WATERBORNE POLYURETHANE DISPERSIONS FOR INKJET PRINTING

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Outline

- Conventional Inks versus EC inks
- Current offerings
- What the next generation products need
- Next Generation materials
- Results
- Conclusions

(WB) UV/EB TECHNOLOGY IN INKJET INKS

	Conventional	UV/EB (EC)
Content	Polymer/Colorants/Additives/ Solvent* or Water	Acrylated Resins/Colorants/Additives Monomers/(PI)
PROs	• Known chemistry • Adhesion on substrates (solvents) • Initial investment	• Very rapid curing • Improved quality (resolution & color strength) • Low VOC • Better resistance properties
CONs	• Low speed • Lower resolution & color • Poorer resistance properties • VOC*	• Very opaque inks don't cure easily • Migration risk Food Packaging: ~~Monomers~~/(PI fragments) • ~~Odor~~

Waterborne UV/EB Technology - Best of Both Worlds?

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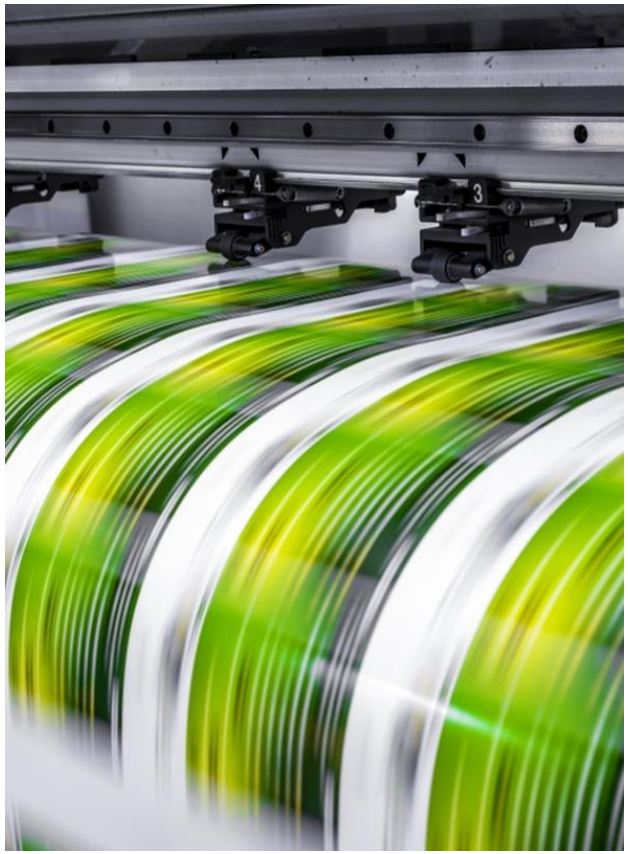
The Coating Resins Company

WATERBORNE EC PRODUCTS FOR INKJET INKS



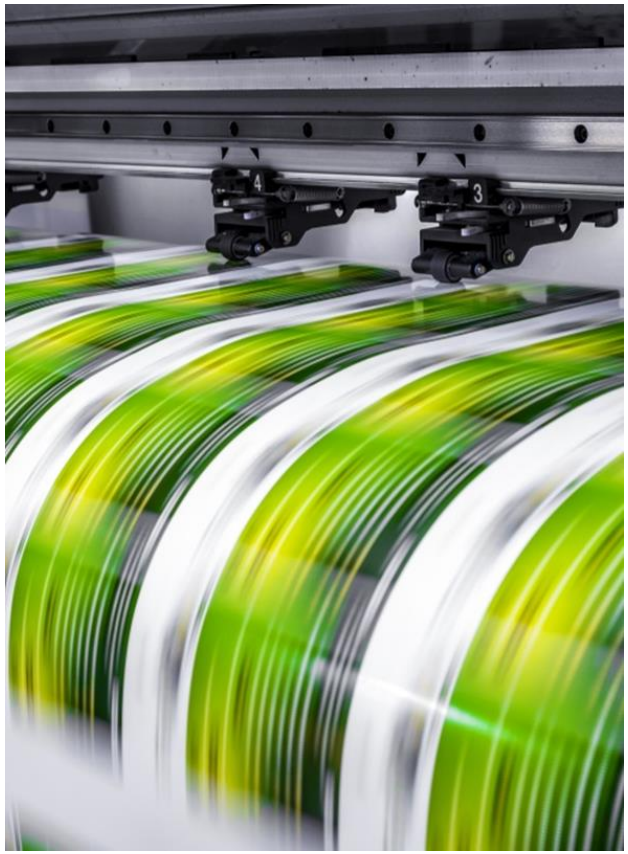
	Tack-free	Resolubility	Label-free	BPA-free	Tin-free	Low Migration
UCECOAT® 2801						
UCECOAT® 2802						
UCECOAT® 2803						

