Digital Color Printing in Flexible Packaging (DCP) – Threat or Opportunity?

Karolina Rosenberger and FabianBönsch
algroup lawson mardon packaging services ltd.

Abstract

Significant challenges are facing the packaging business and DCP might be one of the answers.

DCP is a new way of thinking for the print-buyers and the print-producers and will or better is already affecting the packaging industry. But there are still many inquiries to do.

First of all to understand the potential which this technology can offer and secondly to learn how to deal with it.

All available systems on the market are not meeting the packaging requirements, yet.

It was necessary to find partners which will share the interests to explore the suitability of the technology to develop a tailor made DCP process for the packaging industry.

A lot of work has been investigated in the the workflow, print process and the toner requirements.

Most of the printing problems caused by technical limitations, e.g., web guiding, fusing, feeding and finishing properties have to be solved.

The packaging requirements are somewhat different as for papers therefore toner and material modifications are necessary.

Together with software suppliers specific Colormanagement developments to improve print quality and also to simulate and transfer the different conventional print processes to a digital 4 color press have been started.

DCP is a new business that opens markets with new rules and approaches and which is still in motion.

Therefore we at LMPS believe to become an innovative and competend partner/supplier for our customers it is necessary to investigate in this technology the future.

Digital Color Printing in Flexible Packaging (DCP) – Threat or Opportunity?

What has been the Lawson Mardon motivation to start this project?

Significant Challenges Are Facing the Packaging Business and DCP Might Be One of the Answers

It's a new important technology which will or is already affecting the packaging industry. There are still many many questions requiring answers!

First of all to understand the potential which this technology will or can offer and secondly to learn how to deal with this technology.

Lawson mardon believes that the DCP technolgy will have an impact on their business.

Even the customers are forcing the packaging industry for **BETTER FASTER CHEAPER** deliveries at **lowest cost.**

Objectives

DCP will have a lot of potential but all the available systems on the market are not meeting the packaging requirements, yet.

Therefore it was necessary to find partners which will share the Lawson Mardon interests to explore the suitability of the technology for the packaging industry.

Lawson Mardon believes that the co-operation, started together with some technology leaders in DCP, will give them a strong position, to learn and understand the needs - and than if the technology is usable to develop a tailor made digital printing machine.

Generally, Lawson Mardon wants to explore the suitability of the DCP processes for packaging industry's applications.

Than to find out if and how it is possible to adapt their substrates - what kind of pretreatments and finishing equipment are required.

What is Lawson Mardon looking for?

To have a system which can print short runs, below 20'000 m cost efficient in the next 1 to 3 years with a very quick turn around time. And last but not least to evaluate the real total costs of DCP, including prepress, consumables, maintenance, repair, running costs, amortization, logistics ...

First results

Almost every type of flexible packaging material have been tested on the digital presses to find out the restrictions.

It is important to know that it is more than "just to press a button", that means there are a lot of settings to make, to print on new/different substrates.

Much time is needed to get the right settings and to make a structure printable.

Packaging Requirements (only a selection)

Sensorical tests (odour, taste)
Migration tests (FDA approval)
Light fastness
Good adherence & abrasion resistance
Tapefastness
Coefficient of friction
Barrier properties
Finishing properties
Heat sealing resistance
Sterilization resistance
Chilled/frozen products/re-heatable (oven /microwave)

Selection of Printed and Tested Substrates

PET SiOx (LM brandname Ceramis) is a polyethylene terephthalate, with a SiOx barrier layer in nanomicrons.

A coating top-beam makes the inorganic material SiOx evaporate. It has excellent barrier properties against gases, moisture and loss of aroma, and is often used for food packaging.

Mixpap Lid film for yoghurt cups. A coated paper is laminated to a metallised PET film.

Pushthrough-foil Aluminium foil with a seal lacquer on one side. Mainly used for pharmaceutical packaging applications like e.g. blisters, ...

OPP Orientated polypropylene. Often used for flexible packaging, laminated against other films like PE, PVDC, PET, EVOH...

Print Process

It is even possible to print on 12 micron PET / SiOx-films as well as on foil, foil/PP with 120 micron or cardboard with about 350 g/sqm.

The fusing temperatures of the materials are totally different and there is no correlation with the thickness - that means for every structure there has to be defined the right settings.

Problems have been created by duplex printing. It seems that the plastic lamination works like an isolator so that the charging needs special adaptations.

Influenced by the high fusing temperatures and the unstable temperature settings shrinking especially on PE and OPP films has been seen.

