	0,718310	0,255639	0,267993	13	0
Linear 12:12-7:1	0,750000	0,718310	0,256209	0,268591	12	0
RBF 14:14-19-7:1	0,777778	0,774648	0,241123	0,237365	14	19
RBF 14:14-29-7:1	0,763889	0,802817	0,224865	0,225928	14	29

Tab. 2 shows that the network on the basis of multilayer perceptron MP 14:14-13-7:1 has shown the greatest efficiency. The structure of the network is in Fig. 4; the outcomes of the discernment is in Tab. 3.

Program STATISTICA Neural Networks enables to range entry variables to select the most significant and to eliminate whose that do not give the helpful discernment information.

Table 3

Multilayer perceptron MP 14:14-13-7:1 efficiency

Diameter of a roller	50,00	49,92	49,86	49,67	49,55	49,50	49,36
The network of MP 14:14-13-7:1 the Discernment on a spectrum of vibration (14 parameters)							
% Correct	100,0000	82,50000	80,48780	90,24390	75,60976	82,92683	85,36585

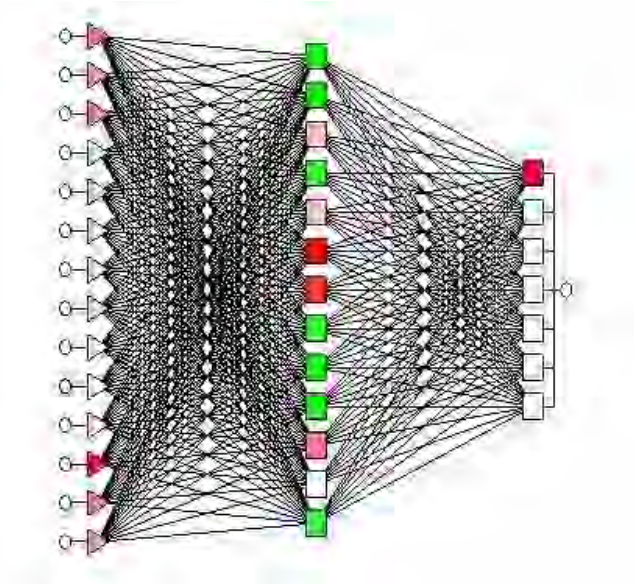

Figure 4. Multilayer perception MP 14:14-13-7:1

In Tab. 4 outcomes of the all entry variables ranking for five networks are represented.

Table 4.

All entry variables ranking for five networks

Title	the Rank of an entry variable													
Frequency	3,75	6,26	8,75	12,51	98,85	249	289	2437	4876	7165	9600	12050	14450	16900
1 network	7	3	5	1	6	8	12	10	4	11	9	2	13	14
2 network	5	3	4	2	7	10	6	12	11	13	9	1	—	8
3 network	5	3	4	2	7	9	6	12	11	—	10	1	—	8
4 network	5	3	4	2	7	9	6	12	11	—	10	1	—	8
5 network	7	3	9	2	5	10	8	12	11	14	13	1	4	6

The table above shows that information frequency 12,5 Hz is of maximum sensitivity for the first network (the rank 1), the second place is attributed for the 12050 Hz resonance frequency of a roller, and the frequencies of 289, 7165, 14450, and 16900 Hz may be eliminated as not informative (the ratio for them less than 1).

Besides, in linear networks (2- network and 3- network) the variables for which STATISTICA could not define a rank have been automatically discarded, accordingly the number of entry neurons for them has been decreased (see is reduced tab. 3).

Conclusions

Thus, the usage of neuron networks technologies for polygraphic equipment cam mechanisms diagnostics has shown the high performance. Notwithstanding what, this method demands the big size of preliminary researches, tutoring of the network, and the defined technology of data origination. Having trained neuron the network, it can repeatedly be used in future for the diagnosis on the basis of new data. Also it is possible to assume, that this technique will be effecient for the diagnostics of the other elements and mechanisms of a polygraphic equipment. We plan to continue the work in this direction in future.

The modern automated polygraphic equipment is equipped with the built-in functional diagnostics systems providing both the control of the technological process and troubleshooting of the electronic and mechanical systems and operations. Usage of the neuron networks technologies enables to supplement these systems by the controls of the physical wear of the equipment that will undoubtedly increase the quality of the final product and decrease the service expences.

On the basis of the undertaken research it is possible to offer the following construction algorithm for the neuron networks-based diagnostic systems:

1. To split the variety the object's statuses into classes (compilation of the alphabet of classes);
2. To choose of space of characteristics and to describe the classes of the object statuses by means of the said characteristics either by direct processing of the initial a priori information, or on the basis of the tutoring or self-training methods;
3. To develop the technical means to define characteristics;
4. To develop the information processing methods and logics, to construct neuron networks;
5. To estimate the discernment system's effectiveness in its different operational modes, etc.

THE COMPARATIVE ANALYSIS OF THE OPERATORS USED FOR EDGE DETECTION OF THE IMAGE FOR THE ADJUSTMENT OF SHARPNESS

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Abstract

The visual perception of subjects is defined to a considerable extent by sharpness of their borders (edges). The image having fine color balance, but not possessing a clear boundaries between color areas, can be perceived as unsatisfactory on quality. Therefore sharpness adjustment is an important task of prepress. Adjustment can be carried out by various modes. Furthermore, before decision-making on a choice of the strategy of sharpness adjustment, it is necessary to attribute the image to one of the groups from the point of view of semantics. It can be made on the basis of the edges analysis. For this reason special attention should be given reliability of these procedures. Now for decision of this problem there is a set of program operators, such as Canni-operator, LoG-operator, Sobel-operator, Prewitt-operator and Roberts-operator. These operators use various algorithms of allocation of important borders on the image. The main goal of this experiment was comparative analysis of different operators and revealing the most effective of them. Special attention was given also to the analysis of received images histograms (quantity of pixels as for edges). It gives some recommendations of practical importance. It allowed to choose most effective operators, which can be used further for the purpose of the sharpness adjustment.

Key words: Sharpness, Image quality, Edge detection, Operators for edge detection, Semantics of the images, Comparative analysis, Histograms.

Introduction

The visual perception of subjects is defined to a considerable extent by sharpness of their borders. The image with fine color balance, but without a clear boundary between color areas, can be perceived as unsatisfactory on quality.

Therefore sharpness adjustment is an important stage of images processing. Before decision-making on a choice of the sharpness adjustment strategy it is necessary to attribute the image to one of groups from the point of view of semantics. It can be made on the basis of edges analysis.

Operations of edge detection are carried out at the first analysis stages of images, and their quality performance is very important for speed, accuracy, and sometimes possibility for further analysis. For this reason special attention should be given reliability of these procedures. Nowadays for the decision of this problem there is a set of the software, one of which is program MATLAB. In this program there is a possibility to use various operators for allocation of contours. The most important of them are the following:

1. **Canni edge detector,** which principle can be described as follows:

1) the image smoothes out by the Gauss-filter for noise reduction,

2) in each point the gradient is calculated $g(x,y)=[G^2_x+G^2_y]^{1/2}$ and also edge-direction: $\alpha(x,y)=\text{arctg}(G_y/G_x)$ Difference points are defined as points of a gradient local maximum,

3) Difference points cause growth of crests on the image of a gradient module. Then the algorithm traces top of these crests and appropriates zero value to points which locations are not on a crest. Further crest pixels are exposed to threshold processing with the use of two thresholds T1 and T2, and TI < T2. The crest pixels, which value is more than T2, are called as strong, and the pixels which values get to an interval [T1,T2], are called as weak,

4) The algorithm makes connection, adding to strong pixels the weak ones.

