A Look at PU Leather Innovations Featuring TFL Hydro PU

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TFL

- TFL is a leading worldwide supplier of chemicals for the leather and coating industry (formed by a merger of Rohm, CIBA and Stockhausen leather chemical businesses in1996)
- TFL is headquartered in Weil, Germany with main R&D lab in Switzerland and TFL Academy in Montebello ,Italy
- TFL is servicing the market out of 5 production plants (France , Italy ,Brazil, India and China) and 17 application and service centers
- TFL has been pioneering innovation in the field of ecological processing techniques:

- 1910 first time use of industrial enzymes in leather processing
- 1963 full enzymatic unhairing system
- 1994 wider spread introduction of chromium free tanning –TFL WHITE LINE® SYSREM
- 1992 Development of water based acrylic dispersions with TPE properties
- First to introduce solar reflective coatings for flexible substrates (**TFL COOL** ® technology)

Why venturing out to ‘non leather’…?

share of uppers used for shoe in (% of consumed shoes)*

	US-market		EU-market	
	2011	2017	2011	2017
leather (genuine)	32	21	29	24
synthetic leather	32	43	38	39
textile	35	35	24	30
waterproof/other	1	1	6	6

*P. Mangione , Global Footwear Summit , Shanghai , 2017

Reasons for decline of leather shoe uppers

- Long period of high hide prices (2012 -2016)
- Problems of leather supply chain to accommodate fast changing fashion market with new, light weight designs (leisure, sports shoe) in a short time at competitive costs
- ‘high’ carbon foot print of natural leather
- Issues with restricted substances (mainly Chromium VI)
- Uprise of ‘ vegetarian and vegan ‘ trend

Animals are slaughtered for leather….

PETA to run anti-leather ad campaign in U.S. shopping hubs

United States
Published: 03 September, 2018

People for the Ethical Treatment of Animals (PETA) is to run an ad campaign against leather, fur, down and wool in five major shopping destinations across the U.S..

Scheduled to be launched this Autumn, the PETA's ads are already in place at Mondawmin Mall, Baltimore, and at the Town East Mall in Mesquite, Texas. PETA says is it also running the campaign on 20 taxi-top ads in New York City; on a billboard in Syracuse, New York, near the Destiny USA mall (one of the six largest malls in the country); and on a billboard near Desert Hills Premium Outlets in Cabazon, California, near Los Angeles.

"Just like us, animals are made of flesh and blood, feel pain and fear, and value their lives", said Christina Sewell, Campaigns Manager, PETA. "PETA's moving ads urge shoppers to leave items that stripped animals of their lives on the rack and opt for chic and humane vegan clothing instead."

The ads aim to tell shoppers that "animals are not ours to wear".

Source : ILM Magazine, Aug.Sept.2018

Learning from leather……

Hide

\+

water
energy
sustainable chemicals

decomposition
biomass

Leather

Chromium (VI) ?
Carbon foot print
Vegan
polluters

Sensitive to costs
fast changing designs
High volumes
Mainly synthetics

Large volumes
Short usage time

Recyclable ?

Renewable ?

What kind?

How much?

MATERIALS
ENERGIES

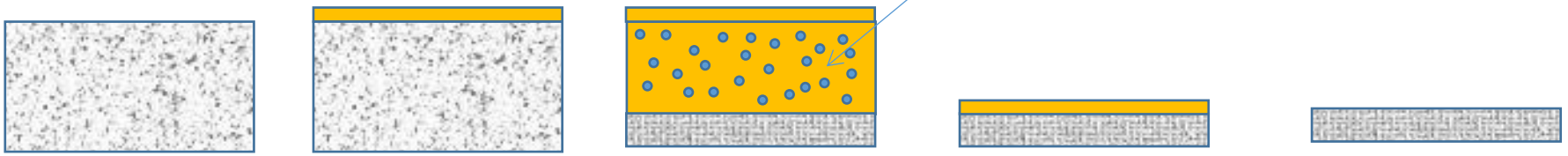
Performance
Quality / durability
Eco sensitive

