WATER-BASED FLEXOGRAPHIC LAMINATION INKS

DISSERTATION

Aida Michailidou, Stamatina Theohari and Diana Tsimi

Introduction 1/2

- Environmental issues
  (directives-legislations)
- Water-based inks as an eco-efficient printing solution
  (according to BASF calculation tables)
- Lamination inks application areas

Introduction 2/2

- Physical properties of liquid inks
  (specifications - quality control)
- Description and analysis of laboratory tests
- Conclusions

Environmental issues

directives-legislations

- "The Solvent Emissions Directive" (SED)
  - invest in incineration equipment
  - substitute approximately 75 % of its solvent-based inks with solvent-free or low-solvent alternatives
- ATEX
  - draw up an explosion protection document
  - take adequate protection measures and
  - provide adequately safe equipment
- "Integrated Pollution Prevention and Control Directive" (IPPC)
  - have a comprehensive environmental permit
  - apply "Best Available Techniques" (BAT).

Water-based inks as an alternative solution for solvent-based inks 1/2

- Applying 75 to 80 % water-based inks and other solvent-free products is sufficient to benefit from this advantage in most EU member states.

- Water-based inks might be an alternative solution for solvent-based inks when it comes to legislations

Water-based inks as an alternative solution for solvent-based inks 2/2

Total ink-related costs

	Solvent-based inks [k€/yr]	Water-based inks [k€/yr]
ink	437.4	480.3
solvent	80.0	6.4
total ink-related costs	**517.4**	**486.7**

Table 1:"Total ink-related costs"

Total environmental costs

	Solvent-based inks [k€/yr]	Water-based inks [k€/yr]
incinerator; capital	128.0	0.0
incinerator; operational	40.2	0.0
ink waste disposal (k€)	1.7	4.8
waste water treatment; capital	1.6	6.4
waste water treatment; operational	1.3	5.2
total environmental costs	**172.9**	**16.4**

Table 2:"Total environmental costs"

*"BASF has developed a digital cost calculation model summarizing printing-related expenses for flexible packaging converters in cooperation with Paul Verspoor of Sitmae Consultancy". *web_EDC_1010_e_BR_FLX_Line.pdf./P:10*

Lamination inks application areas

- Reverse Print OPP Low-duty lamination

- Reverse Print OPP, PET Medium-duty lamination

- Reverse Print Nylon, PET Heavy-duty lamination

The aim of the study

To develop water-based flexographic lamination inks (CMYK), with properties such as:

- Adhesion to PP substrate (ASTM D3359)
- Drying rate (sec) (internal standard)
- Performance of printed inks (on a substrate leneta 3NT-33)
- Blocking set / off resistance (internal method)
- Lamination bond strength (DIN 53357)

Specifications - Quality control 1/3

- Laboratory tests are clearly stated in Regulations and directives

- The mechanical equipment used are calibrated and all of the test procedure were caried out strictly according to specifications and provisions

Specifications - Quality control 2/3

The most active standardization organizations in the paint sector are:

- ASTM
  (International standards organization)
- BSI
  (British Standards Institution)
- DIN
  (German institute for standardization)
- AFNOR
  (French national organization for standardization)

Specifications - Quality control 3/3

basic physical properties of liquid inks	• Viscosity (ASTM D4212) • pH (ASTM E70) • Solids (ASTM D4713) • Drying rate(Internal method)
basic properties of printed inks	• Adhesion (ASTM D3359) • Block/Set-off Resistance (Internal method)
critical performance printed inks for packaging applications testing	• Lamination bond strength (DIN 53357)

Description and analysis of laboratory research. Necessary equipment

- Zahn Cup No2 (dip type cup)
- K Control Coater , K Bar No 1 (wet film deposit 6μm)
- Heat seal testing machine (Brugger HSG-C)
- Tensile strength tester (Instron 5543)
- Balance precision 0.01 gr

Description and analysis of laboratory research. Consumables

- OPP
- White polyethylene
- 300ml plastic containers with lids
- Tongue depressors
- Petri dishes
- Pipettes
- Scotch 3M

Description and analysis of laboratory research. Raw materials

- Pigment concentrate
- Self-cross linking acrylic emulsion
- Self-cross linking acrylic copolymer solution
- Polyurethane dispersion for lamination ink formulation
- Defoamer emulsion
- Surfactant
- Water
- Two component solvent-free adhesive

Description and analysis of laboratory research. Underwork

- Development of a water-based lamination ink system (summarized in four laboratory tests)
- Printing of a four-color (CMYK) water-based lamination ink system
- Lamination of printed samples (internal method)
- Recording the results of laboratory tests

