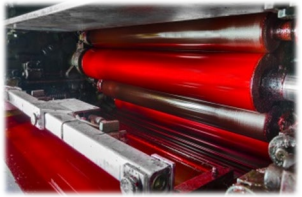
Link to ink
The combined ink know how

UV-LED-EB Technology - Radiant Prospects for the Future

Sector Group Printing Inks
German Paint and Printing Ink Association (VdL)





Content

Link to ink
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Basics

Standard UV

Low Energy UV

LED UV

Electron beam curing (EB)

Inkjet

Food packaging

Content

Link to ink
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Basics

- Standard UV
- Low Energy UV
- LED UV
- Electron beam curing (EB)
- Inkjet
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Colour drying – curing by UV/EB

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Composition of colours

Sheet Fed Ink	Gravure/Flexo Ink	EC (UV/EB) Ink
Pigments	Pigments	Pigments
Resins	Resins	Poly-/Oligomers
Oils	Solvents	Monomers
Additives	Additives	Additives
		Photoinitiators*
		* UV only

Curing / drying process

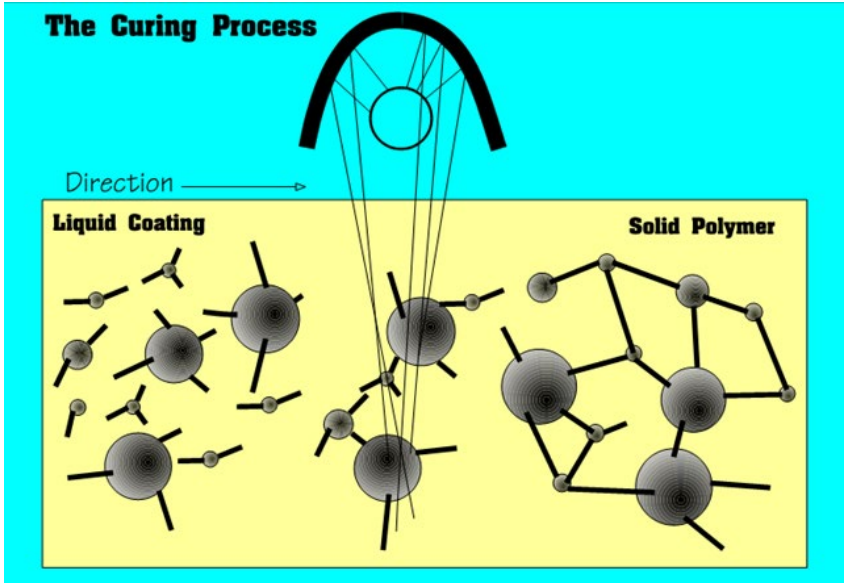
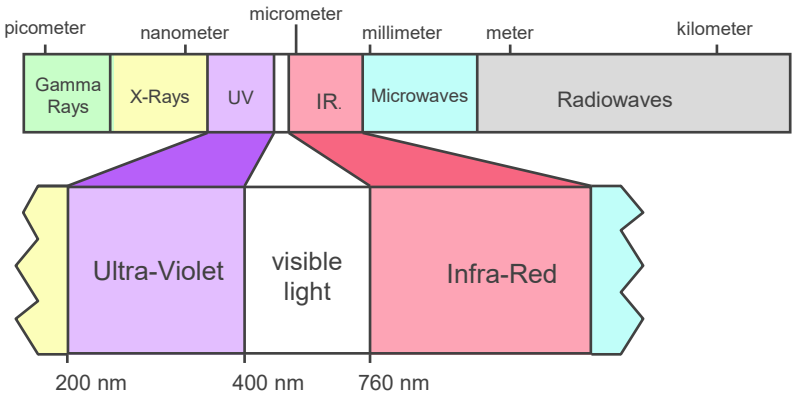