- Recommended use
- Fair use
- Not recommended

STRATEGY FOR NOVEL LOW MIGRATION EC PUDs

1. • Eliminate chemicals of concern (Sn, BPA, APEO, solvent …)
2. • Maximize acrylates with Mw >500 Daltons AND Functionality ≥ 6
3. • Control composition for specific requirements (ex: resolubility)
4. • Validate low migration and [indirect] food contact compliance

WATERBORNE EC PRODUCTS FOR INKJET INKS



	Tack-free	Resolubility	Label-free	BPA-free	Tin-free	Low Migration
UCECOAT® 2801	Not recommended	Recommended use	Recommended use	Recommended use	Recommended use	Fair use
UCECOAT® 2802	Not recommended	Recommended use	Recommended use	Recommended use	Recommended use	Fair use
UCECOAT® 2803	Not recommended	Recommended use	Recommended use	Not recommended	Recommended use	Fair use
UCECOAT® 2804	Recommended use	Recommended use	Not recommended	Recommended use	Recommended use	Recommended use
UCECOAT® 2805	Recommended use	Recommended use	Recommended use	Recommended use	Recommended use	Recommended use
UCECOAT® 2806	Not recommended	Recommended use	Not recommended	Recommended use	Recommended use	Recommended use
UCECOAT® 2807	Recommended use	Recommended use	Recommended use	Recommended use	Recommended use	Recommended use