2. **LoG edge detector.** The function of Gauss:

$$h(r) = -e^{-\frac{r^2}{2\sigma^2}},$$

$r^2=x^2+y^2$, σ, is the standard deviation.

The Laplassian of the Gauss-function is defined as

$$\nabla^2 h(r) = -\left[\frac{r^2-\sigma^2}{\sigma^4}\right] e^{-\frac{r^2}{2\sigma^2}}.$$

Also it is accepted to name this function LoG. The taking of the second derivative is the linear operation, therefore image convolutionion with $\Delta^2 h(r)$ is the same that image convolution with smoothing function and then application of the operator of Laplace. In these actions key properties of the LoG edge detector are displayed. Image convolution with $\Delta^2 h(r)$ gives two effects: it smooths the image (reduces noise) and calculates a Laplacian that reveals edges on the image. Final localization of edges consists in finding of intersections of zero level between double edges.

3. Sobel edge detector. This operator for detection of overfalls uses special masks shown in Fig. 1b [1] for numerical approach of derivatives *Gx и Gy*. The gradient in a central point of a neighborhood is calculated under the formula

$$g = [G_x^2 + G_y^2]^{1/2} =$$
$$= \left\{[(z_7 + 2z_8 + z_9) - (z_1 + 2z_2 + z_3)]^2 + [(z_3 + 2z_6 + z_9) - (z_1 + 2z_4 + z_7)]^2\right\}^{1/2}$$

Edge detection by Sobel operator in program MATLAB is implemented by the function **edge** [2].

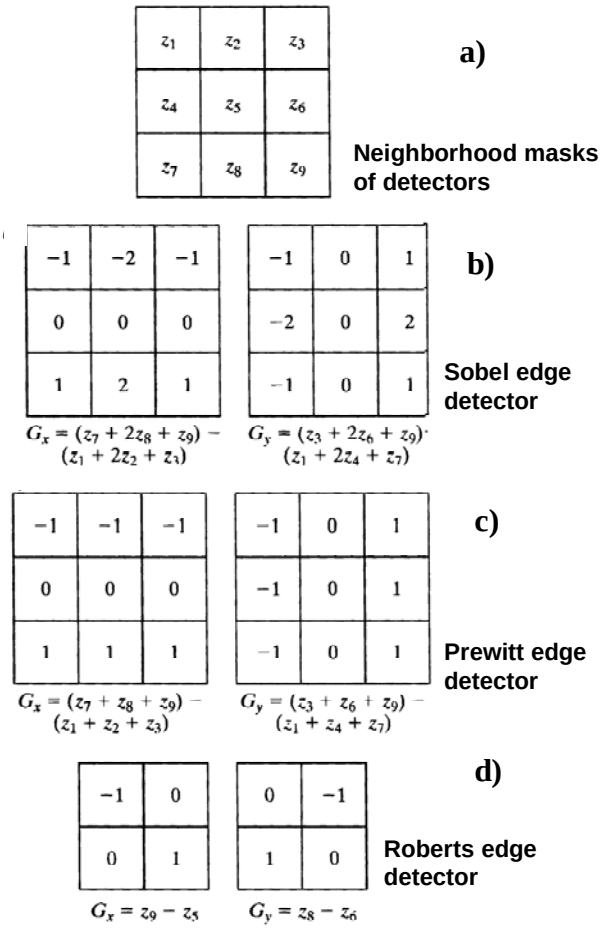


Fig.1 Different edge detectors [1]

4. Prewitt edge detector [3] uses a mask as shown in Fig. 1c**.** Prewitt edge detector is easier to implement from the computing point of view, however thus there can be errors of calculations (it is possible to show, that coefficients 2 in masks provide certain smoothing of result).

5. Roberts edge detector uses special masks for numerical approach of derivatives G_x and G_y as shown in Fig. 1d. It is one of the oldest detectors used at

digital image processing, and from Fig. 1d it is visible that it is arranged easier others. This operator is used in many programms, where simplicity and speed are defining factors of processing.

Experimental

The main goal of this experiment was the comparative analysis of described operators and definiton of most effective of them. The special attention was given also to the analysis of histograms of received images (what amount of pixels from all array are detected by the operator as the edge).

Results and Discussion

The comparative speed-analysis of the operators (Tab.1) has shown that the greatest temporal expenses are demanded by handling by means of Canni edge detector, that can be connected to complexity of algorithm. The fastest and most effective among the presented filters is Roberts's operator.

Table 1.

The comparative speed-analysis of the different edge detectors

Operator	**Time of processing, s**
Canni	33,9
LoG	23,4
Prewitt	23,2
Sobel	23,1
Roberts	23

We will consider the image in Fig. 2a as an example of influence of the operators on real images. It is possible to note, that there are areas on the picture which are not in focus (in particular, the left upper part). It is possible to attribute them to the areas which are not important for the future sharpness adjustment. It’s very important, that only important boundaries in the image (such as flower and stalk contours) are to be selected by the operator. Comparing results of action of various filters, it is possible to note that Canni edge detector, which is declared by some authors [1] as the most powerful among all operators used in program MATLAB, selects not only important boundaries of image elements, but also elements which aren’t important from the semantic point of view. And it is extremely undesirable. One can clearly observe on histograms, that in comparison with other operators Canni detector selected a much bigger part of the information as for the edges. Noise suppression included in Canni algorithm [4] increases computing expenses and leads to distortion and even loss of boundaries particulars that negatively affects the results.

LoG edge detector showed more good results. However, in this case undesirable elements also were partially selected.

Other operators (Sobel, Prewitt and Roberts) coped with the task approximately equally (as shown in Figures and histograms). However, Roberts's operator has certain advantage from the point of view of selected boundaries definition and speed performance.

The experimental data representing the changes are given in Figures 2b-f.

Fig. 2a

Edge-pixels

Canni , megapix	LoG, megapix	Sobel, megapix	Prewitt, megapix	Roberts, megapix
0,22	0,1	0,06	0,06	0,06

