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Agenda

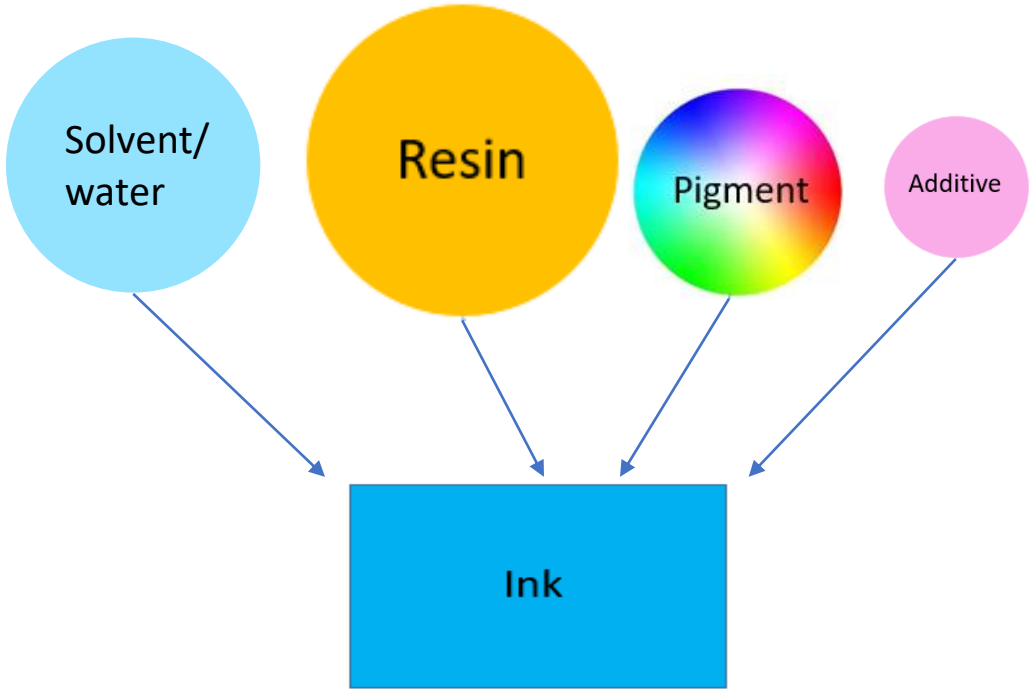
- Composition of inks and drying processes
- UV ink ingredients
- Printing technologies
- Different types of printing presses
- Substrate interactions
- Summary

What is an ink?

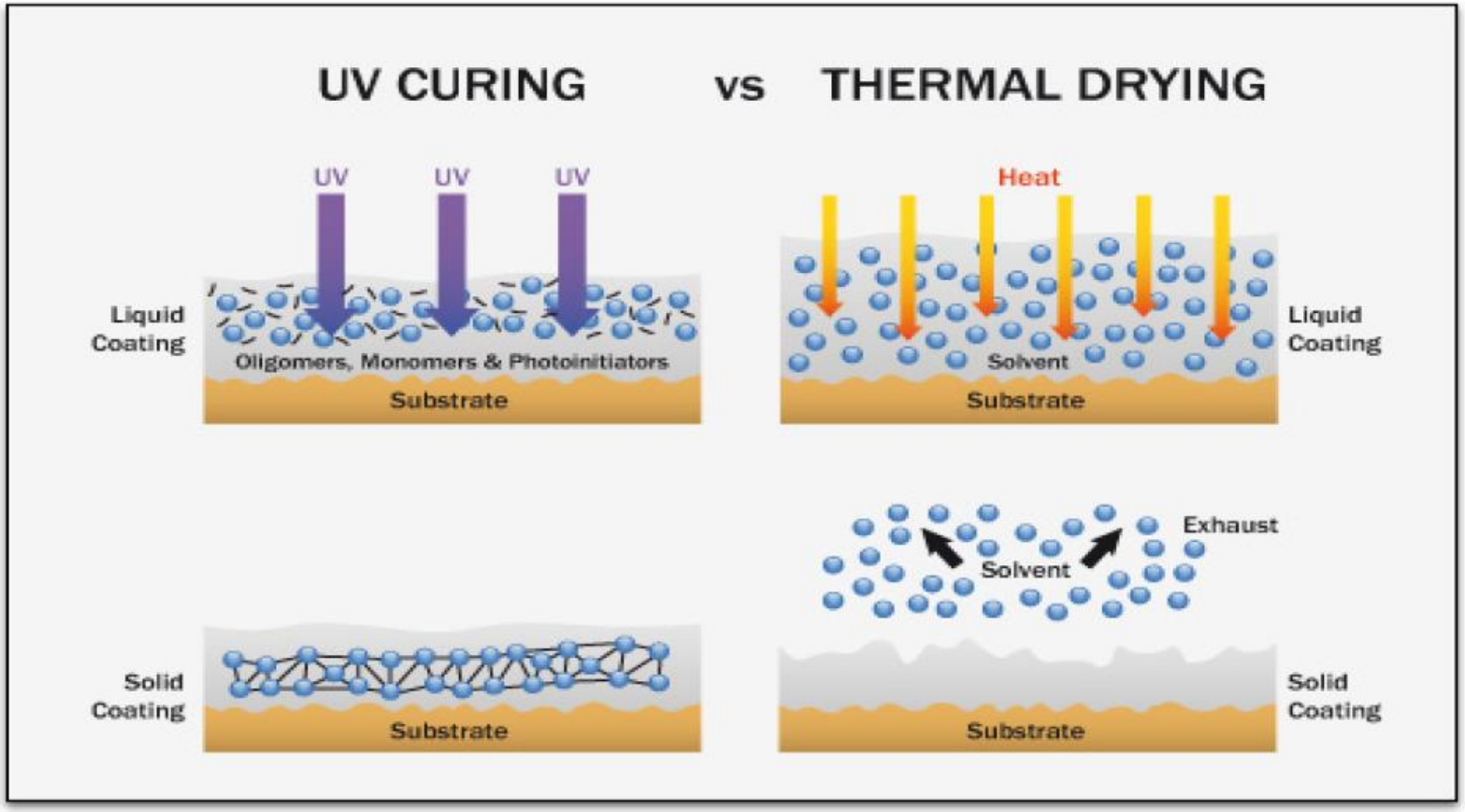
- An ink is a liquid which after a drying process becomes a solid film that covers a surface
  - Used to create different types of images
- A varnish or coating is also a liquid which after drying becomes a solid film, however it is transparent