Recommended use Fair use Not recommended

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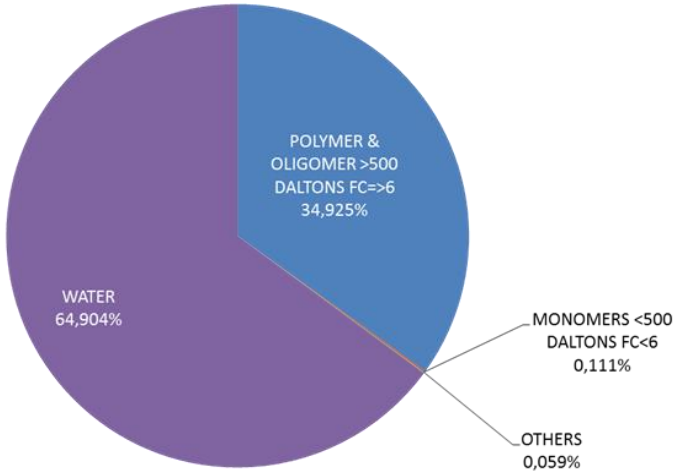
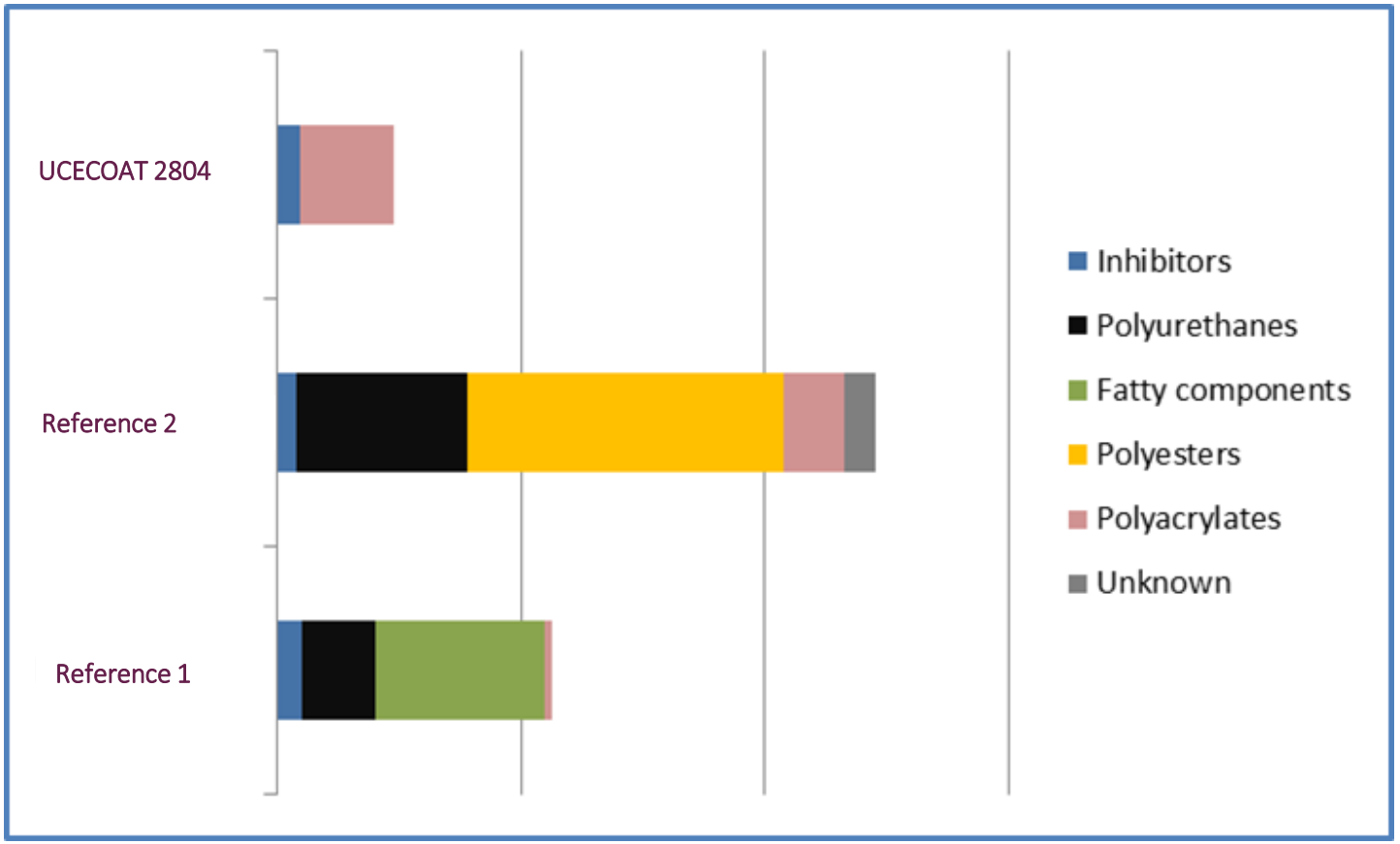


UCECOAT 2804 is > 99.5% (solids) of MW > 500 *and* Functionality >/= 6

VALIDATION OF LOW MIGRATION EC PUD



normalized extraction data (ppb levels) based on combined GC-MS and LC-MS area of screened ions (response factors different between products)

UCECOAT 2804 Shows Favorable Migration Data

MAIN TECHNICAL REQUIREMENTS FOR INKJET INKS

1 INK STABILITY

- Time evolution at elevated temperature (45-60°C) of viscosity, pH, particle size, coagulum

2 INK FILTERABILITY

- Capacity to be filtered efficiently for good nozzle flow in the print head

3 INK JETTABILITY

- Consistency of droplets formation at the nozzles as a function of rheology and surface tension

4 INK RESOLUBILITY

- Resolubility of the dry ink in water to reduce drying & clogging of the print head nozzles

5 INK REACTIVITY

- Curing speed and effectiveness to provide full ink performance with usual or LED cure

