
Novel
Functionalization
Technologies
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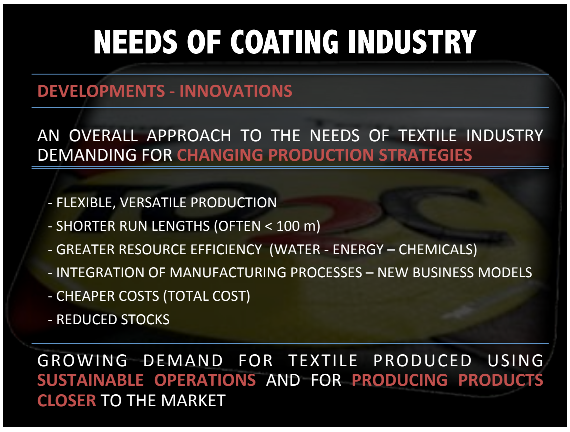
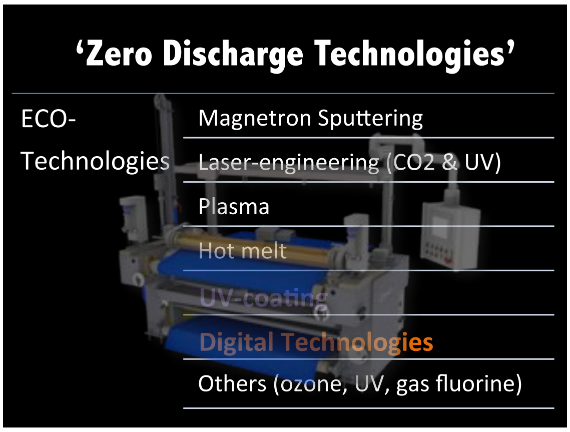
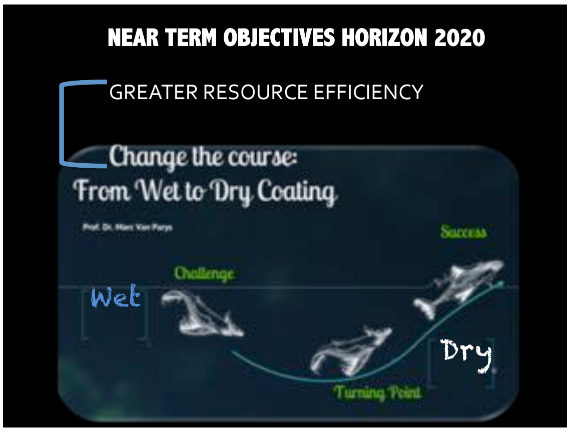
Euratex- Brussels
UNITEX


TEXTILE
INDUSTRY
FEELING MORE PRESSURE

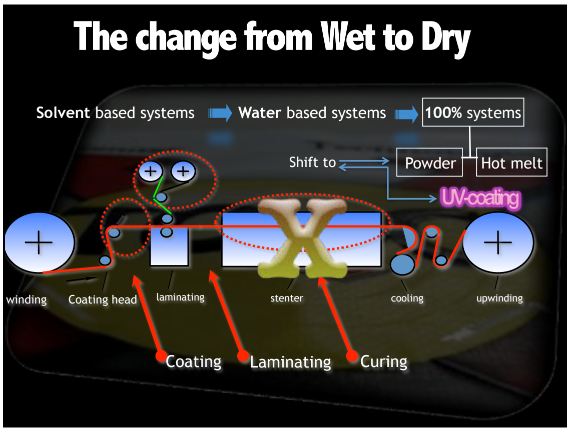

NEEDS OF COATING INDUSTRY
DEVELOPMENTS - INNOVATIONS
AN OVERALL APPROACH TO THE NEEDS OF TEXTILE INDUSTRY DEMANDING FOR CHANGING PRODUCTION STRATEGIES
- FLEXIBLE, VERSATILE PRODUCTION
- SHORTER RUN LENGTHS (OFTEN < 100 m)
- GREATER RESOURCE EFFICIENCY (WATER - ENERGY – CHEMICALS)
- INTEGRATION OF MANUFACTURING PROCESSES – NEW BUSINESS MODELS
- CHEAPER COSTS (TOTAL COST)
- REDUCED STOCKS
GROWING DEMAND FOR TEXTILE PRODUCED USING SUSTAINABLE OPERATIONS AND FOR PRODUCING PRODUCTS CLOSER TO THE MARKET

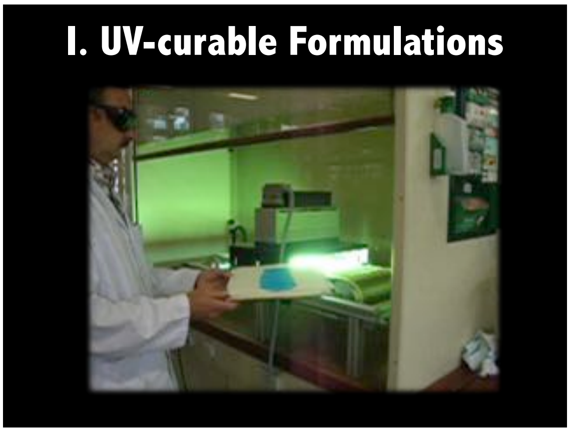

also
We can make a
DIFFERENCE by...
New technologies

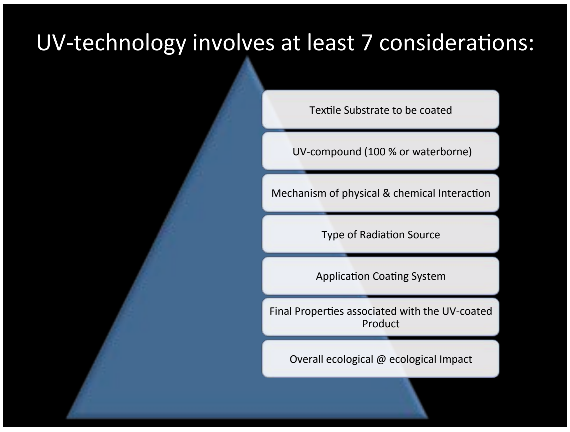

'Zero Discharge Technologies'
ECO-
Technologies
Magnetron Sputtering
Laser-engineering (CO2 & UV)
Plasma
Hot melt
UV-coating
Digital Technologies
Others (ozone, UV, gas fluorine)