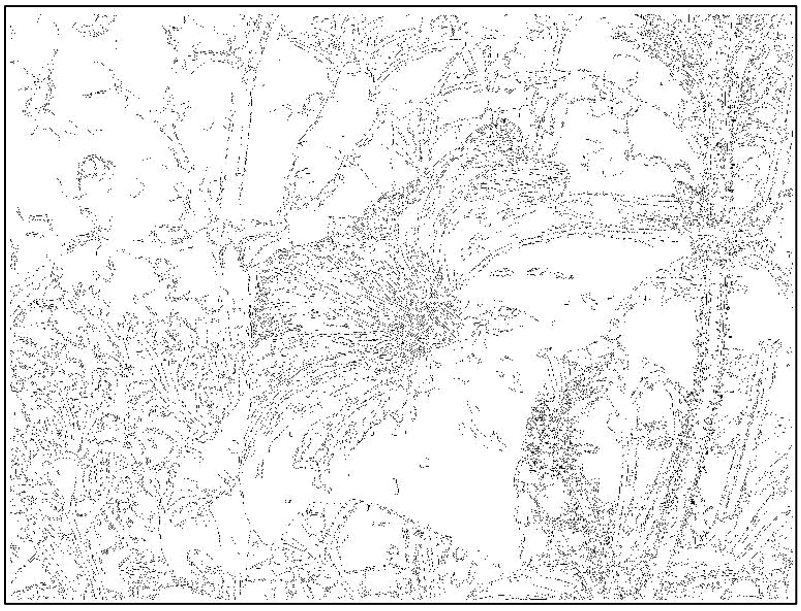


Fig. 2b. Canni edge detector

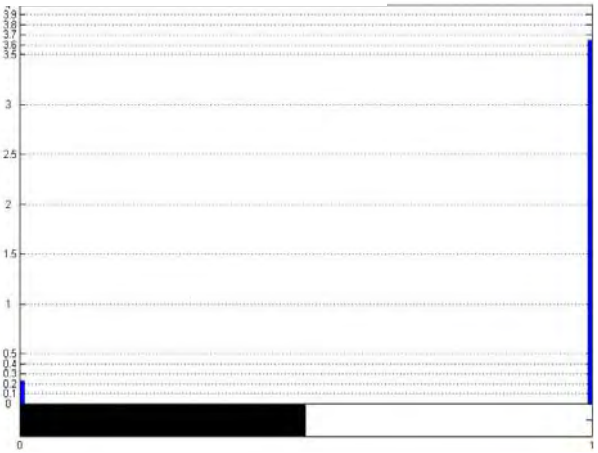
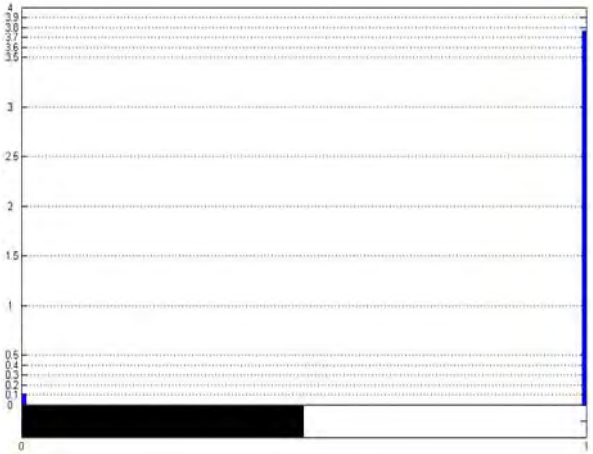


Fig. 2c. LoG edge



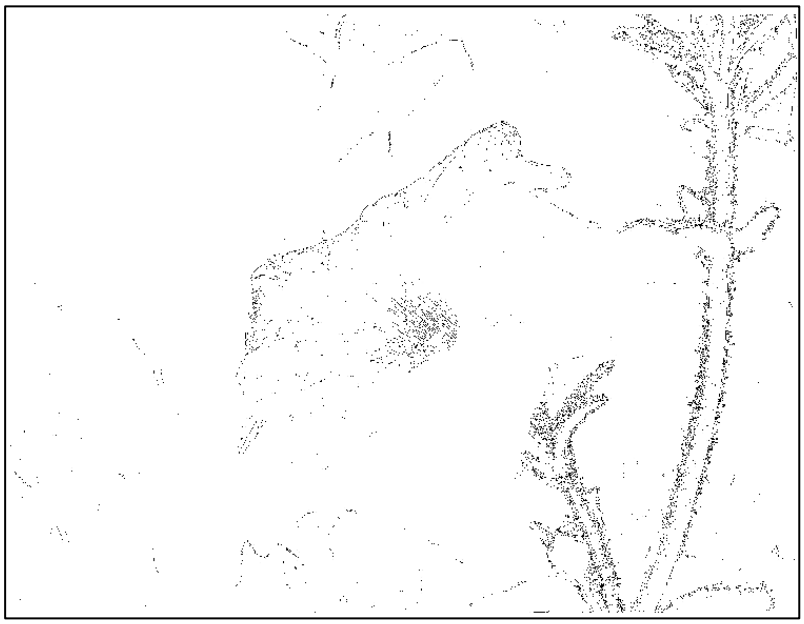
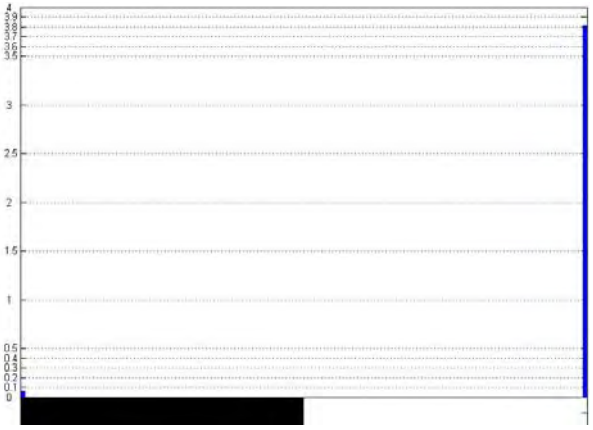


Fig. 2d. Sobel edge detector



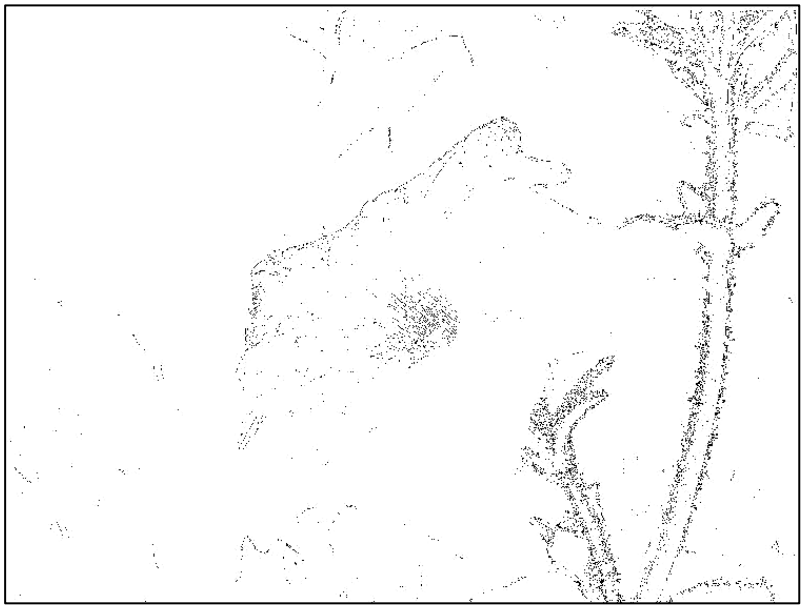
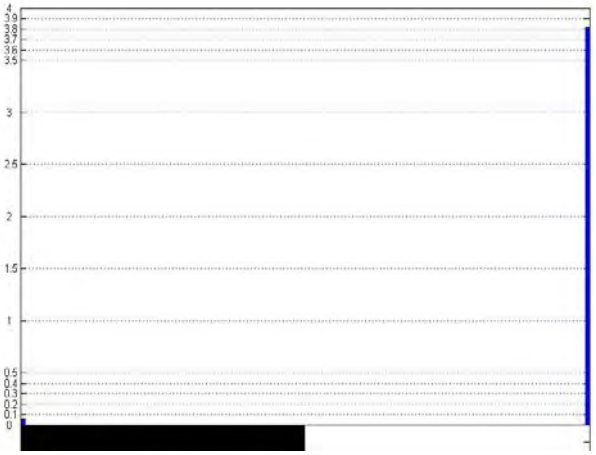