Description and analysis of laboratory research. Presentation of the test results (table1)

	pigment concentrate self-cross linking acrylic emulsion water defoamer emulsion surfactant	pigment concentrate polyurethane dispersion for lamination ink formulation water defoamer emulsion surfactant	pigment concentrate polyurethane dispersion for lamination ink formulation self-cross linking acrylic emulsion defoamer emulsion	pigment concentrate self-cross linking acrylic copolymer solution self-cross linking acrylic emulsion defoamer emulsion
Measurements	***1st test***	***2nd test***	***3rd test***	***4th test***
Viscosity Zahn Cup No2 (ASTM D4212)	23”	29”	33”	35”
pH (ASTM E70)	8.25	8.5	9	8
Adhesion (ASTM D3359)	80%	10%	10-90%	90%
Lamination bond strength (DIN53357)	0.6	1.5	0.7	2.5

Lamination bond strength in N/15mm. OPP//OPP

Table 3:*”Condensed four test measurements”*

Description and analysis of laboratory research. Presentation of the test results (table 2)

Internal methods descriptions:

1. Dilution: flexographic inks 25sec (Zahn Cup No2)

2.Drying rate conditions: Printing on white polyethylene/K Bar 2.

3.Block/Set-off conditions: 60°C/780N/30min.

Measurements	*Viscosity Zahn Cup No2 (ASTM D4212)*	*pH (ASTM E70)*	*Dilution [1](water)*	*Solids (ASTM D4713)*	*Adhesion (ASTM D3359)*	*Drying rate [2](Internal method)*	*Block/Set-off Resistance [3](Internal method)*
Cyan	35”	8.5-9.1	6%	40%	90%	90”-115”	OK
Magenta	30”	8.8-9.5	5%	23%	90%	90”-115”	OK
Yellow	28”	8.5-9.1	3%	30%	90%	90”-115”	OK
Black	33”	8.5-9.1	6%	24%	90%	90”-115”	OK
White	33”	8.5-9.1	5%	37%	90%	90”-115”	OK

Table 4:”*Final test’s measurements*”

Description and analysis of laboratory research. Presentation of the test results (table 3)

Lamination bond strength in N/15mm. OPP//OPP

Adhesive: solvent free, 2.2 gsm dry

Water – based lamination ink system

Measurements	*Lamination bond strength (DIN53357)*	*Lamination bond strength + white (DIN53357)*
Cyan	2.15	1.9
Magenta	2.5	2
Yellow	2	1.9
Black	2.1	1.5
White	2.5	-

Table 5:" *Lamination bond strength (CMYK+W) for W.B* "