Composition of inks

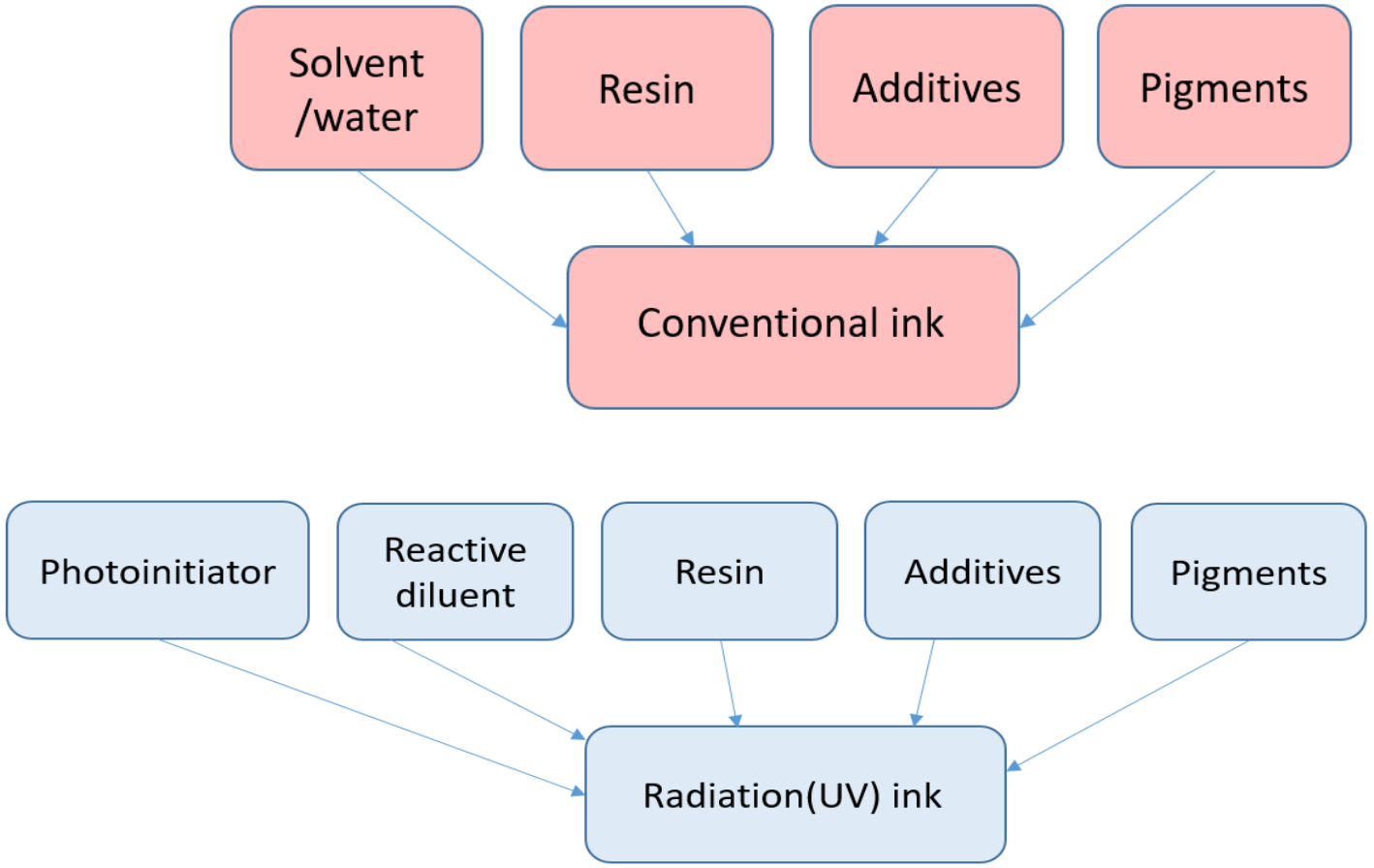
- Different Chemistry of inks
  - UV
  - Waterborne
  - Solventborne
  - Oil