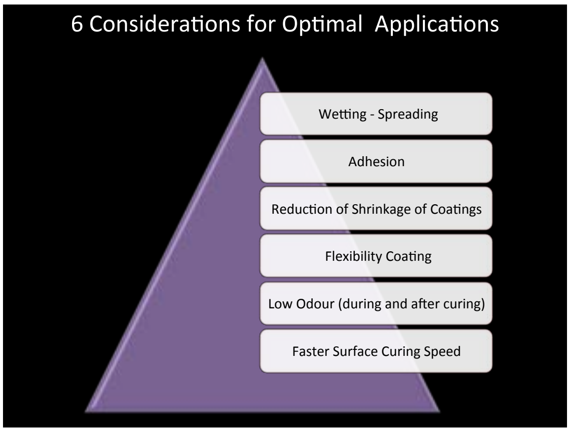

NEAR TERM OBJECTIVES HORIZON 2020
GREATER RESOURCE EFFICIENCY
Change the course:
From Wet to Dry Coating
Success
Challenge
Wet
Dry
Turning Point

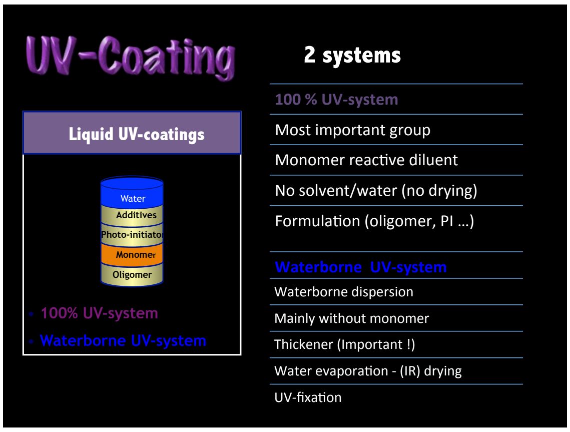

I. UV TECHNOLOGIES
TO2C

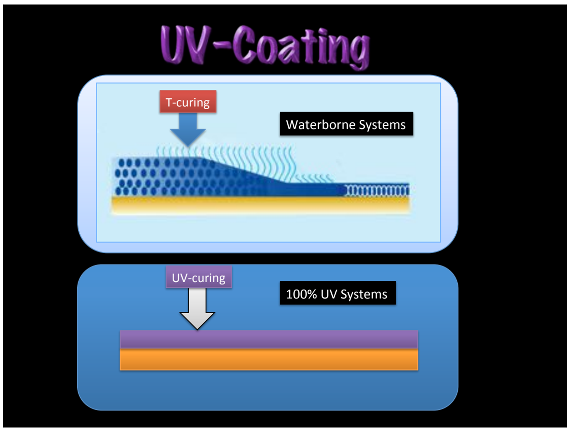

The change from Wet to Dry
Solvent based systems
Water based systems
100% systems
Shift to
Powder
Hot melt
UV-coating
winding
Coating head
laminating
stenter
cooling
upwinding
Coating
Laminating
Curing

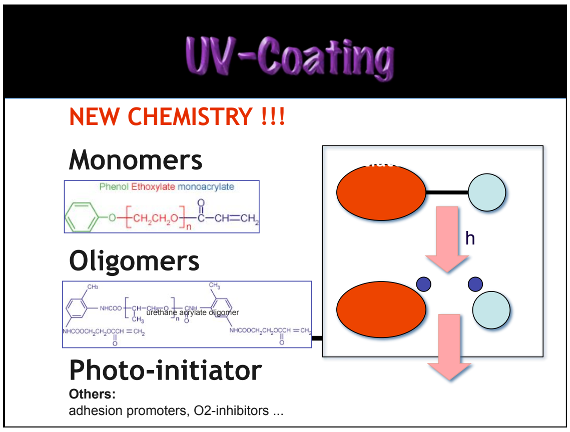

I. UV-curable Formulations

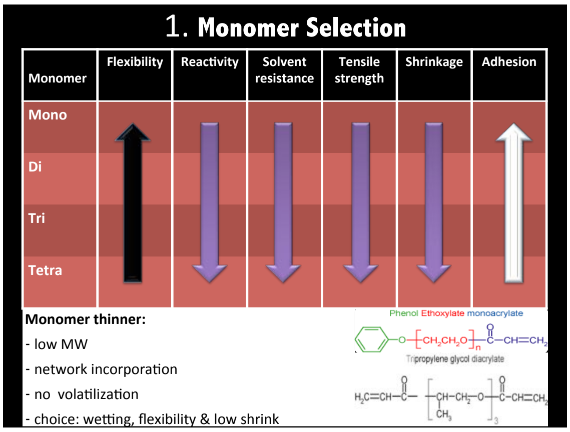

UV-technology involves at least 7 considerations:
Textile Substrate to be coated
UV-compound (100 % or waterborne)
Mechanism of physical & chemical Interaction
Type of Radiation Source
Application Coating System
Final Properties associated with the UV-coated Product
Overall ecological @ ecological Impact