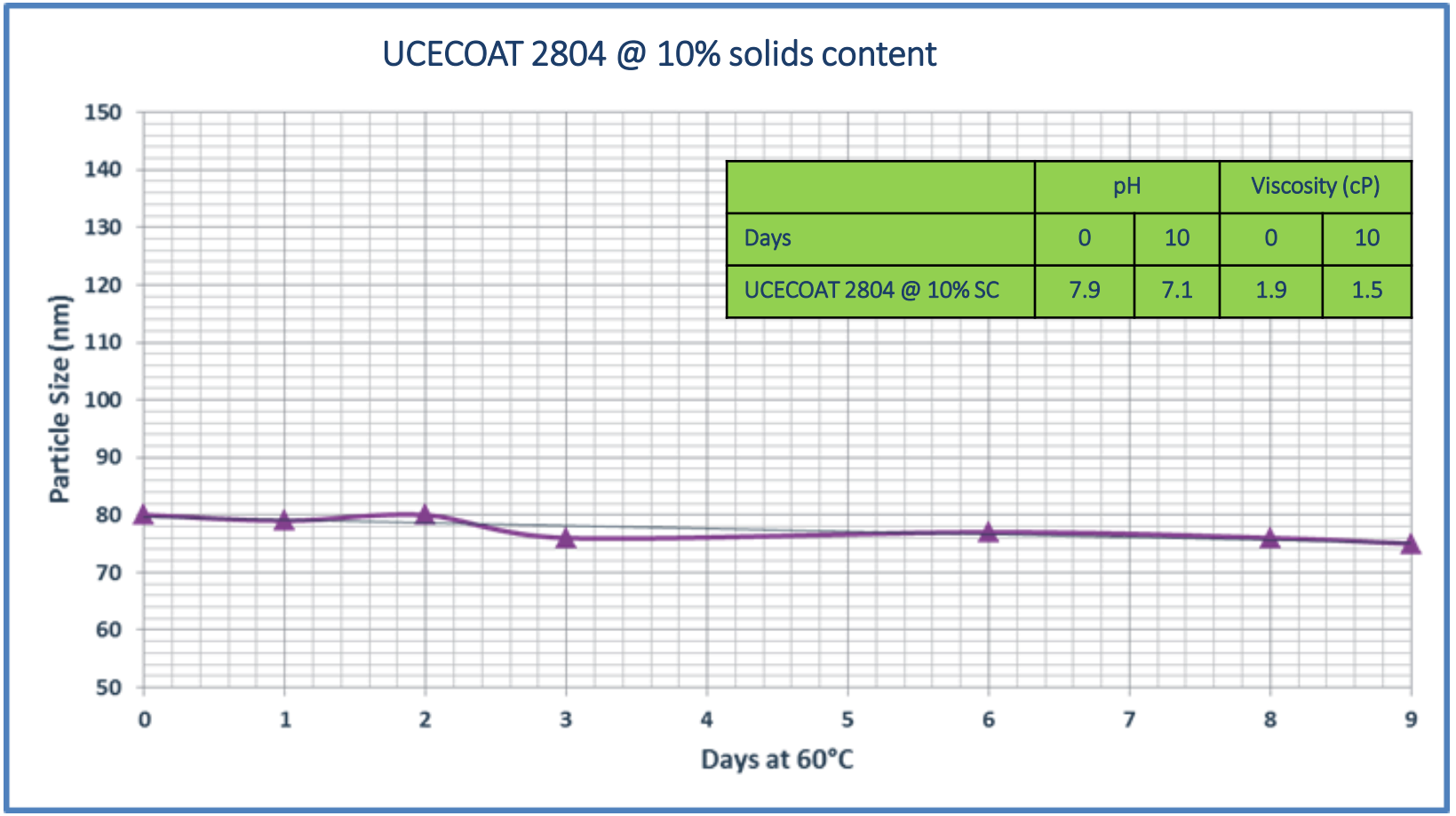
6 INK ADHESION

- Adhesion to substrates in relation with ink shrinkage upon cure

7 INK RESISTANCE

- Mechanical and chemical resistance of the printed material under intended usage