Fig. 2e. Prewitt edge detector



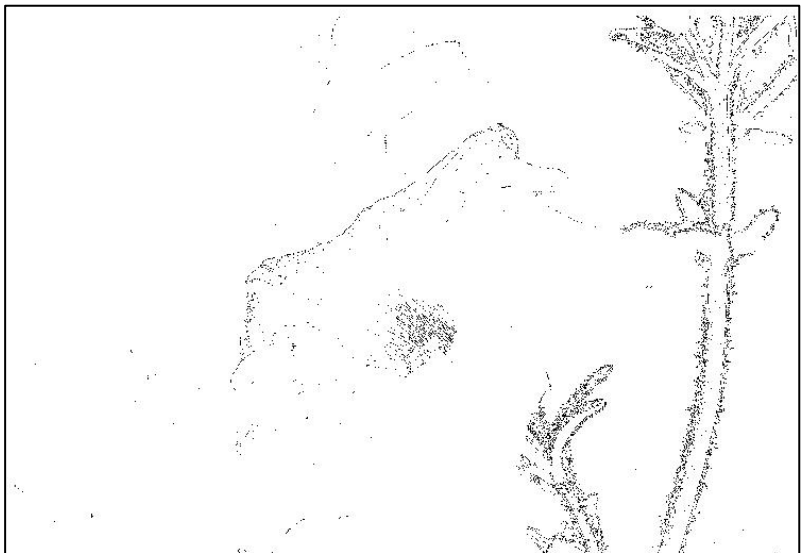
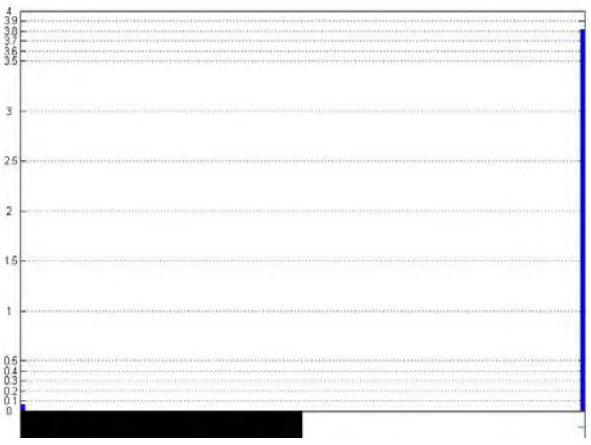


Fig. 2f. Roberts edge detector



Conclusions:

1. The comparative analysis of different edge detectors, which usage is important at determination of the edges in images for the purpose of the further adjustment of sharpness, is carried out.
2. The best results are reached with usage of Roberts operator – from the point of view of spee and from the point of view of selection of important edges of subjects.
3. Roberts edge detector can be recommended for the task decision to classification of graphic originals by semantic signs for the purpose of the further development of recommendations about sharpness adjustments.

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FROM SECONDARY SCHOOL TO BACHELOR – A INNOVATIVE AND INTEGRATIVE EDUCATION CONCEPT OF MEDIENCOLLEGE DRESDEN, A PRIVATE SCHOOL CENTRE FOR GRAPHIC AND MEDIA

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Twelve years ago the private school for graphic and media – the mediencollege – was founded in Dresden. It started as a centre for vocational education in the area of print and new digital arts.

Thus to a contentious and excellent work, school administration and teaching staff delivered education on behalf of the statutory curricular by the Saxony Ministry of Education without losing sight of market demand. This refers not only on the curricular but also to the methods of knowledge transfer.

Small student groups of maximum twenty people; a selective strategy by entrance test, which challenges performance and interest of the applicants, and a thoughtful relationship between lecturer and learner, - these are the most important things for a mutable range of methods within the teaching process.

The advantage of small groups lies in the flexibility of the teaching process. Scheduled ex-cathedra teaching can easily transferred to teamwork or stationary work. For instance:

- parts of self-studies alternate lectures;
- subjects and modular work are connected within interdisciplinary assignment; or
- content of teaching are extended on cooperative projects with local and international companies or associations.

Concerning the latter case, there are annual projects that mediencollege takes part in. One is outTAKE, the so called Youth Media Weekend in the Saxony Parliament; mediencollege provides courses on new media, video, illustration and many more. Another example is CYNETart, an international festival for computer based art; mediencollege provides a comprehensive video documentary, which is broadcasted in the internet.

Furthermore the students pass a special workshop at the end of the second year. Within four weeks there is the chance to sample all the knowledge on agency work. That means that the student groups supply marketing performances to social committed partners or interest groups from the region; for instance CI-

development for Gender Mainstreaming, print media for a literature festival called "Magia Mundi" or staircase paintings for the Diakonisches Werk in Dresden.

Within the last two years mediencollege students were also involved in international cooperation projects in Aberdeen (Scotland) or Kaunas (Lithuania). Together with the partners on site, mediencollege realized video and print productions.

All these things led to the consideration that vocational education is not only a part of straight teaching, it is also important to enrich the education by specific creative content on graphic issues and media issues as well. That is why mediencollege offers a Secondary College for Creation since 2001, and there is a Professional School for Creation focussed on communication design since 2003. These two parts complete the row of professional education at mediencollege. Also academic studies started in the year 2009. In cooperation with the University of Applied Science Mittweida, mediencollege offers two types of Bachelor degrees, Applied Media – Digital Designer (Gamedesign) and Business Management. Besides all that a secondary school will be opened in autumn 2010. So, even the youngest used to encourage their interests on creative industries as early as they can.

Mediencollege is a well known as professional partner for any concern of education on creative industries in Dresden. Students and apprentices come from all over Germany and enjoy the advantage of lifelong learning in a place that carries out international projects and takes care of individual needs. The familiar collaboration of teachers and students and the careful mentoring of their performances occurs exceptional ways on successful careers.

Effective degrees, international work experiences and personal engagement of students and teachers fortify the individual and unique way of that comprehensive school centre called mediencollege.

COLOR SEPARATION FOR DRY-OFFSET PRINTING

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Dry offset printing process combining the characteristics of both letterpress and offset. A special rubber plate prints directly onto the blanket and the blanket then offsets the image onto the substrate. The process is called dry offset because the plate is not dampened as it would be in the offset lithography process. Normally any printing job requires atleast set of 4 positives of negatives for full Colour printing on fiber based substrates Colors (CMYK). However in plastic package printing it is necessary to process images in more than 4 colors, due to contamination of inks, poor trapping abilities of printing wet inks on top of wet ink and printing on non absorbent surfaces. Generally more colours you take for

printing for packages you get the prints closer to original, and the same requires the more number of printing heads in the package printing machines. The package printing differs greatly from traditional separations for printing on paper or fiber based substrates, where practically any color in the spectrum can be successfully created using only four process colors. As dry offset printing is used for printing of rigid plastic packages and metal cans such as round elements as bottles, cans, caps, closures, cups, jars, buckets and tubes. It requires more vigilant art work, skilled pre-press operations, accurate tone reproduction in surface preparation and deep understanding of printing variables in pressroom like dot gain, trapping, pressure setting on machine and effect of temperature in press room. The high speed process can apply for all types of printing jobs like multi-color line copy, halftones, and process artwork up to nine colors in a single pass. The process is economical for long runs. Many Variety store and industrial items are decorated in this manner, but dry-offset is not often used for toiletries and other luxury items. In present paper we have discussed the difference between the normal colour separation and colour separation for the jobs to be printed on Dry offset presses with more number of colour printing units.

STUDY of DESIGN RELATED SECURITY FEATURES in CURRENCY PRINTING

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In the modern era of Printing Technology, currency printing is the abstract of all printing applications. Most of the banknotes employ four types of printing processes namely Lithography, Intaglio, Letterpress, and Silk Screen Printing.

Ink Features : All the inks used in bank note printing offer a certain amount of security because they are not commercially available and hence not available to would be counterfeiters. The inks used have to have a very high performance and be very resistant to environmental conditions such as sunlight, heat, moisture, etc. Ink features are of utmost importance like Colour Choice, Fluorescent Inks, Metallic Inks, Metameric Inks, Magnetic Inks, Optically Variable Inks, and Colour Changing Inks etc. etc.

Substrate Features : The choice of substrate is very important as it has to be a very durable material resistant to tearing, withstanding crumpling and stable to environmental effects such as humidity. In a bid to overcome the menace of fake Indian currency notes, the Government has started giving serious thought to printing currency notes on polymer, a practice prevalent in Australia. "Australian notes are more secure against counterfeiting". Some of the substrate features are Paper Features, Watermark, and Threads.