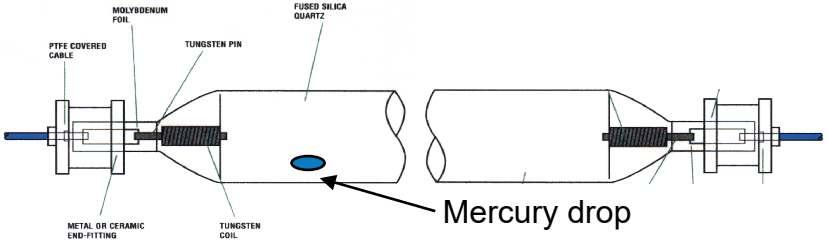
Image source: Sun Chemical

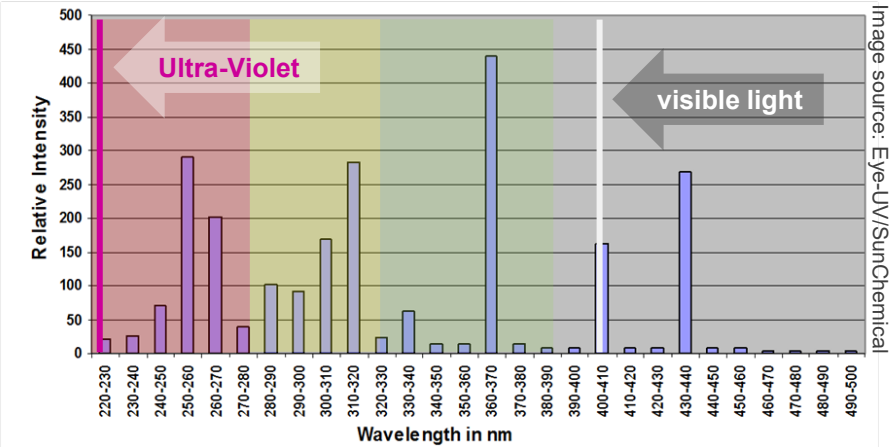
Colour drying – curing by UV/EB

- UV light = electromagnetic radiation
- shorter wavelength than visible light

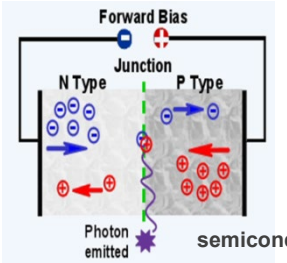


Standard mercury vapour lamp (medium pressure)

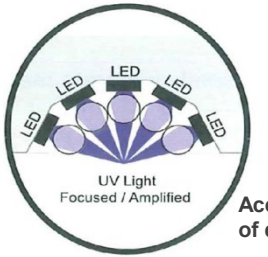




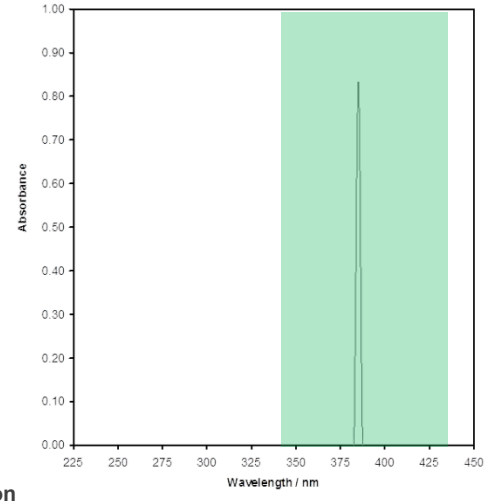
LED UV + LE UV technology



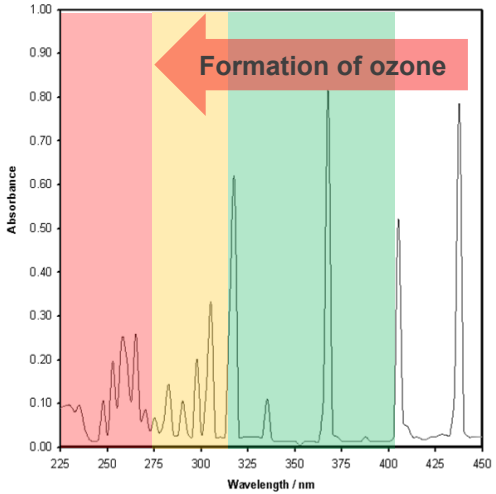
semiconductor



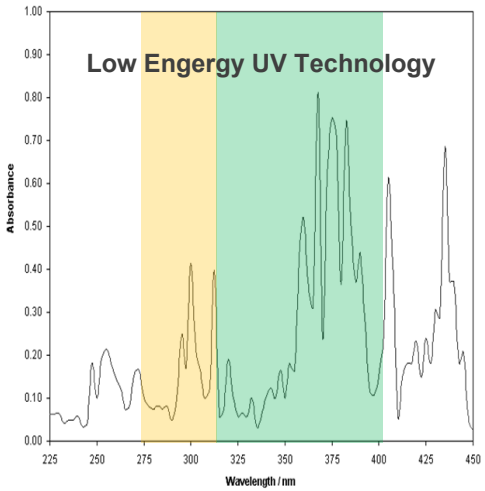
Accumulation of diode



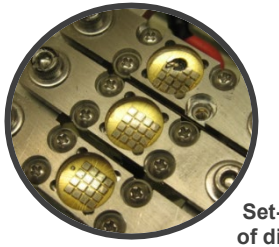
LED spectrum (395, 385, 365nm)