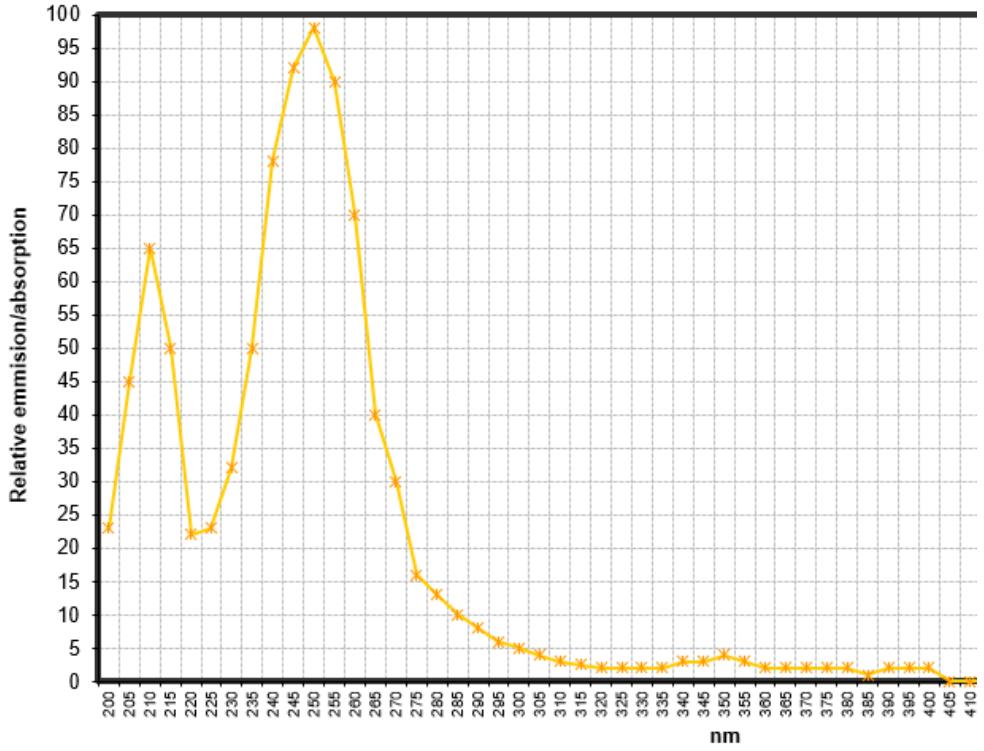
Drying mechanisms



Composition differences



Comparing LED with mercury(Hg)



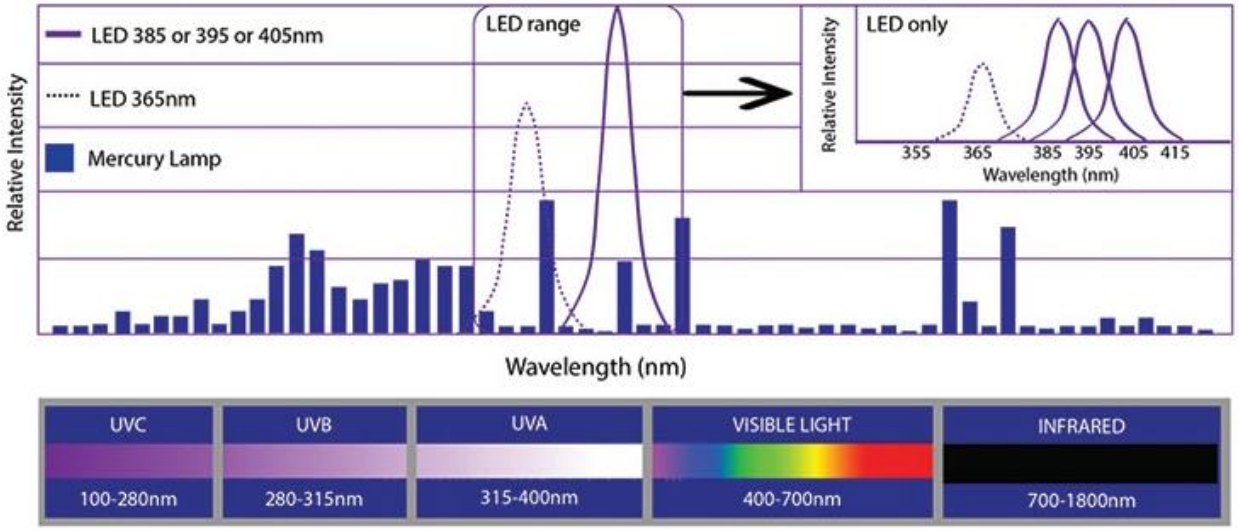
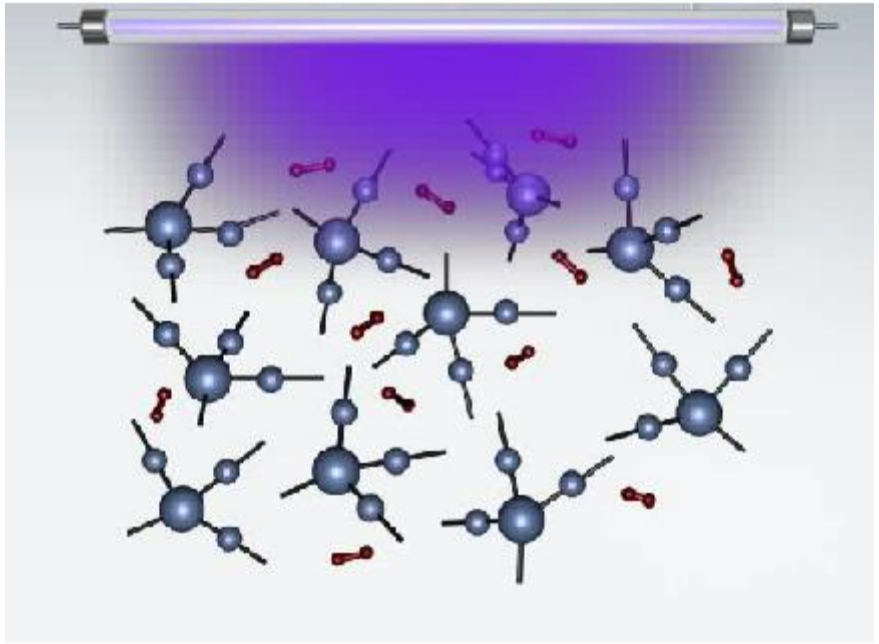