Tapetest (Test With a Tape to Proof the Quality of the Toner Adhesion)

Sealingtests

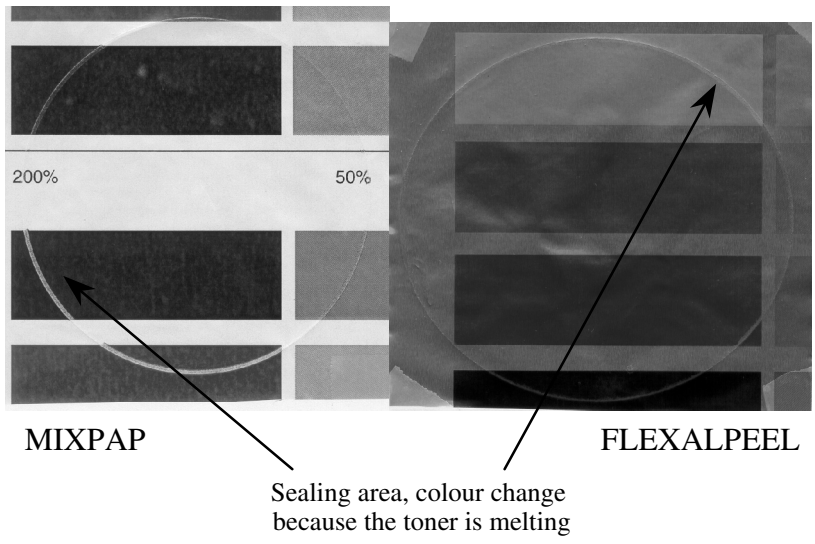
Test to check the temperature resistance of the toner, which is important for packaging applications

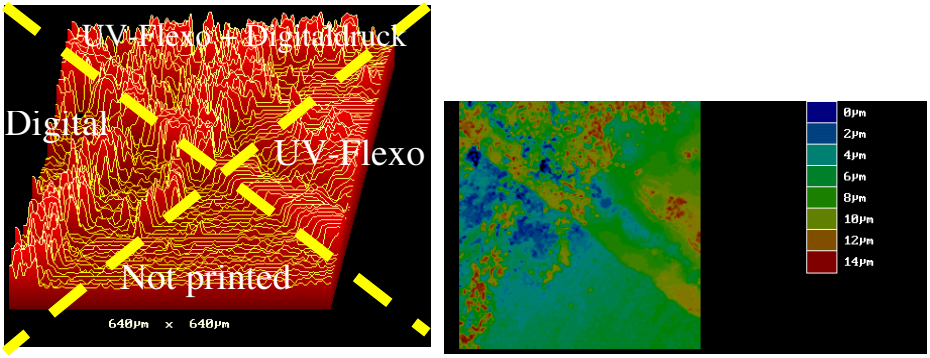
Sealing conditions: 80 N/cm^2 ≅ 120 psi; 0,6 sec, Temperature variation from 120°C => 320°C.

Shrink and Tension Tests During the Print Process

Tested on a DC100

Material	Measured	Before printing	After printing	Difference in %
oPP	width of the roll	420 mm	400 mm	- 4.8
oPP	width of print	278 mm	266 mm	- 4.3
oPP	Height of the print	160 mm	171 mm	+ 6.3
oPP	Front face of the print	133 mm	127.5 mm	- 4.2





Toner Restrictions

	Current Achievements	Future Requirements
Ink gamut	4 + white	Min. 6 Colors + white + digital overlacquer
Lightfastness	Poor magenta + yellow	Improvement necessary
Colormanagement	Different softwares in house	Hexachrome + white
Spot / Glamour colors	No	Gold and silver
Toner particles	5-12 µm	Less than 5 µm
Remelting point	66°C	Higher than 120°C
FDA/BGA/EU directive	Indirect contact / some direct uses	Improvement for direct contact/validation

Gelboflextest (Crinkle-Strength Test for the Toner)
Finishing

Basic tests with different overlacquers but the results are still quite poor, that means there has to be invested more work to show satisfying samples.

Laserscan-Microscope Pictures (Preprinted UV-Flexo Material, Afterwards Printed With the Digital Press)

This picture shows very cleary the problems of the digital process. The surface is in regard to the UV-flexo process very rough with a lot of peeks. The differences in the toner pile high are quite similar up to 14 microns – depending from the ink coverage.

Image Quality Issues

Today it is a 4 colour system which can be improved + white.

The lightfastness problems with magenta and yellow needs improvement. LM believes that it will be useful, to have at least a 6 color system + white.

No color changes in the machine = Hexachromesystem => wider gammut => more pantonecolors.

The melting and remelting point of the toners have to be improved.

Today the toner melts by ca. 66°C - what means temperatures up to 250 °C in the fusingbox (material depending).

A new type for fusing the toners e.g. UV, EB, ... would be very helpful.

FDA / BGA approvals are available for indirect food contact. A big advantage would be a direct ink contact, for e.g. competitive inside prints, pharma packaging, security, ...