Standard mercury spectrum



Spectrum iron-stabilised Hg



Set-up of diode

UV A	315-400 nm
UV B	280-315 nm
UV C	200-280 nm

Image source: Sun Chemical

Electron beam curing (EB)

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How does an electron beam work?

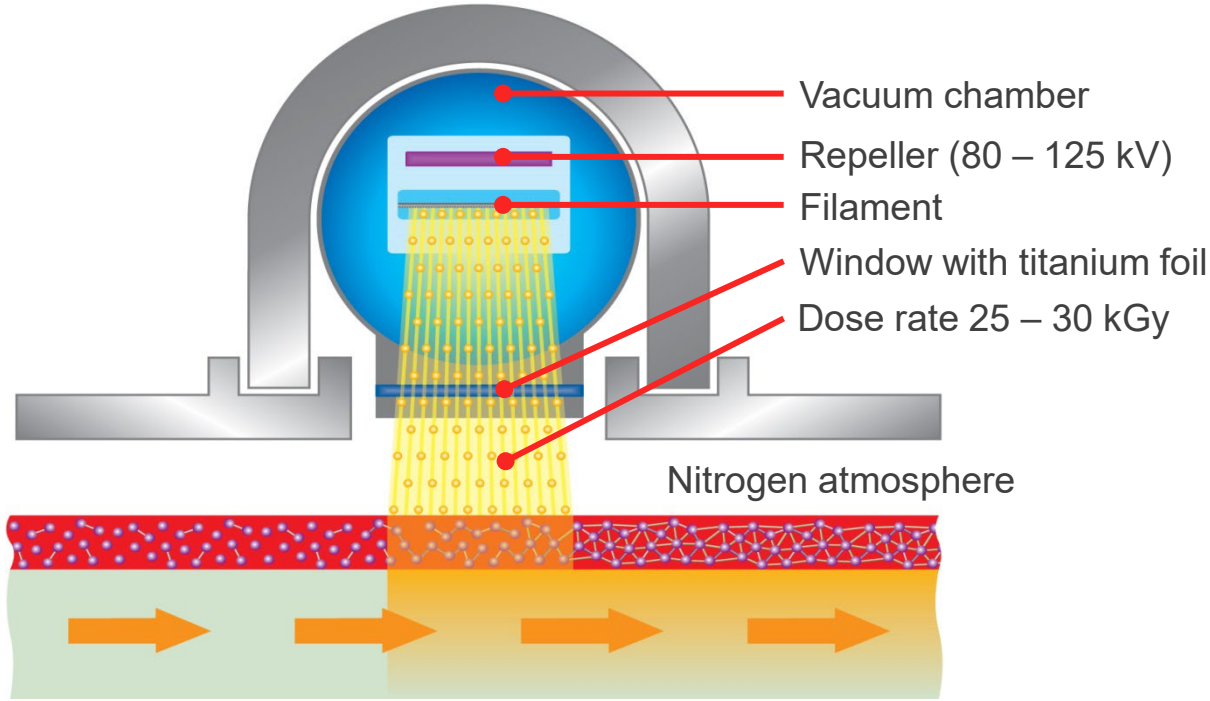

Image source: Sun Chemical

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Standard UV

Applied in all print processes:

- Commercial print (paper, film)
- Label print (paper, film)
- Packaging print
  (paper, cardboard, film, foil, tinplate)
- Objects print
  (cups, tubes, bottles, 3-D objects)

Image source: Siegwerk
(www.siegwerk.com)

Standard UV

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Advantages of UV curing:

- Wide choice of substrates
- Easy handling
  (cleaning, no self curing, no explosion-protection)
- Quality intensification
  (gloss, resolution, abrasion resistance, fastness)
- Immediate processing
- VOC free

Image source: Flint Group (www.flintgrp.com)

Image source: Siegwerk
(www.siegwerk.com)

Standard UV

Challenges of UV curing:

- Investment costs
  (lamp, extraction system)
- Operating costs
  (energy, maintenance, ink)
- Work place safety
  (ozone, handling of ink)
- Food packaging

Image source: Siegwerk (www.siegwerk.com)

Content

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The combined ink know how

- Basics
- Standard UV
- **Low Energy UV**
- LED UV
- Electron beam curing (EB)
- Inkjet
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Low Energy UV

- Developed for commercial printing (sheetfed)
- Avoidance of ozone producing radiation
- Low power consumption
- Special ink system required

Content

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LED - UV

Link to ink
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LED-UV curing used for:

- Commercial print (paper, film)
- Packaging print (paper, cartonboard, film)
- Objects print (tubes, bottles, 3-D objects)

LED - UV

Link to ink
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Advantages

- Energy-saving potential
  (no preheating time, pulsable circuit)
- No ozone creation
- Almost no heat input to substrate
- Long durability
- Constant radiation output
- Free of mercury

Challenges

- Food packaging
  (reactivity / limit of migration)
- Varnishes
  (curing of surface, yellowing, cost)
- Limited choice of raw materials
- Energy density – wavelength
- Young technology

Content

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EB technology – printing technologies

Link to ink
The combined ink know how

EB Offset

- Reel-fed offset printing
  (no lamp for sheetfed offset)
- Tension control of substrate
  (no intermediate drying)
- Flexible printing length
  (request of flexible packaging market)
- Inline printing machines of different machine manufacturers
- Central cylinder offset press

EB flexo

- Central cylinder flexo
  (wet on wet printing)
- Various developments of technology
  (some with intermediate drying)

Other developments

- Narrow web EB lamp
- Screen and gravure printing
- Inkjet

EB technology – comparison UV / EB

Link to ink
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Advantages EB

- Process safety by controlled dose rate
- Low migration potential (photoinitiators, polymerisation)
- Low operating expenses (maintenance cycles, energy, spare parts)
- No heat input (IR) to substrate
- Free of mercury

Challenges EB

- Investment costs
- Influence on substrates
  - Discolouration of some PA, PVC, OPP formulations
  - PE heat-seal temperature
  - OPP- hot tack window
  - Some substrates show fission products
  - Smell of substrates containing chlorine

Content

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The combined ink know how

- Basics
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- **Inkjet**
- Food packaging

Inkjet

- Established printing method for small print jobs
- LED-UV, as well in combination
- 3-D printing
- EB under development
- Many applications with exceptions to be developed

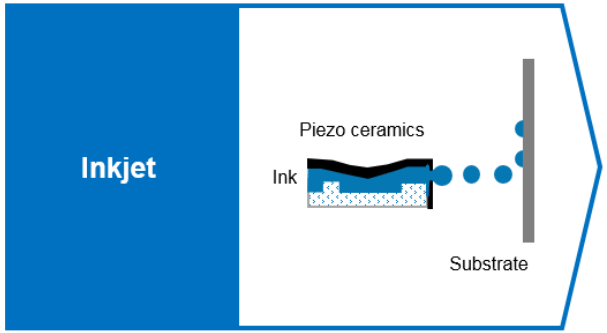

Image source: Siegwerk (www.siegwerk.com)

Inkjet

Advantages

- Prepress software-based only
- No set-up times
- Minimal wastage
- Individualization
- Non-contact printing

Challenges

- Speed of printing
- Dependency of print head – ink
- Food packaging
- Limited choice of raw materials
- Colour spectrum – branding
- Higher resolution