Image source: Phoseon

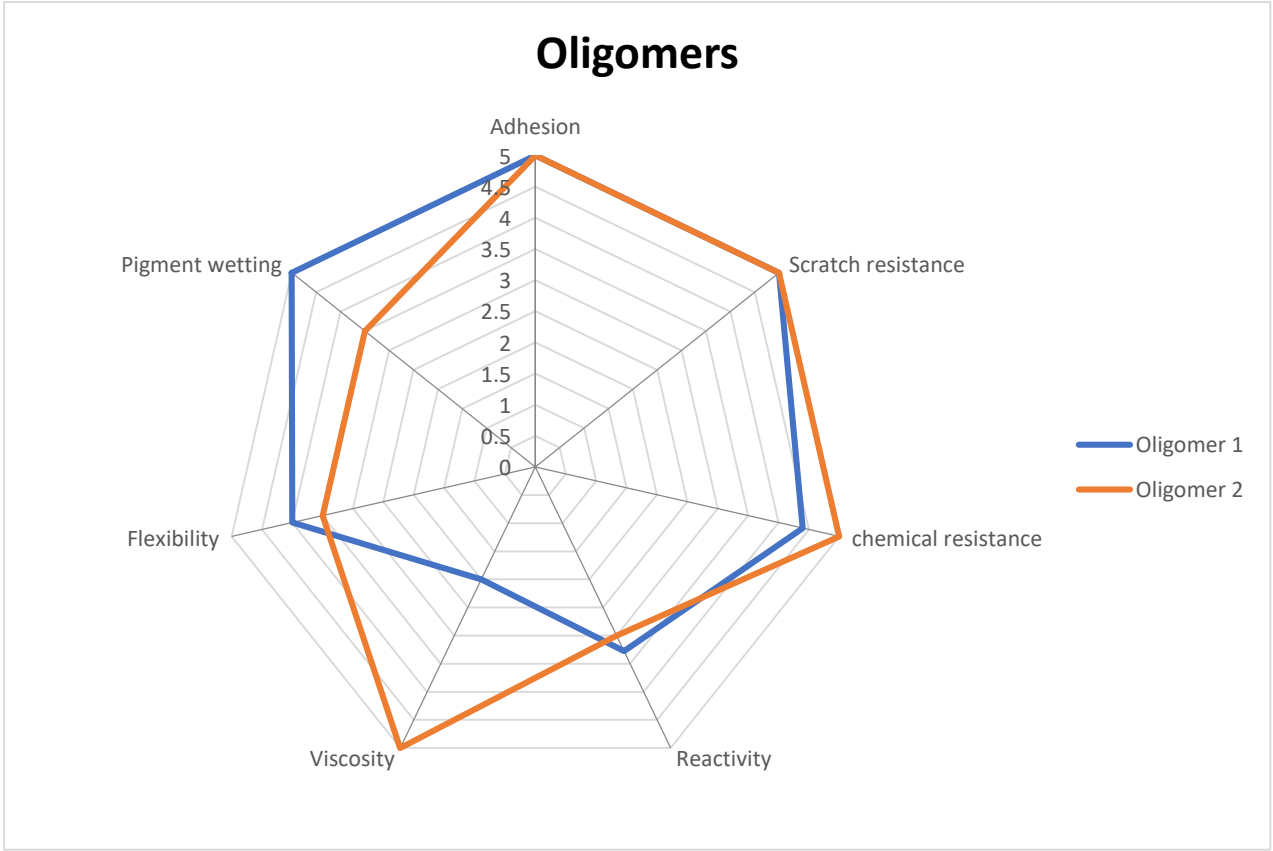
Photoinitiators

- Generates free radicals which is key for the UV-curing process
- Choice of photoinitiator blend is very important for the system



Oligomers (resins)