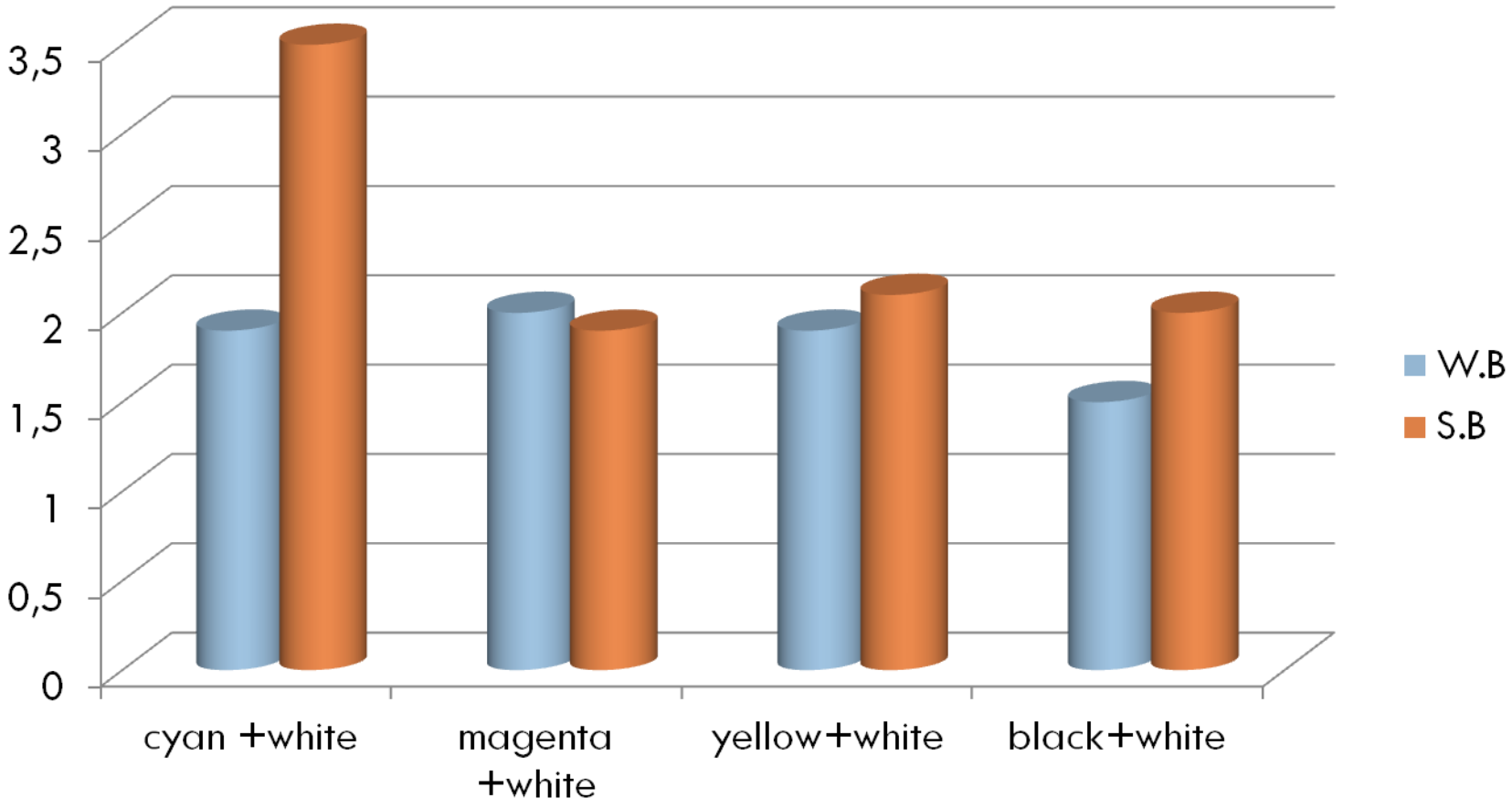
Solvent – based ink

Flexoprop FX(reverse printing lamination)

Measurements	*Lamination bond strength (DIN53357)*	*Lamination bond strength + white (DIN53357)*
Cyan	3.4	3.5
Magenta	3.1	1.9
Yellow	2	2.1
Black	3.4	2
White	3.5	-

Table 6:" *Lamination bond strength (CMYK+W) for S.B* "

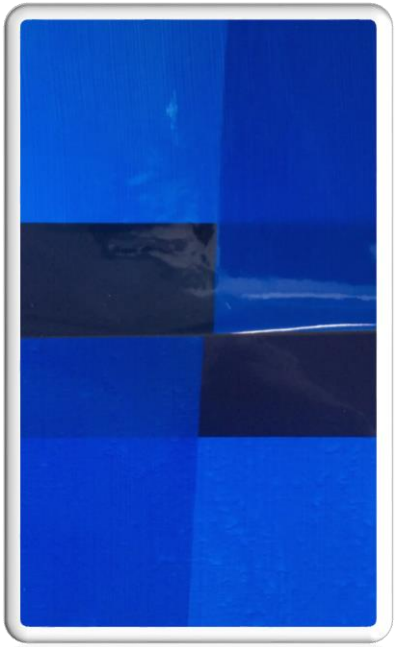
Description and analysis of laboratory research. Presentation of the test results (graph)



Graph:"*Lamination bond strength (CMYK+W) for water and solvent based inks*"

Print

Solvent based

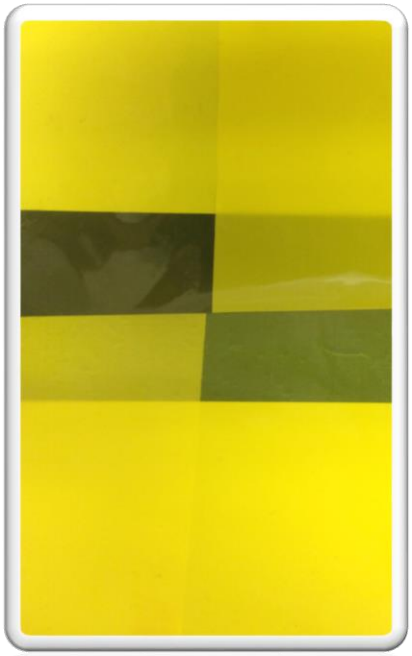


Water based

Solvent based

Water based

Solvent based



Water based

Solvent based

Water based

Conclusions

- The results indicate that in general lines the examined water-based inks gave good results regarding print quality

- Water-based inks showed a good adhesion to the substrate, so they withstand the mechanical stresses during the printing process.

Conclusions

- Weak points were observed that need further investigation and improvement in order to match performance requirements and market demands
- Slow drying rate that in turns requires a lot of energy that affects speed of print production and costs
- Finally, printing under usual processing conditions is required in order to get a full knowledge of the strengths and weaknesses of the examined water-based inks, evaluating the printing effect and correcting any technical issues

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BEYOND INKS... SOLUTIONS

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"WATER BASED INKS FOR FLEXOGRAPHIC PRINTING " / By Fred Shapiro/ PNEAC

"Good prospects from every perspective" / Joncryl® FLX Line – water-based technology for medium duty film printing

THANK YOU FOR YOUR ATTENTION

QUESTIONS?