Design Features : Many of the design features are built around precision

printing that can be achieved by the highly specialised presses used in the production of bank notes. There are many types of design elements that can be worked into a bank note to give protection such as Rainbow Printing, Anti Copy Features, See through Features, Intaglio Detail, Latent Images, and Blind Recognition Features etc.

Security features of currency printing were always remained a confidential and sensitive issue. Currency notes were always counterfeited in the world irrespective of several security and legal features. Therefore, now-a-days it is very relevant study to study the security features and designing features for identification and acceptance of only genuine currency and this study will help in this direction. As it is a non-ending process in the present world, therefore such studies will always be relevant and helpful in future.

Keywords : Fluorescent Inks, Metallic Inks, Optically Variable Inks, Anti Copy Features, Blind Recognition Features, Watermark, Intaglio, Currency Notes etc.

ROLL-TO-ROLL PRINTING PROCESSES & EQUIPMENTS FOR P E M S

Dong-Soo Kim

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Abstract:

The process of manufacturing printed electronics using printing technology is attracting attention because its process cost is lower than that of the conventional semiconductor process. In roll-to-roll printing technology, printing process by gravure/gravure-offset and flexo as well as web transport technology, for printed electronics such as solar cell, OTFT, OLED, RFID antenna, fine line-patterned circuit, printed sensor, point-of-care system, is under development sponsored by government/companies. In general, in order to implement printed electronics, narrow width and gap printing, registration of multi-layer printing by several printing units, and printing accuracy of under 20 μm are all required.

The roll-to-roll printing equipment used for printed electronics comprises an un-winder/re-winder, printing units, dryer unit, guide unit, dancer system, vision system, and various auxiliary devices. The equipment designed and fabricated for this study on printed electronics is substantially that of a cantilever type, but printing units based on several auxiliary blocks can be added and adjusted for the user's convenience. The auxiliary blocks consist of a printing unit, registration unit, vision unit, dancer, load cell, in-feeder, and dry unit.

Printing results obtained through roll-to-roll printing system show fine line-

width/gap of 20 μm and registration under 10 μm.

DIGITAL PRINT MEDIA WITH CHEMICALLY MODIFICATED SURFACE

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([1]North-West Institute of Printing of the St. Petersburg State University of Technology and Design
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Structure of modern media for a digital printing of photographic quality on paper or polymeric basis is a complex multilayer system made of composite materials on polymeric basis each component of which has a definite set of the unique properties inextricably related with properties of other components. In spite of the fact that quality of print is determined by the result of dynamic process of interaction of a material as complete system and the components of printing inks, a determining role in formation of the image on the surface of the paper upper receiving layer plays.

The possibility of printing quality control by modification of chemical and physical characteristics of the print media surface by means of the methods of chemical modification was studied.

Thermal stability of these materials was studied with a thermogravimetric analysis. For the study of influence of chemical modification on the character of a microrelief of the paper surface, method of scanning microprobe microscopy was used.

Value and character of change of optical characteristics of materials depended not only of constructive and technological parameters system and process of modification, but also of the chemical nature of modifying substances, their quantity, etc (authors made an attempt to study the role of the chemical nature of a reagent – the modifier ($TiCl_4$, $SiCl_4$, PCl_3, $POCl_3$, etc.), kinetic of process of chemical layering and their influence on spectrums of reflection and whiteness of the samples surfaces).

Comparative analysis of print media characteristics before and after such modification showed evident variation of the number of parameters (reflection coefficient, optical density, contrast, average local contrast, sharpness, tonal dynamic range, etc.). Parameters value variation and its peculiarities depended on the conditions of chemical – physical impact and the reagents used. The increase of temperature of process and the charge of reagent resulted in monotonous recourse of values of factor of reflection of a surface of papers in range of wavelengths from 350 to 750 nanometers and was observed for all types of modifiers. However, with change of time of reaction such behaviour was not observed. A sudden change of

reflection coefficient (up to 35–40%) in all the investigated range of lengths of waves was revealed. Chemical modification of the paper surface allowed to increase color gamut of the printing system.Systematic analysis of principles of direct control of the processes of monomolecular layers synthesis can lead to the development of unique technology of the production of print media with controlled characteristics.

SYSTEM ANALYSIS OF THE CHARACTERISTICS OF INKJET PRINT MEDIA

Sergey Gnatyuk, Maxim Domasev, Andrey Lihatshov

(North-West Institute of Printing of the St. Petersburg State University of Technology and Design
St. Petersburg State University of Cinema and Television)

Along with traditional parameters (mechanical, geometrical, optical, sorption value) the number of quantitative characteristics of print media was estimated. To examine morphological characteristics of the paper surface authors used method of fractal modeling of the paper surface topology using coefficients of obtained using this method multifractal spectrums as measures of the paper surface uniformity and homogeneity. These coefficients serve as good mathematical values for characterisation of mechanical and physical properties of inkjet paper usually expressed by the paper manufacturer as the quality of paper coating (matte, semi-glossy, glossy, etc.).

Together with these, authors measured paper ink/water resistance, sharpness and local contrast (measured from resolution target), optical density of white and black points, density dynamic range, whiteness of white and black points. For futher estimation of color reproduction quality chroma coordinates of primary cyan, magenta, yellow color samples and their mixture as red, green, and blue color samples were measured. The latter gives important information on color rendering ability of a given material for various groups of colors in an image.

Using QHull algorithm authors obtained geometrical approximations of color gamut body, volume of which, definite in cubic ΔE units, was used as the characteristic of paper color gamut. To find influence of each of these factors on the color gamut volume, two-dimensional correlation analysis was performed. It was noted that all characteristics had strong correlation with color gamut volume. High correlation rates of this characteristic with other quality characteristic of inkjet print media allows to use this characteristic as an integral measure of paper quality

Cluster analysis allowed classifying all the number inkjet print materials from various manufacturers according to these media physical, topological, colorimetric, and optical characteristics and their mutual correlation.

To model each class of materials behaviour the number of discriminant functions was built facilitating the prediction of inkjet print media quality and these quality issues management.

NEW TRENDS IN HIGHER EDUCATION OF UKRAINE

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Recent changes in politics, economics and social life of Ukrainian community as well as its first steps on the way to the integration into European and global market caused the necessity to have not only highly qualified and well trained specialists in all fields but also a significant scientific potential for the future development. Therefore the constant modernisation of the whole education system is of a high priority for Ukraine.

In 2008/2009 the number of higher educational establishments increased to 370 while the number of vocational schools and colleges reduced to 535. Most of them (65%) are state-owned, although they are authorised to enrol students on a fee-for-service basis. About 3mln of students studied there in 2008/2009. There were defined 4 degrees in students training: Junior Specialist, Bachelor, Specialist and Master and 2 scientific degrees: Candidate of Sciences and Doctor of Sciences.

In order to bring together Ukrainian and European systems of higher education a new version of the Law “About Higher Education ” has been designed and offered for implementation. It anticipates the introduction of the following educational degrees:

1. Specialist degree offered by vocational schools and technical colleges (1-3 years of study);
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The implementation of this Law will allow:

~ to correlate the disproportion between the number of vocational schools and higher educational establishments in Ukraine;

~ to implement new standards in education which would be equivalent to those existing in Europe;

~ to make changes in the list specialties and trainings offered by educational institutions in order to bring them clother to the European ones;

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Due to these changes education in Ukraine will be widely accessible, more independent, more student-oriented and highly internationalized. These transformations will contribute to:

~ the improvement of quality, transparency and comparability of higher education standards with those existing in the European Union;

~ higher involvement in the European higher education area through the participation in join projects, Tempus, Erasmus and other programs;

~ teacher staff and students mobilities;

~ web-based teaching and projects development;

~ international cooperation in training specialists and design of educational materials.

