Development of Inkjet Inks for Industrial Print Applications

Marc Graindourze
Agfa Graphics

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Agfa Graphics: integrated & innovative solutions for six segments

**Best-in-class portfolio by segment**

**Commercial Printing**
- Prepress equipment, consumables, software and services

**Packaging & Labels**
- Prepress and inkjet equipment, consumables, software and services

**Sign & Display**
- Wide-format UV inkjet printing equipment, consumables, software and services

**Industrial Printing**
- Industrial inkjet inks; integration of printing into existing industrial manufacturing processes

**Security Printing**
- For high-end security printers who want to protect their designs against counterfeiters

**Newspapers**
- Prepress equipment, consumables, software and services; mobile and cloud solutions
Agfa Graphics – Industrial inkjet printing

• Industrial inks for graphic and non-graphic applications

• Integration of printing into existing industrial manufacturing processes
  • integration of print equipment
  • ink development
  • imaging software and color control
  • workflow solutions

Your partner to integrate print in manufacturing
Industrial Printing – PACKAGING printing by inkjet

- Labels
- Direct to shaped packaging
- Migration-sensitive packaging
- Direct to tube, cans, ...
- Direct to box (multiple)
- Food packaging
- Pharma packaging
Why UV inkjet for industrial printing?

- **UV inkjet printheads**
  - piezo printheads for UV inks
  - resolution, drop placement, operating window
  - printhead – waveform – ink optimum

- **UV inkjet inks**
  - UV ink formulations
  - tuning to the jetting: long latency time, low maintenance
  - tuning to the UV curing (pin / final)
  - tuning to the function: IQ, color, physical properties, …

- **UV printing for industrial applications**
  - single pass printing / multi-pass printing
  - fast drying by UV curing (LED and/or bulb)
  - controlled ink wetting and adhesion
UV inkjet ink compounds and the curing process

MONOMERS

PIGMENT DISPERSION

LIQUID INK

PHOTOINITIATORS

ADDITIVES SURFACTANTS
ADHESION PROMOTORS

CURED INK LAYER
Agfa Low Migration UV inkjet inks – conceptual ink design

Low viscous inkjet ink by combination of:
• highly reactive low viscous monomer
• diffusion-hindered PI system
→ high curing degree
→ low migration of monomers and PI’s

- all compounds on Swiss list
- GMP produced
- Nestlé list, other guidelines

Food safe printed packaging: result of print solution, incl. ink designed for limiting migration.
Only way to know if printed packaging = food safe → migration analysis → compliancy (“10 ppb rule”).
The PRINT process – the INK formulation

single pass UV inkjet printing: system solution ifo application: a range of options

PRE process

- analog priming (clear or white)
- physical (corona, plasma, flame)

primer / white curing

inkjet image

- CMYK curing

POST process

- varnish curing
- analog lacquer / laminate

single pass INKJET printing

wet-in-wet vs pin curing

ink selection: application, substrate(s), curing speed, printhead,
full list of functional specifications, ink set (Wh / colors / Varnish)
Case No. 1 of industrial inkjet printing

Print solution direct-to-box printing

Print on the box when it is a box
- last stage printing
- print exact amounts
- variable box sizes
- image change → no delay

Challenges
- handling different box sizes
- jetting horinzontally
- low printhead maintenance
- different substrate materials
- fast LED drying

Solutions
- UV inks with long latency time
- fast LED curing (low straylight sensitive)
- wet-in-wet color ink set
- controlled ink wetting

Source: Limitronic
What about a solution to use the same printer for multiple type of boxes?