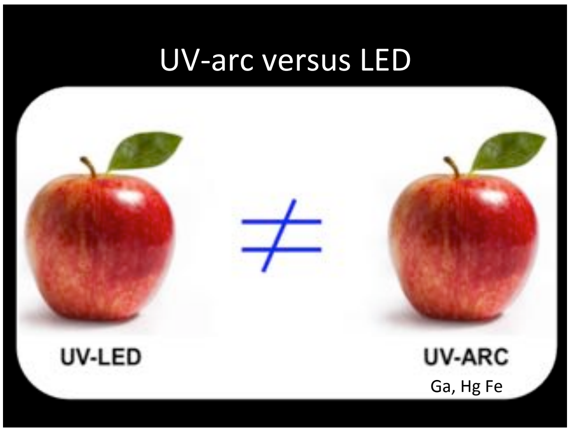

6 Considerations for Optimal Applications
Wetting - Spreading
Adhesion
Reduction of Shrinkage of Coatings
Flexibility Coating
Low Odour (during and after curing)
Faster Surface Curing Speed

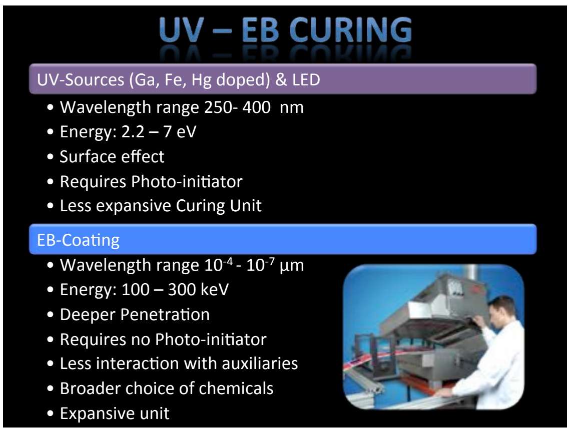

UV-Coating
2 systems
Liquid UV-coatings
Water
Additives
Photo-initiato
Monomer
Oligomer
100% UV-system
Waterborne UV-system
100 % UV-system
Most important group
Monomer reactive diluent
No solvent/water (no drying)
Formulation (oligomer, PI …)
Waterborne UV-system
Waterborne dispersion
Mainly without monomer
Thickener (Important !)
Water evaporation - (IR) drying
UV-fixation



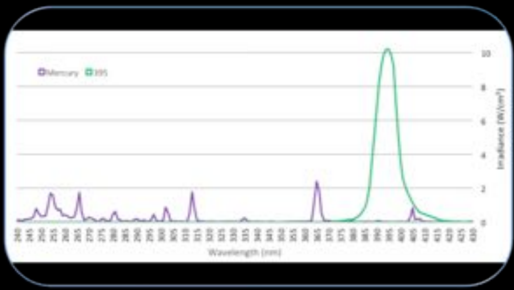




| BENEFITS | | FEATURES |
|---|---|---|
| ADVANCED CAPABILITIES | LED | Heat-sensitive thin substrates<br>Deep, through curing<br>Small compact units<br>Controlled curing intensity |
| OPERATING ECONOMICS |  | Energy efficient<br>Long lifetime<br>Simplified maintenance<br>Increased Yields<br>Low Operating temperatures<br>Instant 100% availability with on and off mode<br>Power adjustable in a linear way (between 0 and 100%) |
| ENVIRONMENTAL BENEFITS |  | Mercury free<br>Ozone free<br>Workplace safety<br>UV-A wavelength |

## PI UV-arc versus LED

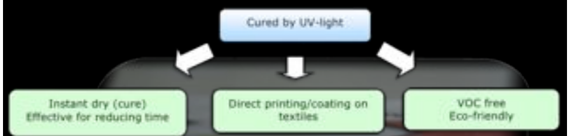



Source:IST-D

## Potential Problems <-> Challenges

- Monomers are not always completely cured due to relative large amount in formulation & possible penetration in fibres (100% systems)
- Diffusion hindered Pis are needed to mitigate handling/healthy risks
- Screen effects hinder optimal curing
- Smell & odour problem
- Eye and skin iritation (HDDA, TPGDA acrylate ...)
- Enchancing shrinkage process (-> internal stress in the support –> curling or poor adhesion)
- Adhesion Problems on PO ...

## UV-curable Coating (100%)




| Ink composition UV-lacquer TRASPARENT | % by weight |
|---|---|
| Butyl acrylate esters | 40-50 |
| HDODA | 15-20 |
| GPTA | 2 |
| Acrylate ester | < 5 |
| Mix of phosphine oxides PIs1 | 8-10 |
| Amine synergist (acrylated) | 10 |

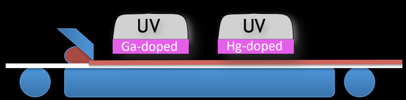
Info:
UV-curing device
LED 395 nm
(IST)

## CONCLUSION: WHY UV?

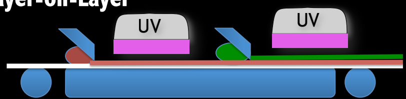
| Advantages | Disadvantages |
|---|---|
| No solvent = inflammable | Relatively expensive chemicals |
| **Little energy** required | Monomers/oligomers |
| Fast drying/curing<br>No drying untill UV exposed | UV can cause burns - avoid skin contact |
| High production speeds | Ozone generation |
| **Thermosensitive Fibres** | (low flexibility) |
| Little space required | Unknown Technology (for most) |
| Relatively low equipment cost<br>- Less space requirements<br>- Modular - implementation in existing coating line | Adhesion problems on some substrates (but can be solved) |