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Food packaging printing

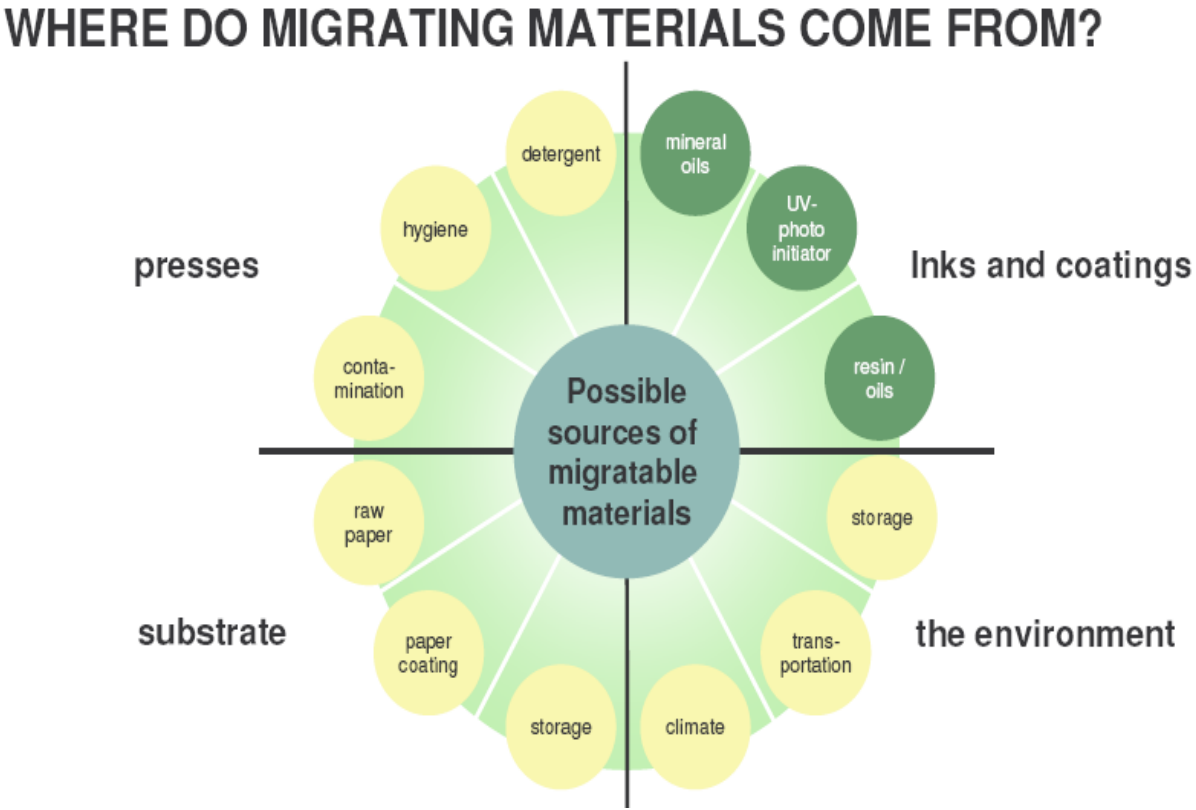


Image source: Sun Chemical

Food packaging printing

TYPES OF MIGRATION

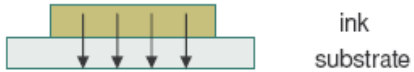
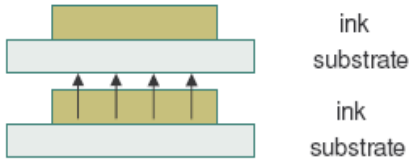
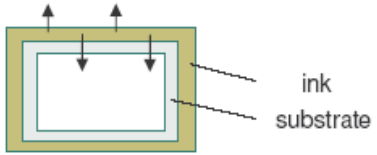
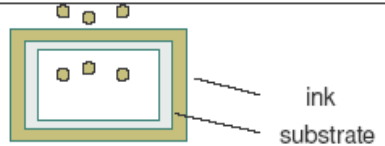
1.	**Penetration Migration** Migration from the printed side throught the substrate onto she unprinted side.	
2.	**Contact Migration** Migration from the printed side to the unprinted side of another sheet in a stack or roll.	
3.	**Evaporation Migration** Migration due to the evaporation of volatile materials by heating (e.g. cooking, baking, or boiling frozen products in their original packaging).	
4.	**Distillation Migration** Migration throught steam distillation during cooking, baking or sterilisation.	

Image source: Sun Chemical

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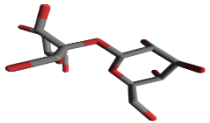
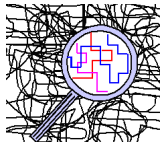
High migration potential		Low migration potential	
Not polymerised specious in the ink film			Polymerised into crosslinked ink film.
Low molecular weight			High molecular weight (> 1.000 Da)
Soluble in food stuff			Hardly soluble in food stuff

Technologies of curing

Technology	Market share 2015	Development of ink	Range of applications
EB	++	++++	++++
UV	++++	++++	+++
UV LE	+	+	+
UV LED	-	+	+

Food packaging printing

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- Printing food packaging with UV / EB curing is possible!
- Requirements:
  - Use of low migration inks
  - Proper processing
  - Confirmation by appropriate analyses of migration

Thank you for your attention!

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VdL
Verband der deutschen Lack- und Druckfarbenindustrie e.V.

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