- Creates the backbone of the UV ink system
- Wide range of Oligomers
  - Urethane acrylates
  - Polyester acrylates
  - Epoxy acrylates
- Wide range of properties
  - Pigment wetting
  - Chemical resistance
  - Scratch resistance
  - Reactivity

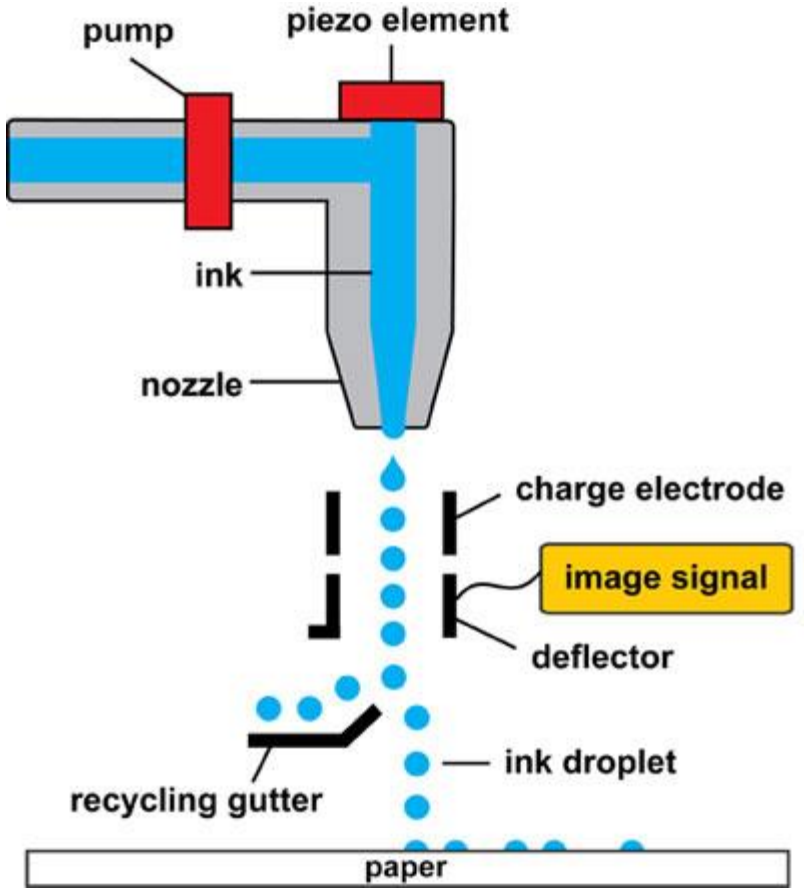


Acrylate monomers

- Low molecular weight reactive compounds
- Used mainly for viscosity control
- Affects end performance

Contact printing/ non contact printing

- Contact printing
  - ink is pressed onto a substrate
- Non contact printing
  - ink is ”sprayed” onto the substrate
  - inkjet printing