## UV-Technology

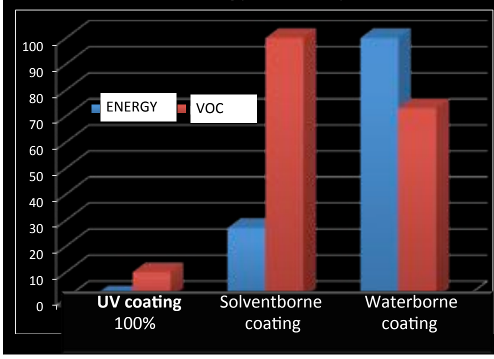
- **Thicker Coatings**

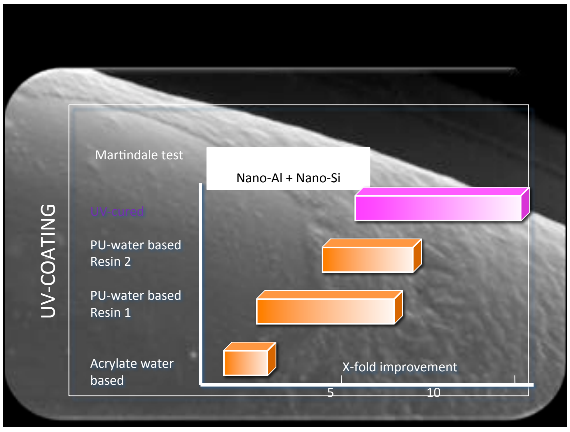


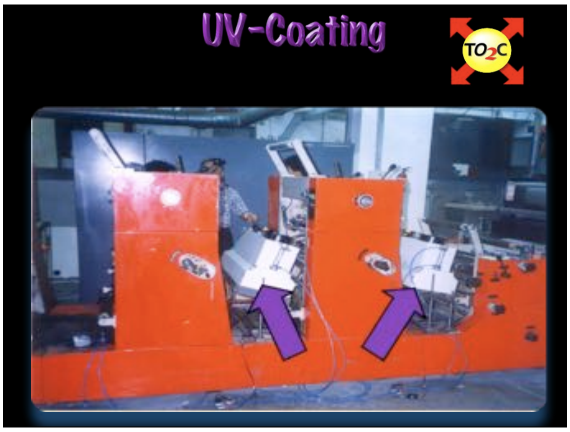

- **Layer-on-Layer**

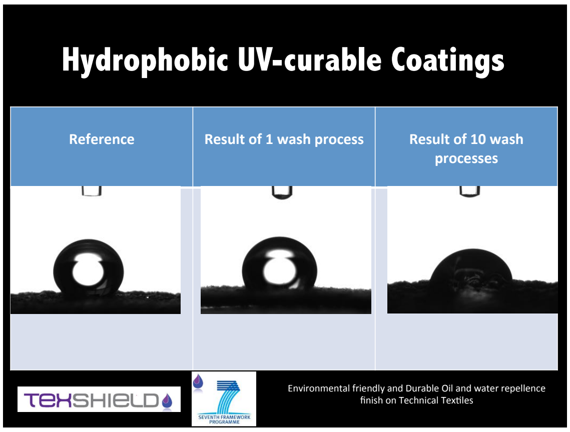


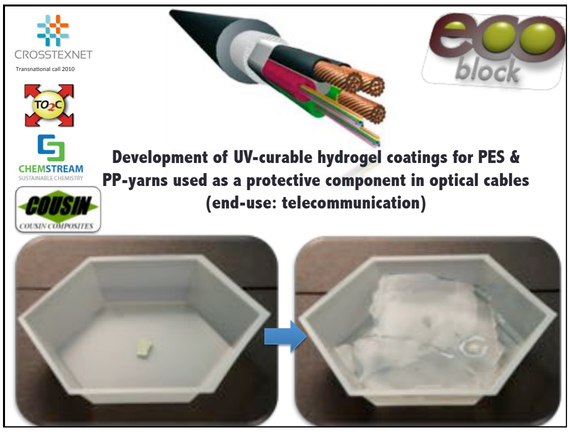

## UV versus Solventborne & Waterborne Coatings on level of Energy Consumption and VOC's

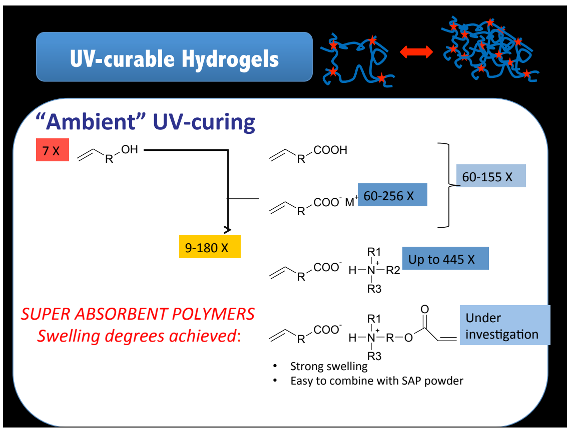


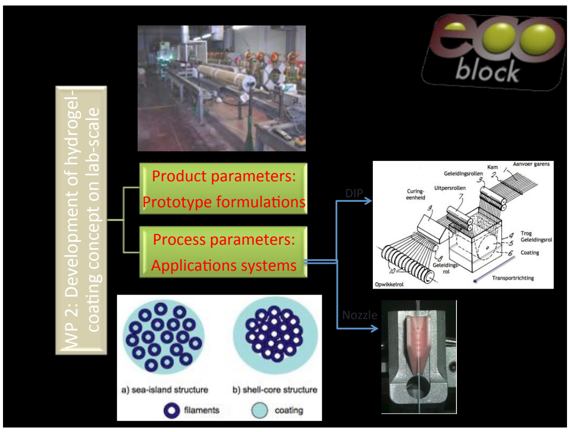

UV-COATING
Martindale test
Nano-Al + Nano-Si
UV-cured
PU-water based Resin 2
PU-water based Resin 1
Acrylate water based
X-fold improvement
5
10


UV-Coating
TO2C


Hydrophobic UV-curable Coatings
Reference
Result of 1 wash process
Result of 10 wash processes
TEXSHIELD
Environmental friendly and Durable Oil and water repellence finish on Technical Textiles


CROSSTEXNET
TO2C
CHEMSTREAM
COUSIN
eco block
Development of UV-curable hydrogel coatings for PES & PP-yarns used as a protective component in optical cables
(end-use: telecommunication)


UV-curable Hydrogels
"Ambient" UV-curing
7 X
9-180 X
60-155 X
60-256 X
Up to 445 X
Under investigation
SUPER ABSORBENT POLYMERS
Swelling degrees achieved:
Strong swelling
Easy to combine with SAP powder


eco block
WP 2: Development of hydrogel-coating concept on lab-scale
Product parameters:
Prototype formulations
Process parameters:
Applications systems
DIP
Nozzle
a) sea-island structure
b) shell-core structure
filaments
coating