INVESTIGATION OF INFLUENCE OF THE RUNNING DIRECTION OF PAPER AND CARDBOARD AND DEFECTS OF MATERIAL TO THE EIGENMODES OF VIBRATIONS

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Nowadays the quality of printed production has to meet very high requirements. The quality of the print and packaging is influenced by numerous factors. Among the main causes affecting the print quality are: the normalization level of the printing process, the quality of the main and additional materials used and their compatibility.

There are a lot of relevant paper and cardboard characteristics, and a number of methods and devices, corresponding to the modern measurement precision and reliability requirements, for measuring quality parameters of publishing production. The control of quality parameters is usually performed according to certain criteria for evaluating particular paper/cardboard properties and characteristics. However traditional methods of analysis of dynamic characteristics of qualitative and defective polygraphic materials, for example analysis of eigenmodes of vibrations, especially when static and dynamic forces occure simultaneously, are not sufficiently clear and this prevents to perform wider investigations of dynamic characteristics and their influence to the quality of printing.

Thus in this paper, using modern research methods of analysis of vibrations and digital optics, the eigenmodes of vibrations of paper and cardboard which is

qualitative, but with different characteristics, and also with defects by taking into account machine direction of the material are investigated.

The aim of this paper is to investigate the influence of running direction and defects of materials to the eigenmodes of vibrations of polygraphic materials – paper and cardboard – when mathematic modelling and the optical method of time average projection moiré are used.

The aim can be achieved by carrying out the following objectives:

- Has been study the stresses and deformations caused by paper/cardboard sheet vibrations, by applying the finite element method in the case of symmetric and non-symmetric sheet loading, depending on the running direction of the paper/cardboard.
- Has been study the standing wave shapes under symmetric and non-symmetric load on the paper/cardboard sheet, by using hard abrasive particles and comparison with the numerical results.
- Has been investigate the correlation between the running direction of the paper/cardboard and eigenmodes of paper/cardboard subjected to vibrations under symmetric and non-symmetric load on the paper/cardboard sheet, when the paper/cardboard is of high quality or defective (uneven thickness, torn, stabbed, non-homogenious, creased, etc.). To form the matrix connections of the eigenmodes of vibrations of the paper and its quality.
- Has been estimate the stability of cardboard taking into consideration the direction cardboard.

Conclusions and recommendations were based on the obtained study results.

Conclusions

1. By using FEM method and time average projection moiré method, influence of the machine direction of paper/cardboard, of character of loading and of some defects to the eigenmode were determined.
2. Methodology for investigation the eigenmoden of paper/cardboard sheet in the dynamic mode has been developed, based on the models of mathematical analysis of paper sheet vibrations In given case mathematical model of paper sheet was analyzed, as the membrane and as the plate, depending on the stiffness due to bending and running direction of paper, under symmetrical and non-symmetrical loading.
3. The results of experimental investigations showed, that analysis of eigenmodes by using the corborundum abrasive grains might be performed, when frequencies of vibration excitation are from 5 Hz to 225 Hz (having 10^{-5} m and 10^{-6} m excitation amplitudes). The method of time average projection moiré might be used in the higher frequency zone (for paper from 100 Hz to 550 Hz, having 10^{-6} m excitation amplitude, for cardboard from 50 Hz to 300 Hz, having 10^{-5} m and 10^{-6} m excitation amplitudes).
4. When analysing the results of the experimental study with silicon carbide granules under symmetrical paper load, it was noted that the obtained nodal lines of

standing waves correspond to the results of the mathematical model more precisely when the paper sheet is analysed as a membrane. The experimental findings show that the shapes of the paper/cardboard nodal lines of standing waves are similar and do not depend on the paper type; the only difference is that under the impact of vibrations, the shapes of the nodal lines of standing waves get formed at higher frequencies in paper than in cardboard at the same excitation amplitude.

5. The eigenmode of Plano Plus paper, obtained by the time average projection moiré method, correspond to the mathematical model, which is based upon the assumption that paper is analysed as a plate. By using this model, the stiffness matrix was determined more precisely.

6. When analysing eigenmodes of different paper/cardboard types, formed by using the projection moiré method under symmetrical paper band load, it was found that different configuration modes were formed in materials of different stiffness – offset paper Plano Plus (80 g/m^2, stiffness in machine direction 0,42 mNm, stiffness in croos-machine direction 0,31 mNm), coated paper Luxo Satin (300 g/m^2, stiffness in machine direction 3,6 mNm, stiffness in croos-machine direction 2,4 mNm), and cardboard Mirabell (250 g/m^2, stiffness in machine direction 7,5 mNm, stiffness in croos-machine direction 3,5 mNm). Besides, the bigger the stiffness values in machine and cross-machine directions, the more different were the mode configurations in machine and cross-machine directions.

7. The obtained results of experimental tests under non-symmetrical paper/cardboard sheet load (both in machine and cross-machine directions) when using abrasive silicon carbide granules and the time average project moiré method show that at the same vibration excitation amplitude the same mode configurations are formed at a higher excitation frequency than in the case of symmetrical loading.

8. The tables of matrix connections of quality and defective paper are obtained, depending on the machine direction of the paper and on the type of defects of the paper/cardboard. From these tables influence of various defects to the eigenmodes of paper/cardboard can be determined.

9. Initial stability problem of the shell type cardboard package was explored using numerical methods. The applied numerical models are based on general FEM relationships. It was observed, that the deformation of the package in the initial stage of deformation coincides with the first stability eigenmode, while further deformations in the process of compression were investigated experimentally. Semi - analytic FEM method was applied for the solution of this problem.

10. Using the method of tension of paper/cardboard mechanical parameters necessary for the mathematical model have been measured. The impact of the paper/cardboard running direction on the mechanical properties of the material under certain paper/cardboard package tension and compression loads has been determined. Experimental results show that paper/cardboard under tension in machine direction can carry from 170 to 380 % higher loads compared to cross-machine direction, and that any size cardboard packages with the side walls machine direction perpendicular to the package vertical axis can carry much 10% to 33% bigger load than the packages with the side walls cross-machine direction

parallel to the package vertical axis. Paper stiffness in machine direction is bigger than in cross-machine direction.

11. Results of experimental and numerical investigations can be applied for the design of paper/cardboard packages. These results of investigations (the tables of matrix connections) can be applied in a computer-based system for qualitative evaluation of paper/cardboard that is based on automatic comparison of eigenmodes of qualitative and defected paper/cardboard.

DESIGN of a VIRTUAL PRINTER for INDUSTRIAL INKJET APPLICATIONS

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(London College of Communication)

Christophe Mercier,
(Xaar Piezoelectric Printheads Ltd.)

Olivier Morel and James Fox,
(Xennia Inkjet Technology Ltd.)

This study was carried out as part of a Knowledge Transfer Partnership (KTP) between LCC and Xennia. It focussed on the design specifications of industrial inkjet printers, in which the printing heads are mounted individually on a moving carriage. The in-plane print head rotation was identified as one of the reasons for the misplacement of ink dots. The study investigated the influence of the angles of CMYK printing heads on final print quality. Some mechanical tolerances are given to achieve different levels of print quality.

A two-step approach was followed. In the first step, the layout of the nozzle plate was simulated by computer and a prototype was built to validate the simulations. In the second step, a CMYK virtual printer was developed. The geometric layout of the nozzle plate was added to the CMYK virtual printer and the model was tested with a XAAR 760 GS8 print head. Experimental results were in fair agreement with simulations for the single-colour approach. Acceptable cone angles for one and four colours were derived.