Contact printing methods

- Several different print methods
  - applying different ink film thicknesses

Offset Litho 1,2-1,5

Letterpress 1,8-2,5

Flexo 2-4

Gravure 6 - 10

Screen 8 - 10

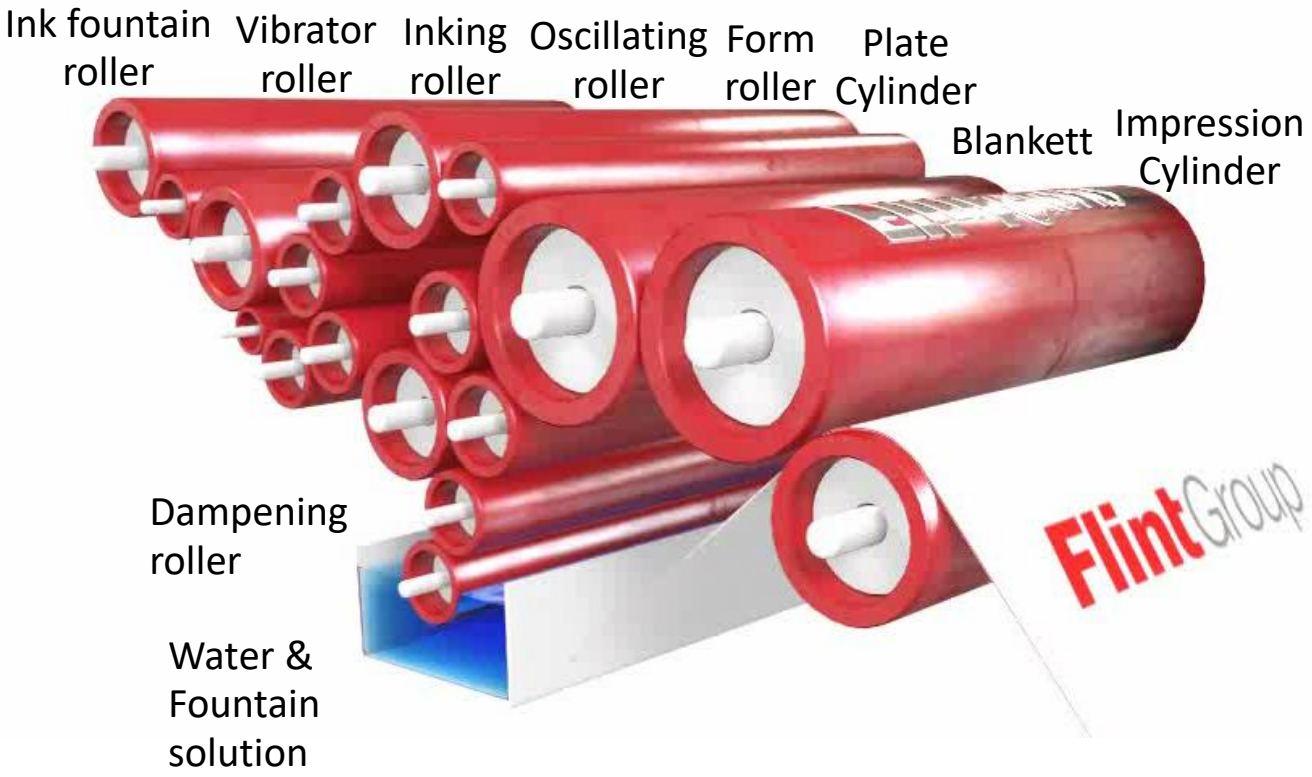
Overview methods and ink

Print method	Ink type			
	Solvent	Water	Oil	UV
Flexo	X	X	–	X
Letterpress	–	–	X	X
Offset	–	–	X	X
Screen	X	–	–	X
Gravure	X	(X)	-	-

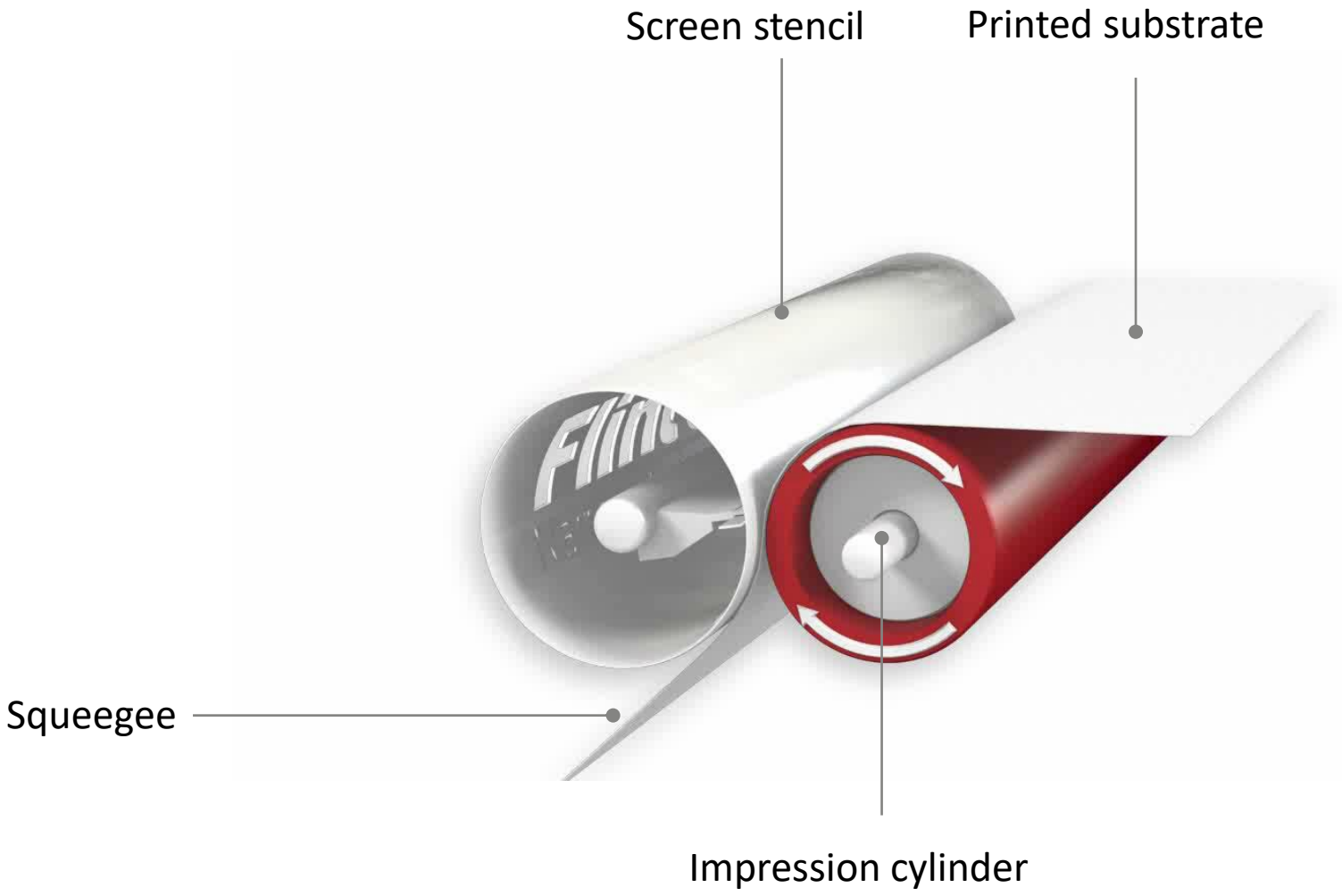
Gravure

- Produces a print from an engraved cylinder
- Traditionally been the higher quality of flexible packaging printing
- Printing speeds are typically between 120 m/min to up to 300 m/min
- 10 printing stations all in a row
- Each printing station is able to print one colour perfectly on it’s own