## Some results on semi-industrial scale

| Spec | Original Status | UV-curable hydrogels | Competitor reference | Units |
|---|---|---|---|---|
| Dtex PES yarn | 1670 | | 1670 | Unit |
| Dtex coated yarn | 4100 | | 3444 | g / m |
| Coated yarn weight | 0.410 | | 0.344 | g / 10 km |
| Coating weight | 0.243 | | 0.177 | g / m |
| Water absorption of coated yarn | 18 | | 29.3 | g / m |
| Water absorption of coating | 74.07 | | 165.5 | g $H_2O$ / m yarn |
| Water absorption of coated yarn | 43.9 | | 85 | g $H_2O$ / g coating |

## II. Digital Finishing -Coating Technologies


## State-of-the-art of Digital Technologies


## Some Facts

Potential for DP-printing is 40 billion $m^2$

Digital Printing accounts for only 1-2%

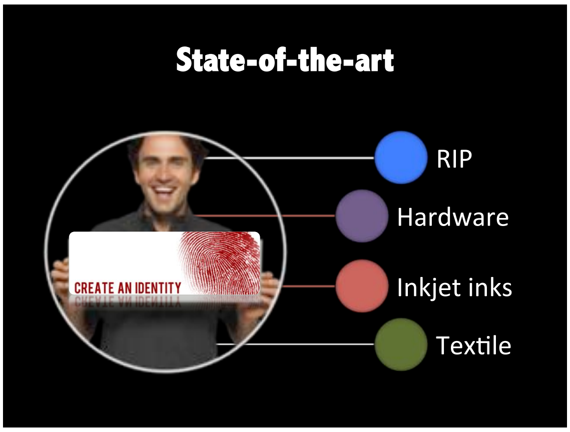
60% of all consumption is in EU, China, Japan & USA

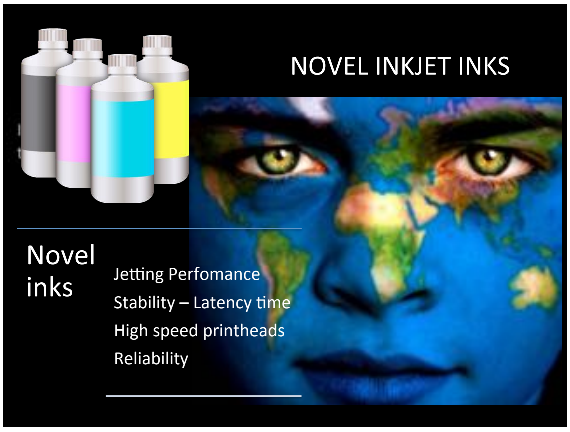
> 60% of all production is in India, Bangladesh, Pakistan, Vietnam, Thailand and Indonesia

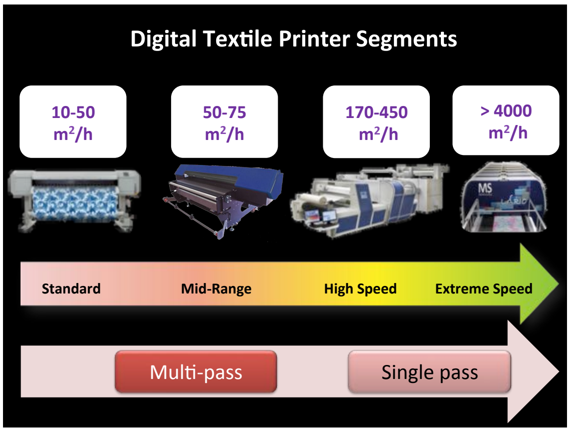
## II. Why Digital Printing Interior Textile?

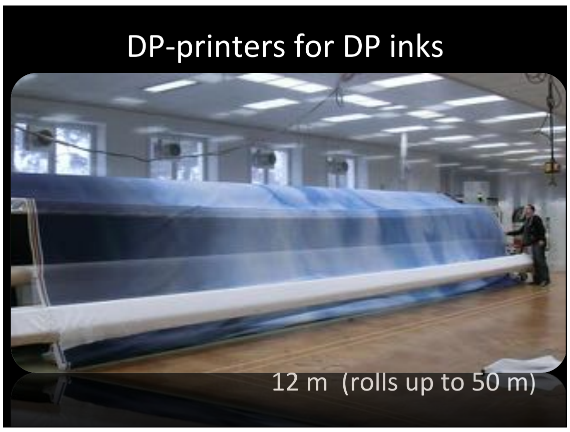
- Creative – Designing benefits
- Technical & Quality benefits (but also 'issues'!)
- Economical and ecological issues


The change is clear:
from analog to digital
DP is still a 'Niche' BUT Gap is closing fast !

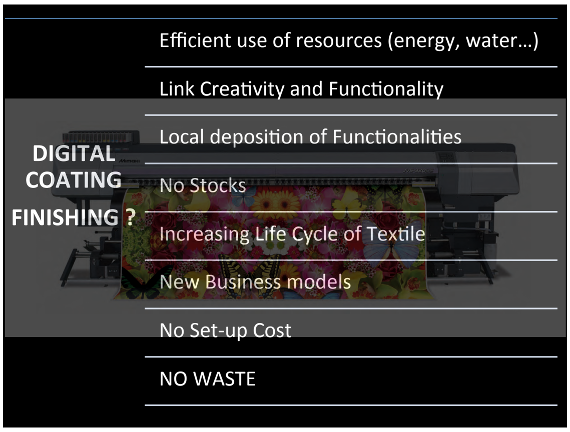

State-of-the-art
RIP
Hardware
Inkjet inks
Textile
CREATE AN IDENTITY

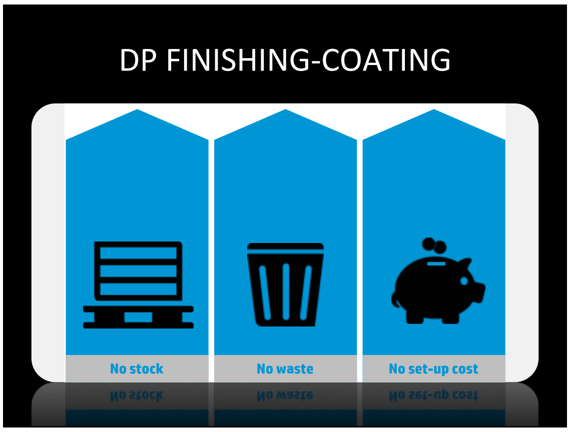

NOVEL INKJET INKS
Novel inks
Jetting Perfomance
Stability – Latency time
High speed printheads
Reliability