Print Restrictions

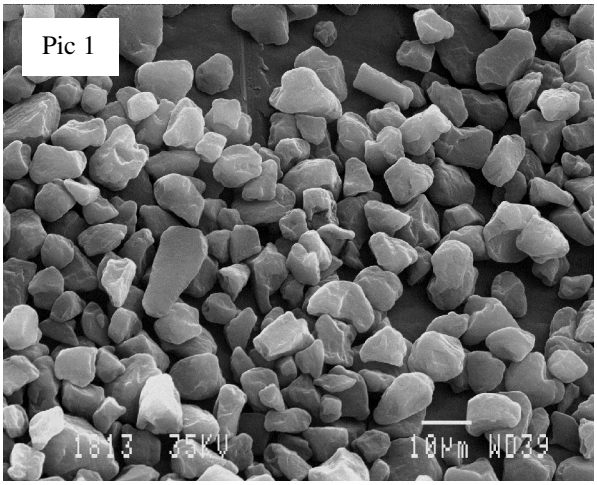
Technolgy issues which need to be improved. Most of the printing problems are caused by mechanical limitations.

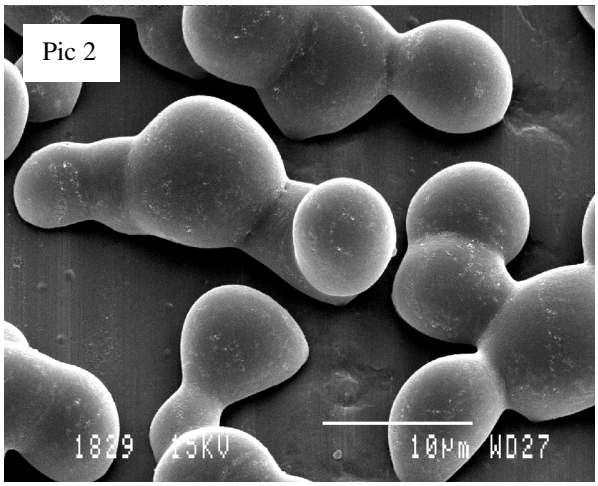
The web transportation through the machine is designed for paper and not for flexible packaging materials.

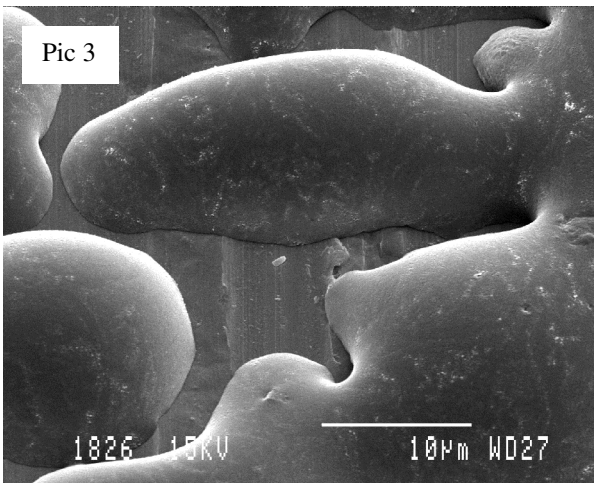
This creates very often creasing and wrinkling problems and embossing on aluminium substrates.

The temperature measurement and control - which is software controlled - is not suitable for packaging materials what leads to overheating problems and further to sticking and blocking of low melting plastics.

Foil/plastic laminates causes problems with charging and static charge.







Pic. 1: Unfused toner (toner particles 5-12µm)

Pic. 2: Unsatisfied toner fusing

Pic. 3: Fused toner

- Printed on aluminium foil enlarged 1000fold -

The Unwind and Rewind is also designed for paper and not for sensitive enough for thin films.

Toner Fusing

Pictures which have been made with a Scanning Electron Microscopy (SEM) for characterisation of surface topography - just to give a better understanding what is happening during the fusing process with the toner.

Current Work on Colormanagement

ICC Profiles for different substrates

Simulation of a 4-color UV-Flexopress on the Digital Press

Colorgammut analyses

Spotcolor reduction

Summary

There is still a lot of work to do.

First of all to solve the major technical problems on the print machine and the toner issues.

LM also has to go on with the material screening and pretreatment of the substrates.

Next step prototype development with all the technical and image issues and the know-how of Lawson Mardon regarding the film/foil feeding and finishing issues and colormanagement to simulate the conventional print processes.

And last but not least with the technology tracking. Electrobeam imaging and Inkjet technologies are also increasing in print quality and suitability for packaging.

We as Lawson Mardon firmly believe in this technology – it will affect the packaging industry.