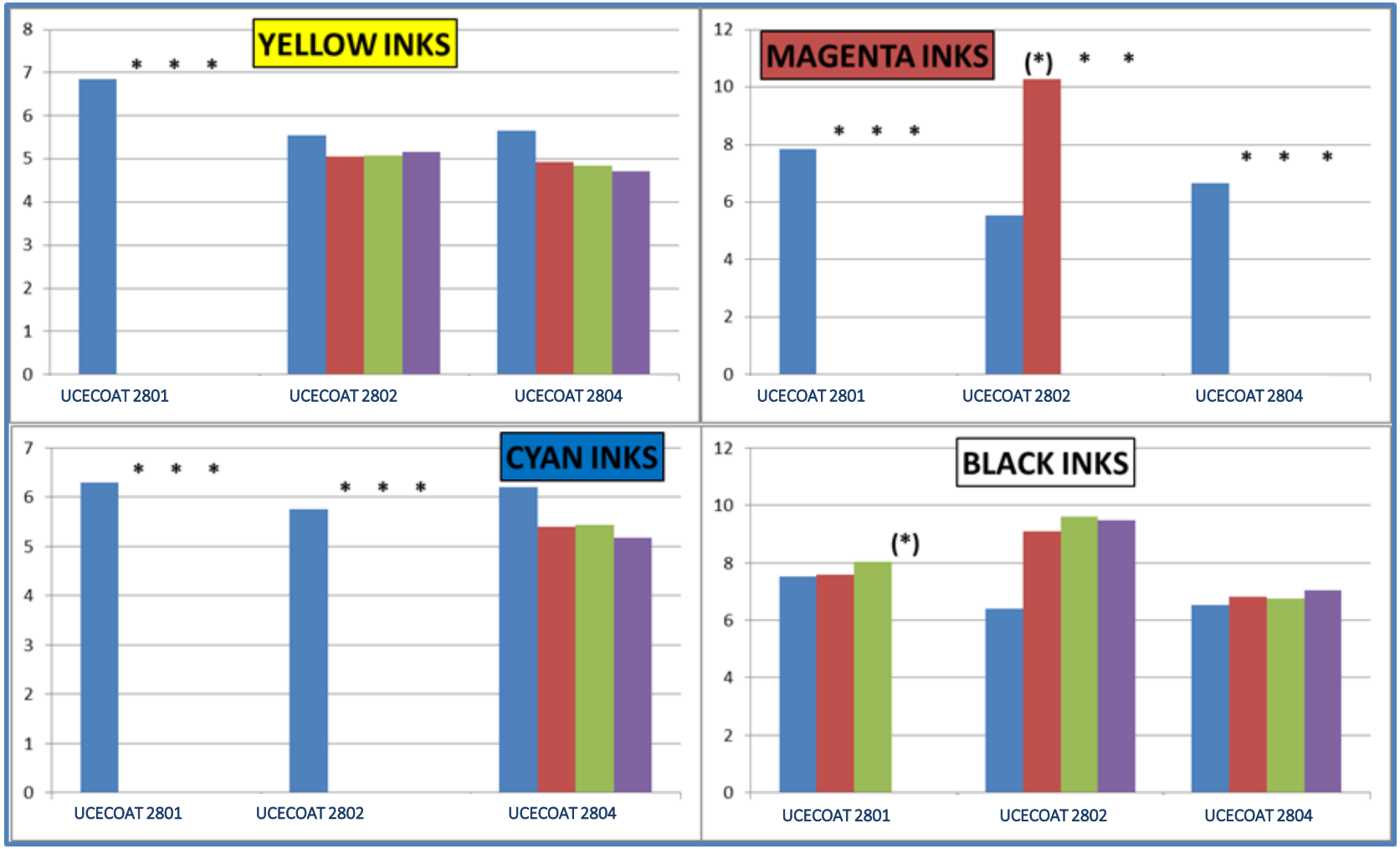
STABILITY REQUIREMENTS FOR INKJET INKS



	pH		Viscosity (cP)	
Days	0	10	0	10
UCECOAT 2804 @ 10% SC	7.9	7.1	1.9	1.5

Evolution of Mean Particle Size, pH, and Viscosity at 60°C for UCECOAT 2804 at 10% Solids Content → Stable