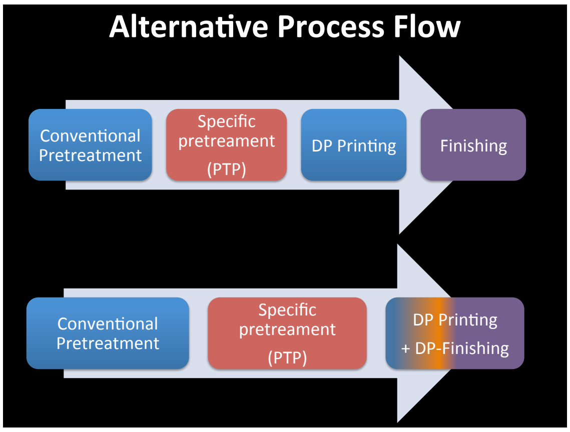

Digital Textile Printer Segments
10-50 m²/h
50-75 m²/h
170-450 m²/h
> 4000 m²/h
Standard
Mid-Range
High Speed
Extreme Speed
Multi-pass
Single pass

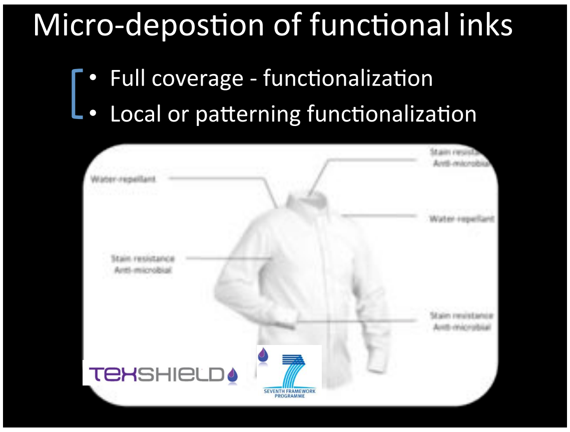

DP-printers for DP inks
12 m (rolls up to 50 m)


Creativity meets Innovations !
DIGITAL TECHNOLOGIES IS MORE THAN PRINTING!
New developments
Functional inks
From Ideas to Industrial Productivity

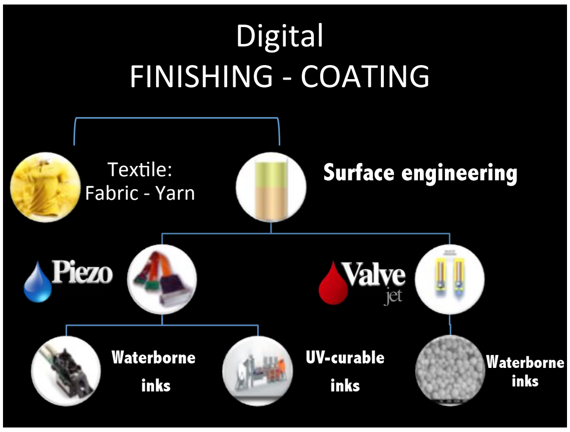

DIGITAL
COATING
FINISHING ?
Efficient use of resources (energy, water…)
Link Creativity and Functionality
Local deposition of Functionalities
No Stocks
Increasing Life Cycle of Textile
New Business models
No Set-up Cost
NO WASTE


DP FINISHING-COATING
No stock
No waste
No set-up cost


Alternative Process Flow
Conventional Pretreatment
Specific pretreatment (PTP)
DP Printing
Finishing
Conventional Pretreatment
Specific pretreatment (PTP)
DP Printing + DP-Finishing

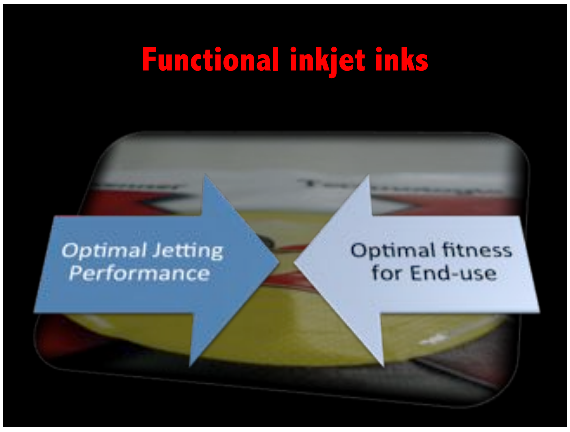

Micro-depostion of functional inks
Full coverage - functionalization
Local or patterning functionalization
TEXSHIELD


Piezo printhead
Which let us jet functional inks?