- Printer design: handling the ‘box’ and the distance to the printheads → multiple format printing
- Ink design:
  - CMYK ink set which delivers image quality and adhesion to multiple substrates
  - Extendable with white ink when needed
  - Also RED ink available as spot color (e.g. CLP printing application)

‘versatile’ INK solution
- Controlled ink wetting on multiple substrates
- High color gamut
- Image sharpness
- No surface damage
- LED curable inks

Source: Limitronic
Case No. 2 of industrial inkjet printing

Print solution direct-to-shape on food / beverage cups

Beverage cups – diary food cups - ...
  • personalisation (stadium cups, party cups, ...)
  • short runs – variable runs (part of the image)
  • print multiple images in one run

Challenges
  • direct to shape printing
  • high output (# cups / min)
  • PP cups → ink wetting
  • food/beverage safety (migration + set-off)

Solutions
  • flame pre-treatment
  • ink design → food safe
  • white ink design (adhesion, homogeneous white,...)
  • wet-in-wet color ink set

Source: Polytype

flame pre-treatment

white ink

CMYK ink set
Case No. 3 of industrial inkjet printing

Inkjet printing for all parts of the box
example: medicine box

- All three parts of the box printed digitally
  - pharma blister (aluminium foil)
  - folding carton box
  - paper with instructions (40 g paper)

how printed?
- KM1024iM / Altamira Pack LMX inks
- KM1800i / Altamira Pack SUV inks
- KM1800i / Agfa UV Black ink

Print on all parts of the packaging
- last stage printing
- print exact amounts
- variable run lengths
- fast update of content

Challenges
- small fonts; high text sharpness
- high print speed
- high resolution printheads
- industrial reliability

Solutions
- reliable jetting @ high speed
- Black ink: high density, neutral K
- controlled wetting on thin paper
- blister: limit set-off of ink compounds → pharma safe

Source: Industrial Inkjet Ltd
Direct print in medical bags (IV-bags, blood bags)
example: IV-bag

Print direct on IV-bag
• print on empty bag (before filling)
• include coding → track & trace
• exact number of prints
• easy change between files

Challenges
• direct to shape printing
• print before sterilization
→ high migration risk
→ risk of flaking-off of ink

Solutions
• pre-treatment
• ink design for durability (steriliz. step)
• ink design → limit ink migration
→ pharma safe
Inkjet printing on black surfaces – packaging and product printing
need for high opaque white ink

Direct Product Printing
- direct to shape printing
- including unique codes
- customization
- at the manufacturing location

Challenges
- direct to shape printing
- ink adhesion @ multiple substrates
- white opacity
- industrial reliability

Solutions
- printhead allowing high laydown
- ink supply reliability
- white ink opacity / shelf life
- ink design
  → adhesion / scratch resistance

Source: Limitronic
Inkjet printing direct to shape on tubes, cans, etc
example: direct print on aerosol can

Source: Martinenghi

Direct to Shape on Aerosol Can
• connect to manufacturing process
• variable run lengths
• image variation within 1 run
• special series

Challenges
• high image and text quality
• direct to shape printing
• “necking” after printing
• adhesion and scratch resistance

Solutions
• primer and pre-treatment
• small dot size / intercolor pinning
• very controlled ink wetting
• ink adhesion on primer
Inkjet printing on closure caps example: HDPE closure caps for beverage bottles

Closure cap printing
- full color printing
- mass customization
- production speed (36000 caps/h)

Challenges
- HDPE surface ‘contaminated’
- colored caps → white ink first
- LED curing (final curing)
- instant adhesion (caps fall in box)

Solutions
- extensive pre-treatment
- LED cure dose optimized
- instant adhesion by ink design
- ink design → limit ink migration → beverage safe

Source: Sacmi
Inkjet printing on closure caps → versatility again
example: printing PS lids of food boxes

Lid printing of food boxes
- full color printing
- mass customization
- production speed

Challenges
- throwing distance
- variable lid sizes
- LED curing (final curing)
- instant adhesion (stacking of lids)

Solutions
- transport system optimization
- adapted pre-treatment
- instant adhesion by ink design
- ink design → limit migration of ink compounds → food safe

Source: Sacmi
Summary and conclusions

- inkjet ink development is part of **full SOLUTION approach**
  - **INK is key** element of the print solution
  - **INK matching** as part of the manufacturing process

- inkjet ink tuning to the **printing system + end-quality**

- inkjet ink optimisation to the **full manufacturing process**

- **UV-curable inks** can fit to a large variety of applications
  - labels & packaging, including direct to packaging
  - UV inkjet inks for food and pharma packaging
    - limit migration by ink design as part of the full print solution (substrate dependant) (proven by migration testing)
    - industrial reliability (consistent quality)