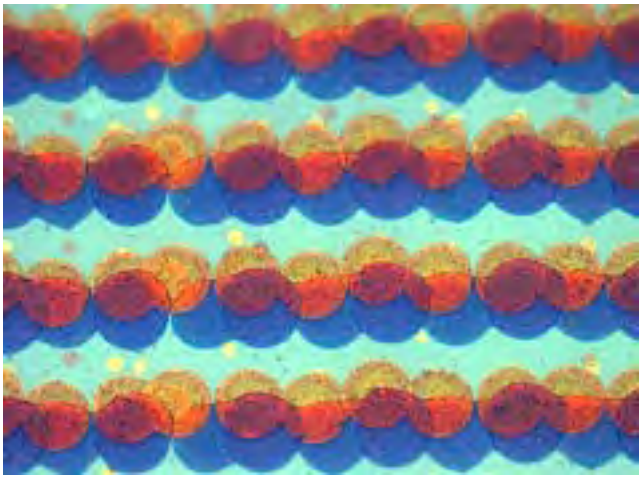

Figure. Micrograph of misregistration of CMY dots.

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Bohdan Durniak, Yaroslav Uhryn

(Ukrainian Academy of Printing, Dr of Technical Sciences)

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NON-DESTRUCTIVE METHODS FOR OLD BOOK CHARACTERISATION

Klementina Možina[1], Klemen Možina[2] and Sabina Bračko[3]

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Introduction

The book production quality is of great importance. In order to achieve an excellent reproduction and proper print quality in a reprinted book or facsimile, it is important to have comprehensive knowledge of paper characteristics, printing ink properties and of proper typesetting. Recently, the use of non-destructive methods for the characterisation of archival or museum documents has gained recognition, especially the microscopic and spectroscopic techniques, image analysis [1, 2] and sonic velocity.

The purpose of the research was to define standard and unconventional non-destructive methods for the characterisation of paper and typographic properties of original books in order to produce a reprint of best quality.

Experimental

The study compared the original edition of fairytales, which was designed by an important Slovenian architect, Jože Plečnik (1872–1957), first published in 1944 in two different bindings, i.e. as a hardcover (Book 1) and as a paperback (Book 2). The book blocks of both followed the identical graphic design and typography. Apart from the complete design of the book, the architect also

designed all the decorations and decorative initial letters. Hand typesetting was used, and while both reprints were printed using the letterpress technique [3], different paper grades were used. Since the first edition was sold out, two paperback reprints were subsequently published as well, i.e. in 1958 (Book 3) and another in 1988 (Book 4). While the first reprint used the letterpress technique, the second one used offset printing [3]. In both reprints, it is stressed that they are according to the graphic design completely the same as the original [4, 5]. However, this was not at all the case.

Paper properties

The analysis of the basic physical and chemical paper properties of the originals (Books 1 and 2) and of the reprints (Books 3 and 4) comprised the analysis of grammage (ISO 536 standard [6]), thickness and specific volume (ISO 534 standard [7]), roughness (ISO 8791-2 standard [8]), porosity (ISO 5636-3 standard [9]), specular gloss (ISO 8254-1 standard [10]), brightness (ISO 2470 standard [11]), opacity (ISO 2471 standard [12]) and colour properties (ISO 5631 standard [13]). Furthermore, to attain the information on sonic velocity, an impulse detector Morgan Dynamic Modulus Tester, Pulps Propagation Meter PPM-5R was used. The measurements were performed on the paper surface, with the frequency of 10 kHz in machine direction (MD) and cross direction (CD). Sonic velocity was calculated with Equation 1 [14, 15]:

$$C = \frac{l\,[\mathrm{cm}] \times 10^{-5}}{t\,[\mu s] \times 10^{-6}} = \frac{\Delta l}{\Delta t}\,[\mathrm{kms^{-1}}] \quad (1)$$

where

C is sonic velocity [km/s],
l is distance between piezoelectric crystals [cm], and
t is time needed for signal to travel from transmitter to receiver [s].

To compare the chemical composition of all four papers, the Fourier Transform Infrared (FTIR) spectroscopy technique was used. The FTIR spectroscopy spectra of all papers using the Attenuated Total Reflection (ATR) technique [16, 17] were recorded on a Perkin-Elmer Fourier transform infrared spectrometer equipped with a deuterated triglycine sulfate (DTGS) detector.

The measured properties of the four papers used in the studied books (Books 1–4) are presented in Table 1, and Figures 1 and 2.

Typographic properties

To compare the typographic properties of all four books included in our study, we analysed the typeface, type size and leading. The type size is given in Didot points. In typography design, it is also useful to know the typographic tonal density (TTD) of different typographic elements. TTD refers to the relative blackness or shades of grey of type on a page. It can be expressed as the relative amount of ink per square centimetre, pica or inch [18]. The changes in

various type features can create variations in TTD [18, 19]. The difference in TTD was measured numerically with image analysis by means of the computer program ImageJ [20].

The results and analysis of the measurements can be found in Table 2. The differences in the used type style, typeface, type size, leading and TTD are demonstrated in Figure 3.

Results and discussion

Paper properties

The analysis results of the paper properties of all four books cannot give the original values of the properties the papers had at the time of their production. Since the papers in Books 1 and 2 are 66 years old, we have to consider that the paper has aged significantly.

Table 1: Paper properties of Books 1–4

Paper properties	Book 1	Book 2	Book 3	Book 4
Grammage [g/m^2]	107.84	81.83	59.09	49.02
Thickness [µm]	167	137	102	78
Specific volume [cm^3/g]	1.11	1.68	1.69	1.63
Roughness [ml/min]	519	1329	678	365
Porosity [ml/min]	90	443.50	262	259
Specular gloss [%]	4.68	4.00	3.98	5.80
Brightness [%]	65.39	49.33	52.25	57.98
Opacity [%]	96.66	99.57	98.88	97.05
Colour, CIE L* a* b* (C/2°)				
Lightness, CIE L* [%]	89.86	83.57	84.35	86.06
Red-green, CIE a* [%]	– 0.57	1.99	0.39	– 0.20
Yellow-blue, CIE b* [%]	12.34	18.06	16.88	13.98