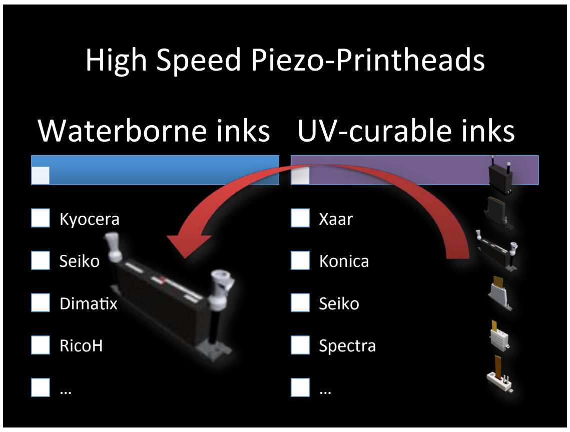

Digital
FINISHING - COATING
Textile:
Fabric - Yarn
Surface engineering
Piezo
Valve jet
Waterborne inks
UV-curable inks
Waterborne inks

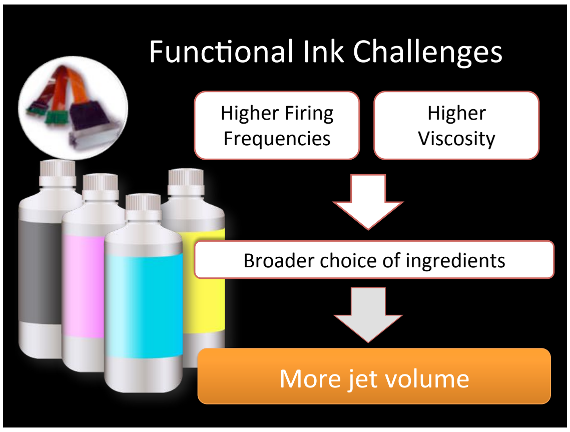
## Digital Printing versus Digital Coating

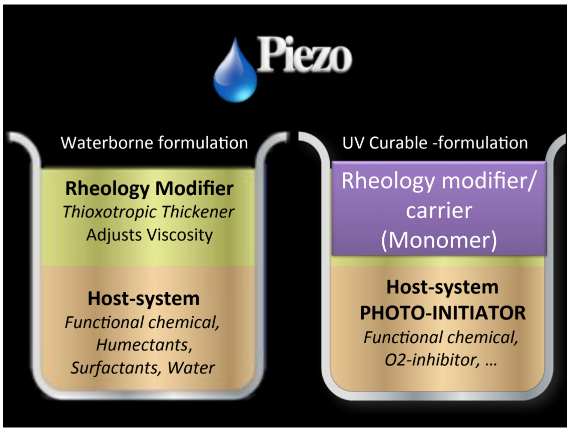
| | |
|---|---|
| PRINTING | Resolution (greyscale print heads…) |
| | Image quality |
| | Colour buildup |
| | Gamut |
| | Fastness (rub, wash …) - durablity properties … |
| COATING | Quantity of functional product |
| | Full coverage – localised/paterned deposition |
| | Fastness – durability properties |
| | Target Functionality |

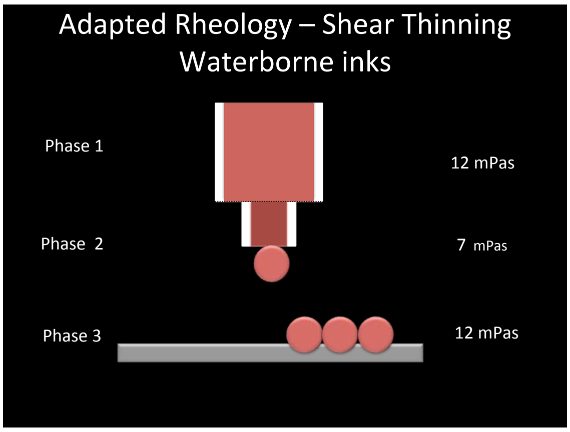


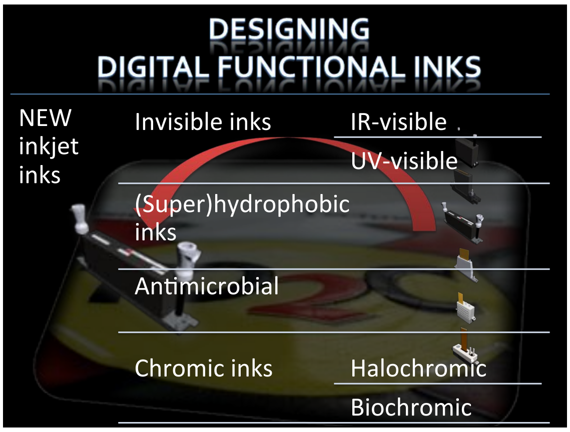


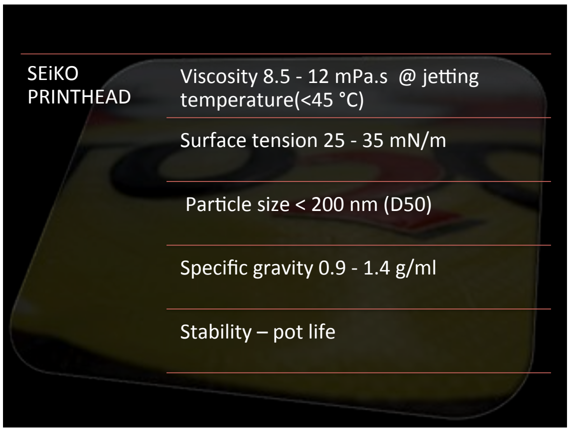



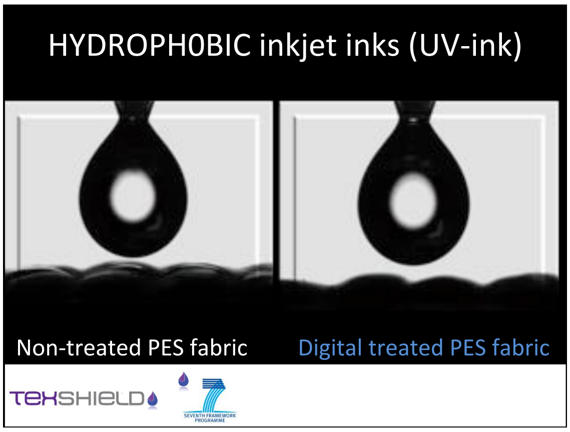




Piezo
Waterborne formulation
Rheology Modifier
Thixotropic Thickener
Adjusts Viscosity
Host-system
Functional chemical,
Humectants,
Surfactants, Water
UV Curable -formulation
Rheology modifier/ carrier (Monomer)
Host-system
PHOTO-INITIATOR
Functional chemical,
O2-inhibitor, …