STABILITY REQUIREMENTS FOR INKJET INKS



* = sedimentation

Viscosity Evolution of UCECOAT Inkjet Inks at 50°C
at 0, 2, 4 and 6 weeks: Some are Stable

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SPF FOR CMYK INKJET INKS: FILTERABLE AND JETTABLE

Step 1 : Prepare Pigment dispersion	
Water	13.85
Pigment wetting agent	2.00
Defoamer	0.10
Biocide	0.05
Pigment	4.00

Step 2 : Add the following letdown to the pigment dispersion	
UCECOAT 2804	24.00
Water	32.90
Propylene glycol	19.00
Substrate wetting agent	0.10
Surface tension modifier	1.00
Photoinitiator	3.00

All CMYK inks could be Filtered, and Jetted on Dimatix disposable piezo print heads

RESOLUBILITY REQUIREMENTS FOR INKJET INKS

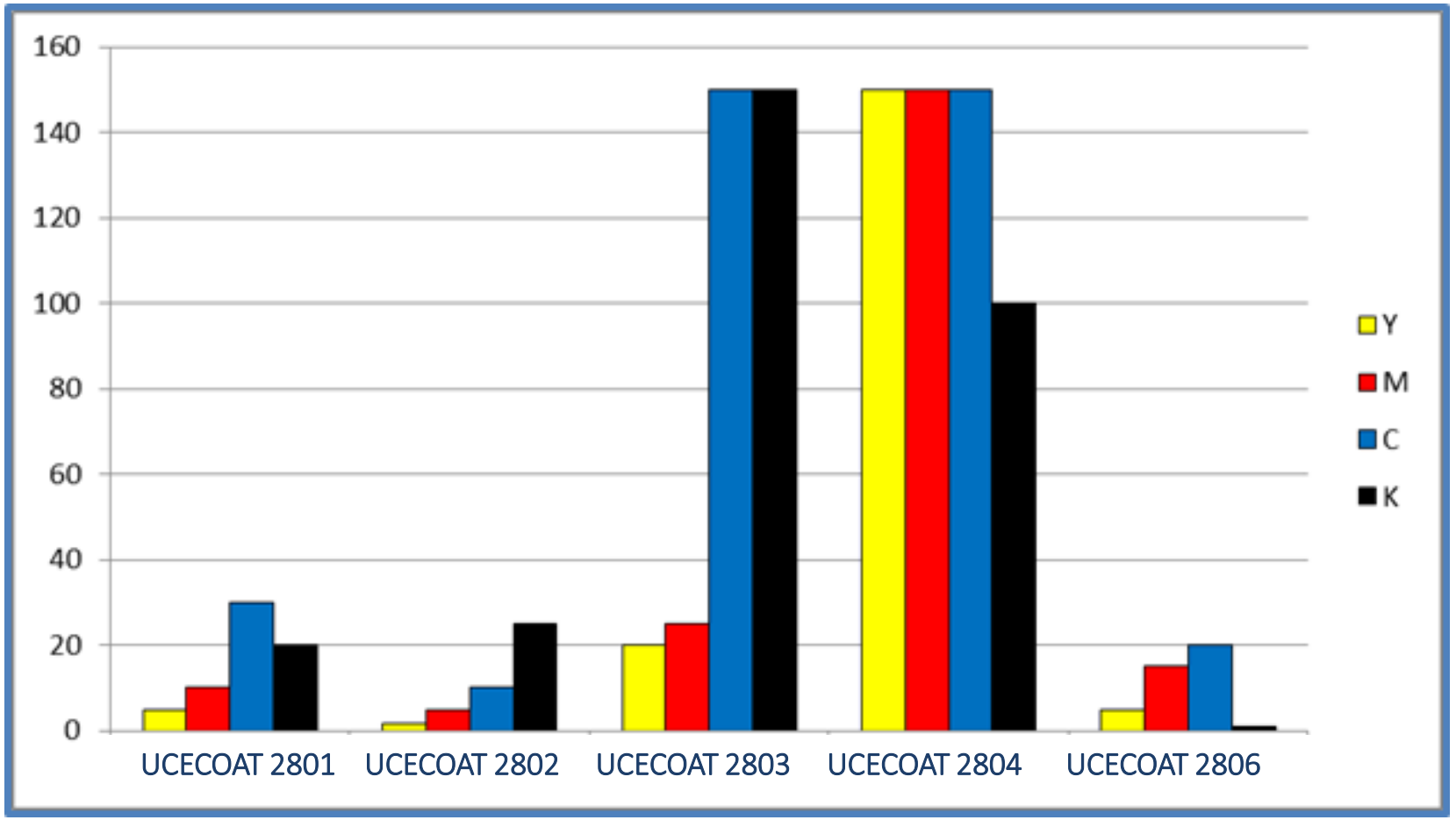
UCECOAT 2804

UCECOAT 2806, UCECOAT 2801,
UCECOAT 2802

All Inks are Resoluble After Dry, but Before Energy Cure
1 minute @ RT in water
(proprietary pigmented product formulation)

REACTIVITY REQUIREMENTS FOR INKJET INKS

Hg Lamp Cure: 5 µ coating; highest line speed (m/min) for dry surface



UCECOAT 2804 is Fastest Curing UV PUD

REACTIVITY REQUIREMENTS FOR INKJET INKS

UV LED Lamp Reactivity

- 395 nm; 16 watt/cm^2
- 5 µ clear coating
- highest line speed for mar free surface

- TPO-L and BAPO at 1.5 – 7% levels
- Maximum 12 fpm cure speed
- More work to be done in this area
  - Evaluate other photoinitiators

UV LED Cure Speed of EC PUDs Needs to be Improved

ADHESION REQUIREMENTS FOR INKJET INKS

Adhesion determined on corona treated substrates for EC PUDs in 4 colors
(Tape pull with TESA 4104)
Inks cured at 3 x 30 m/min; 140 W/cm Hg lamp

	UCECOAT 2801	UCECOAT 2802	UCECOAT 2803	UCECOAT 2804	UCECOAT 2806
PP C58					
LDPE					