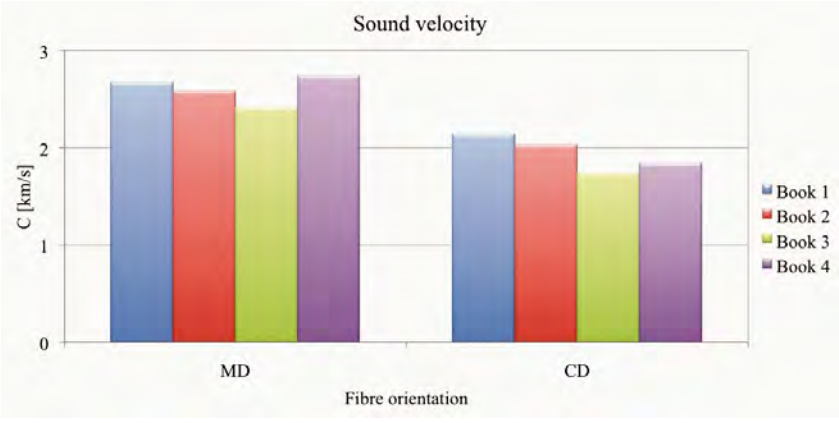

Figure 1: Sonic velocity of studied papers

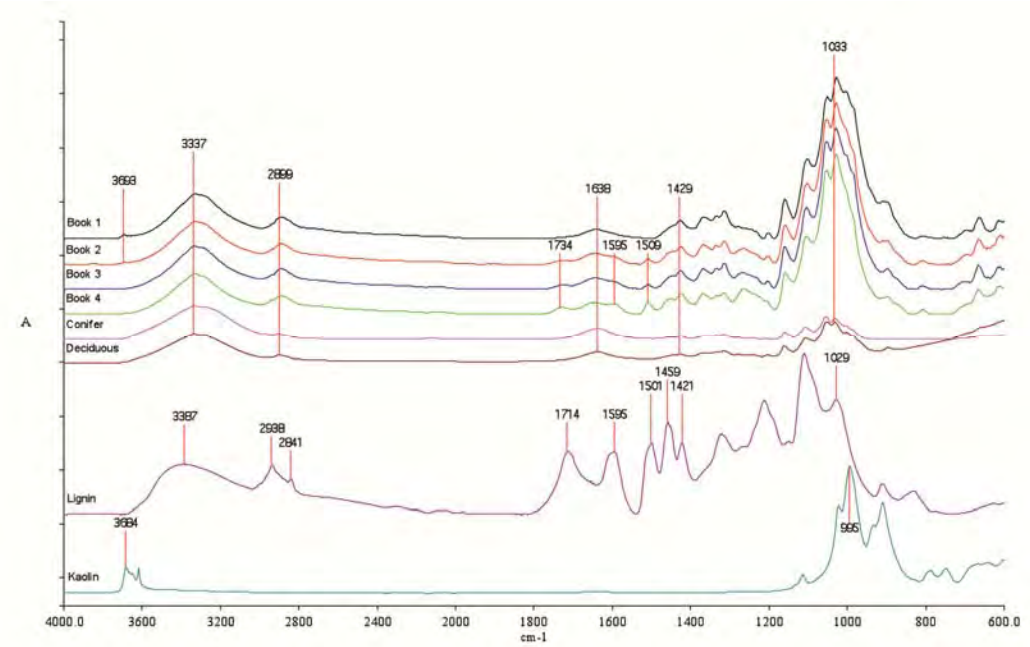

Figure 2: FTIR-ATR spectra of all four papers from Books 1–4, of conifer cellulose, deciduous cellulose, lignin and kaolin

The papers used in the first edition have different grammage (cf. Table 1). The grammage of the papers in both reprints is much lower than it was in the original paperback edition (Book 2). There are also substantial differences in thickness, esp. if comparing the original editions with the reprints. The specific volume of the papers in Books 2–4 is extremely high, which indicates that the papers of these books were produced without fillers or with just a small amount of them in the paper composition. The paper used in the original paperback edition (Book 2) is noticeably poor according to the roughness and porosity. It is evident that the paper in Book 4 is calendered and has accordingly also the highest specular gloss. For the quantitative determination of paper anisotropy, the sonic velocity method was applied. The highest measured velocity, i.e. the highest anisotropy, is on the paper from Book 4 in MD (cf. Figure 1). The FTIR-ATR spectra of the four papers (cf. Figure 2) show that the basic material of all papers is cellulose pulp fibre. The differences among the four spectra arise at the wavelengths 1714 cm^{-1}, 1595 cm^{-1} and 1501 cm^{-1}, where the peaks in the FTIR-ATR spectrum of the papers from Books 2–4 can be seen, but not from Book 1. The peaks at the mentioned wavelengths are attributed to lignin. The result indicates that the paper from Book 1 has less lignin present than the other three studied papers. At the wavelength 3684 cm^{-1}, the peaks in the FTIR-ATR spectrum of papers from Books 1 and 2 can be seen, but not in the spectrum of Books 3 and 4. The peak at the mentioned wavelength is attributed to kaolin. The papers do not contain calcium carbonate as filler.

The brightness of the paper in Book 1 is higher and the yellowness lower compared with other papers (cf. Table 1). It is evident that this paper has a smaller amount of lignin. The opacity of the paper in Book 1 is the lowest, while the opacity of the paper in Book 2 is the highest. The colorimetric property measurements of the papers (cf. Table 1) indicate already from the

measurement of brightness [21] that the paper in Book 1 has the highest values of lightness (L*). Among the four papers, only small differences in values of a* can be noticed. The value b* is extremely high. The high positive value of b* indicates that the papers are much yellower than they are expected to be. The yellowness of the lignin fibres in the paper is much higher [22]. The lowest value of b* is seen on the paper from Book 1, which confirms that this paper contains a smaller amount of lignin than the other used papers.

From the analysis results of all four papers, it can be concluded that the papers from the reprints (Books 3 and 4) are different from the one used in the original paperback edition (Book 2), while the paper grades are completely different from the one used in the hardcover edition (Book 1).

Typographic properties

Among all editions, important typographic differences can be observed (cf. Table 2). The differences exist already in the size of layout, i.e. in its width and height (Book 3), or merely in its height (Book 4). In both books of the first edition (Books 1 and 2), the same typeface was used with the same typographic properties. The text was set in bold slab serif typeface [23] (cf. Figure 3). In the first reprint (Book 3), the same bold slab serif style was used, but different typeface (cf. Figure 3). In the second reprint (Book 4), a completely different type style was applied, i.e. garald [23] (cf. Figure 3). The type size of the body text in Book 4 is larger from the original (Books 1 and 2). The most noticeable difference in the TTD can be seen when using various type style and typefaces, respectively (Book 4). If the same size of type had been used, the TTD in Book 4 would have been even lower.

Table 2: Differences in layout size, type style, type size, leading and TTD in all editions

	Book 1, Book 2	Book 3	Book 4
Layout size [pt]	204 × 282	216 × 278	204 × 280
Body typeface	slab serif; bold	slab serif; bold	garald; bold
Size/Leading [pt]	8/10	8/10	9/10
TTD [%]	19.58	20.90	16.76

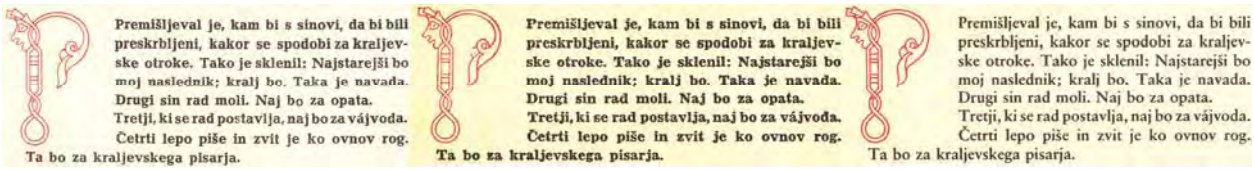

Figure 3: Part of book page from original edition (1944, left), Book 3 (middle), and Book 4 (right)

The typography used in Book 3 and especially in Book 4 does not match the typography of the first edition. From the typographic point of view, the books are completely different.

Conclusions

The research results of the standard and non-destructive testing methods indicate that we cannot obtain the actual property values the papers had when they were produced, since the papers are 66 (Books 1 and 2), 52 (Book 3) and 22 (Book 4) years old. Nevertheless, there are clear differences in the paper composition, basic structural properties, and optical and colorimetric properties. There are also substantial differences in the layout sizes, used typefaces and their sizes, and in the typographic tonal density. The latter could have been avoided if an appropriate typeface and matching type size had been used. It would have been more difficult to avoid the differences in paper, due to the 14- or even 44-year gap between the printing of the three editions. The results of measuring the physical, optical and colorimetric properties of the paper showed that natural ageing greatly influences paper, and leads to poorer optical and colour properties.

The non-destructive testing methods, such as the spectroscopic technique, sonic velocity and image analysis, have proved to be very useful for characterising the properties of paper and typesetting.

When reprinting a book, more attention should be paid to the typography and paper used. Book 3, published in 1958, and Book 4, published in 1988, are unfortunately not genuine reprints as intended. Hence, it can be said that a unique work of Plečnik's book design and cultural heritage has been lost.

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