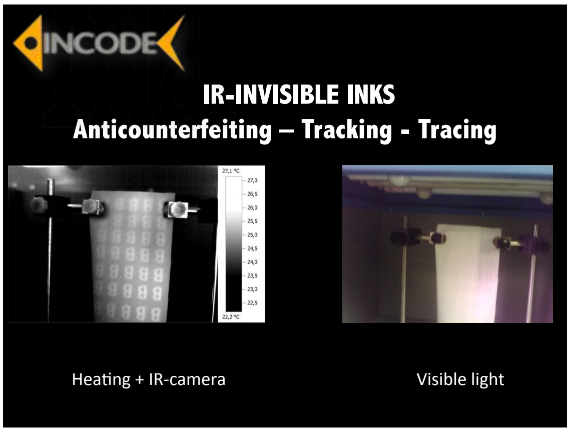

Adapted Rheology – Shear Thinning
Waterborne inks
Phase 1
12 mPas
Phase 2
7 mPas
Phase 3
12 mPas


DESIGNING
DIGITAL FUNCTIONAL INKS
NEW inkjet inks
Invisible inks
IR-visible
UV-visible
(Super)hydrophobic inks
Antimicrobial
Chromic inks
Halochromic
Biochromic

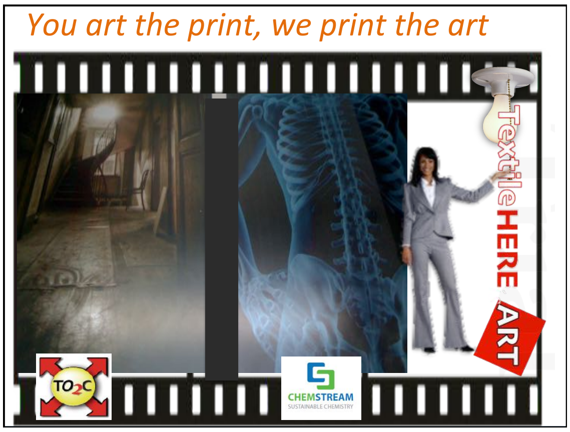

SEiKO PRINTHEAD
Viscosity 8.5 - 12 mPa.s @ jetting temperature(<45 °C)
Surface tension 25 - 35 mN/m
Particle size < 200 nm (D50)
Specific gravity 0.9 - 1.4 g/ml
Stability – pot life


HYDROPHOBIC inkjet inks (UV-ink)
Non-treated PES fabric
Digital treated PES fabric
TEXSHIELD


INVISIBLE INKS
Anticounterfeiting – Tracking - Tracing
INCODE
Fraunhofer
NEW & ORIGINAL
Original
100% ORIGINAL
Or pirate products?


INCODE
IR-INVISIBLE INKS
Anticounterfeiting – Tracking - Tracing
Heating + IR-camera
Visible light

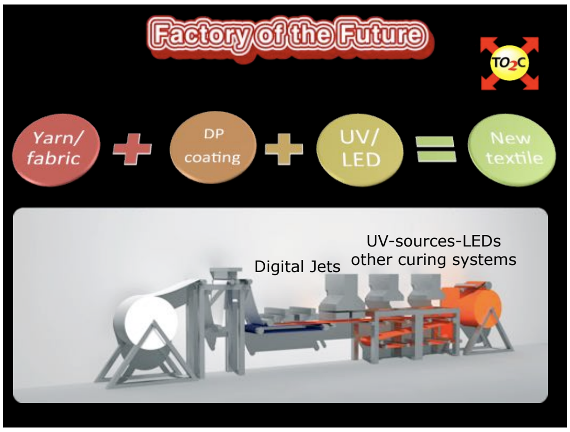

INVISIBLE
Fluopigments
Two versions:
a) Waterborne
b) UV-curable inks
CHEMSTREAM
CHEMSTREAM
Textile HERE is ART


You art the print, we print the art
Textile HERE ART
CHEMSTREAM

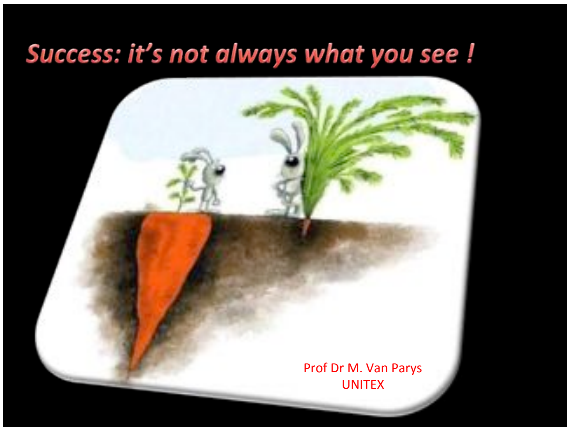

Playing with UV-inks
Textile HERE ART


Digital
Coatings
New
Possibilities
UV-
coatings
Finishing/Coating
Layer-on-layer
• Flexility/versatility -> Layer-on-layer coating
• Different thickeness/add-on 1-12 g/m²
• Design Coatings – dedicated places
• Coating on thermosensitive substrates (PP, PE) possible
• Economic/ecologic advantages (no VOCs)


UV-curable Inks
New
3D Printing


Factory of the Future
TO2C
Yarn/ fabric
DP coating
UV/ LED
New textile
Digital Jets
UV-sources-LEDs
other curing systems


8th EUROPEAN COATING CONGRESS
3-4 September 2015
Ghent – Belgium (HoGent)
www.unitex.be
COATING INDUSTRY
In TRANSITION
unitex
HoGENT


Success: it's not always what you see !
Prof Dr M. Van Parys
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