PET 45 µm					
PVC					
PET RNK					
OPP NND					
PC					

Darker dot means better adhesion – no dot, no adhesion

Adhesion varies by Substrate, UCECOAT, and Color

ADHESION REQUIREMENTS FOR INKJET INKS

Adhesion determined on untreated substrates for UCECOAT clear coats
Cured at 12 fpm; 395 nm, 16 watt/cm² UV LED lamp

Substrate	Tape #	UCECOAT 2807	UCECOAT 2804	UCECOAT 2806	UCECOAT 2801	UCECOAT 2802	UCECOAT 2803
PC	600	100	100	30	80	100	50
	610	90	100	100	90	90	100
Rigid PVC	600	100	100	100	100	100	100
	610	100	100	100	100	100	100
White PE	600	0	100	100	20	30	0
	610	95	100	100	100	100	90
HIPS	600	100	100	100	100	100	100
	610	100	100	100	100	100	100
White PP	600	100	100	50	0	0	10
	610	100	100	100	100	50	100
PET	600	100	100	100	0	100	80
	610	80	100	90	90	90	100
Average Adhesion		88.8	100	89.2	73.3	80	77.5

Adhesion Indicates Good Through Cure with UV LED Lamps

CONCLUSIONS & OUTLOOK

- Waterbased EC inkjet inks are an alternative to both waterborne inkjet inks and 100% solids EC inkjet inks, and bring multiple benefits over the other technologies.
- UCECOATs can be designed to provide low migration and low extractables, and this provides the potential to formulate waterbased EC inkjet inks and coatings for food packaging.
- Inkjet inks based on UCECOATs meet the basic technical requirements of inkjet inks.
- This new inkjet technology requires innovations in formulation know how in order to fine tune the properties of the CMYK inks.
- There is a broad range of UCECOATs designed specifically for inkjet inks, and these can be combined to obtain various properties

THANK YOU FOR YOUR ATTENTION!

Questions?

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