Offset



Rotary screen



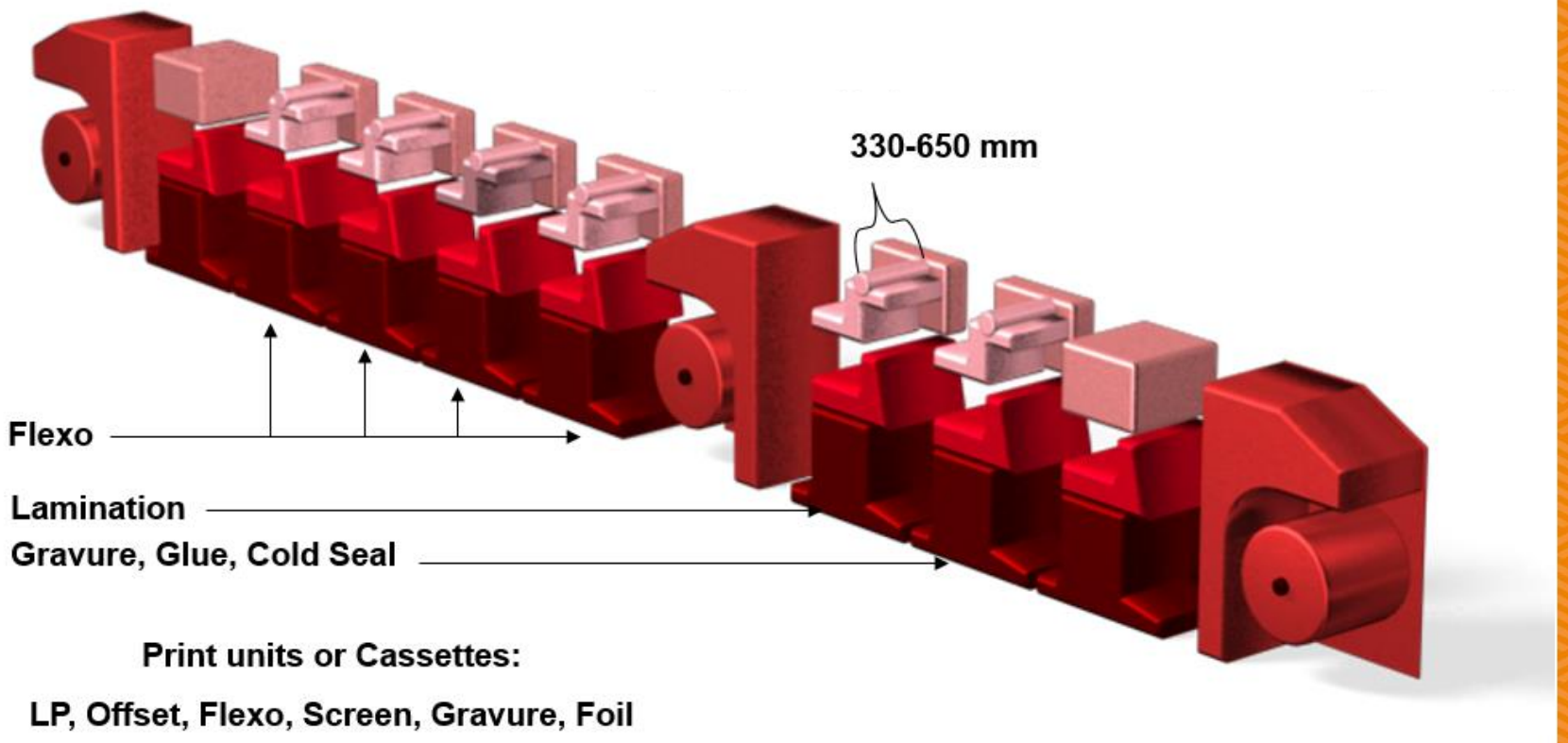
Flexography

Wide web press

- A typical flexo press has between 8-10 print units
- Most printers have at least one of these presses
- Larger print houses may have several

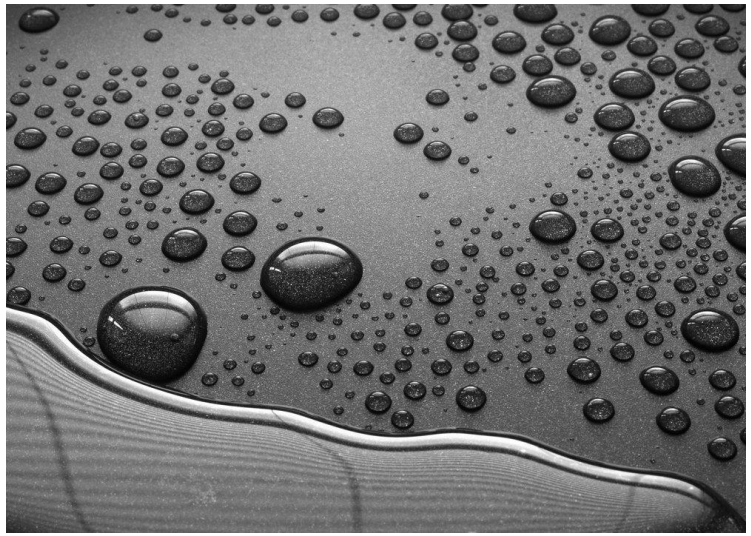
Narrow web

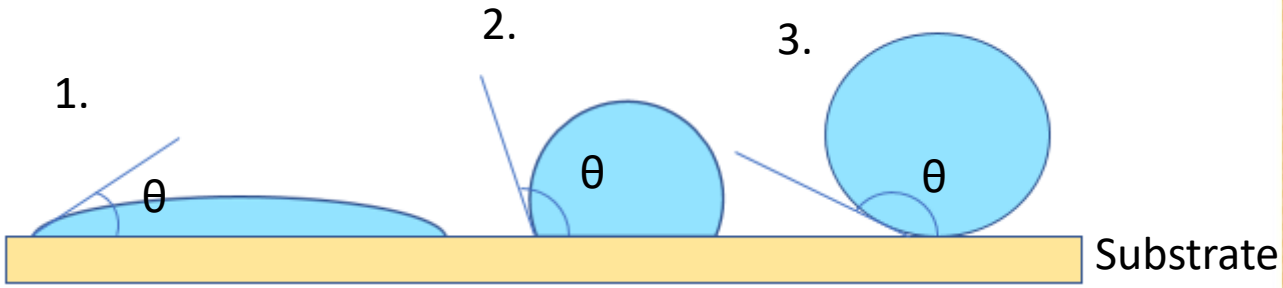
- Flexibility and efficiency
- Handles a broad range of substrate thicknesses



Surface tension basics

- Wettability depends on the surface energy measured in dynes/cm (mN/m)
- Once the droplet comes in contact with the substrate a contact angle θ arises
- Surface energy of the substrate > liquid → situation 1
  - Contact angle θ<60° leads to good surface wettability
- Surface energy of the substrate < liquid → situation 3
  - Poor wettability can lead to several problems with adhesions, flowout and pinholes





Surface tension basics

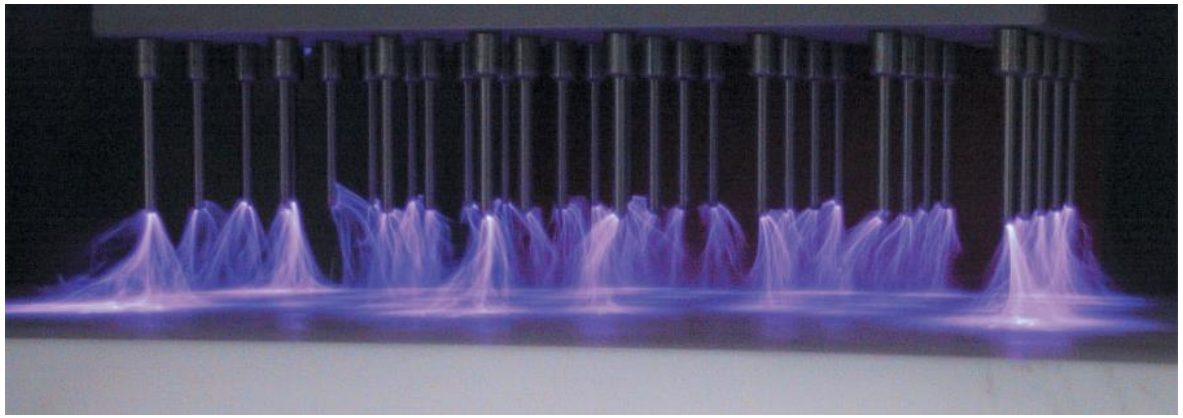
- Untreated common materials (30 Dyne/cm)
- Common acrylates (35 Dyne/cm)
- Solutions for increasing the surface energy of the substrates
  - Top coatings (PPTC)
  - Corona treatment

Material - untreated	Surface energy (Dyne/cm)
Polypropylene (PP)	29
Polyethylene – Low density (PE-LD)	31
Polyethylene – High density (PE-HD)	32
Biaxial oriented polypropylene (BOPP)	32

Acrylate monomer	Abbreviation	Surface energy (Dyne/cm)
Tripropylene glycol diacrylate	TPGDA	34
Hexanediol diacrylate	HDDA	36
Dipropylene glycol diacrylate	DPGDA	35
Trimethylolpropane triacrylate	TMPTA	38

Corona treatment

- Substrate is exposed to free electrons
  - Changes the polarity of the substrate
  - Changes chemical groups at the surface – Hydrogen bonding
- Waterbased and UV products have no substrate ”attack” and these chemical interactions become very important



Summary

- Four types inks – Solventborne, waterborne, oil and UV
- Drying processes – Spagetti is everywhere!
- Four main building blocks for inks, five for UV
- Contact and non contact printing
- Wide web, Mid web and Narrow web presses
- Surface energy is important for adhesion

Thank you for you attention!
Any questions?