Longer usage time

Many design options

PU coat

Protection
design
Haptics

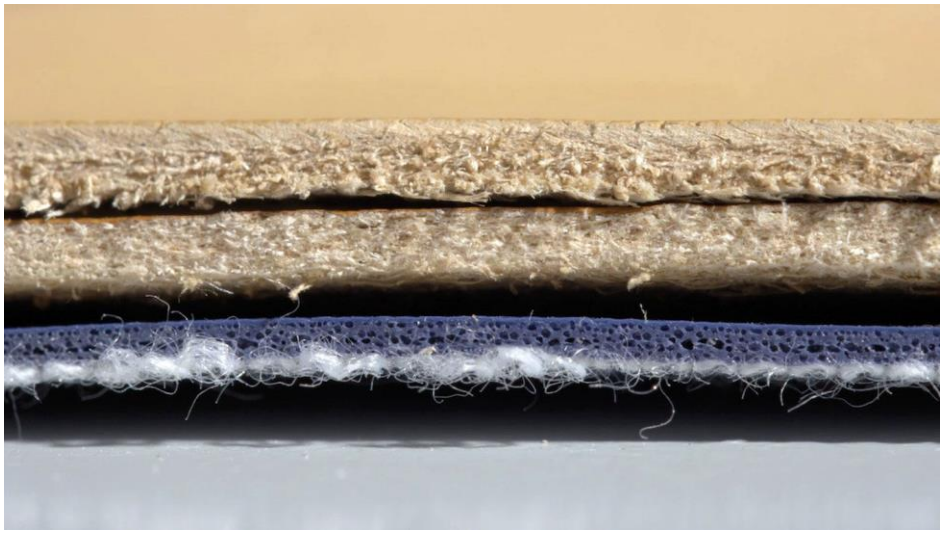


Foamed PU coat

Leather
Microfiber
(PP,PES,PA)

mech. strength
dim.stability
comfort

Woven fabrics



leather

microfibre

PU

Many terms being used : PU leather, Microfiber leather, …….

Do not use term ‘ leather’ if not made from an integral piece of hide

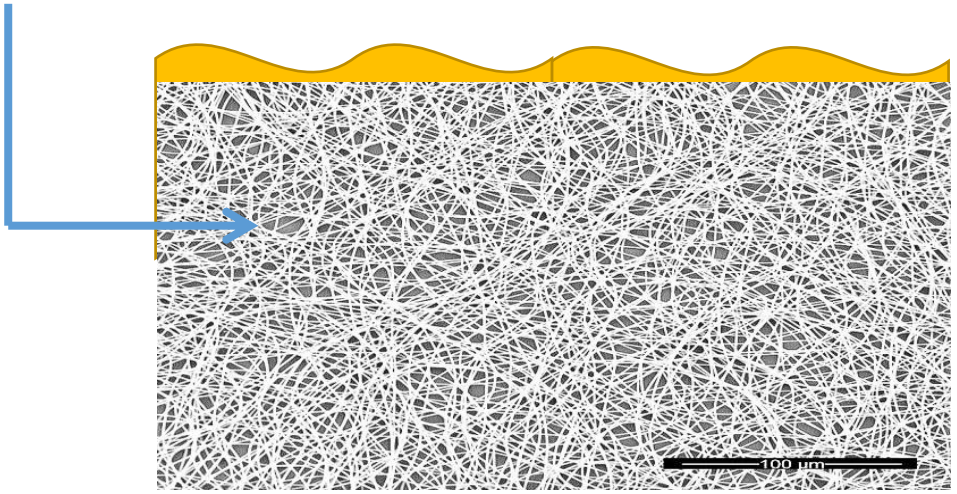
Weight = resources (….sustainability)

Product (1.2 mm thickness)	Specific weight (g/ cm ^{3})
Leather (natural)	0,4-0.9
PVC coat (not foamed)	0,9-1
PU coat (foamed)	0,6-1
PU coat (not foamed)	1- 1,2
Microfiber	0,2-0.4

*leather: 70% collagen,12 % water, 18% tanning chemicals /salts

Focus : textile substrate

Density textile < density polymer coating (foamed) < polymer coating



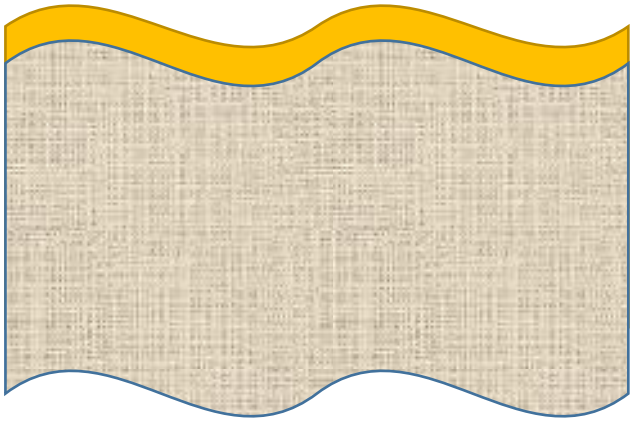
Textile substrate to form significant majority of total thickness (body)

- Major contributor to mechanical strength (tensile, tear , stitch …)
- Wide selection of textile fibers (synthetic, natural..) engineered to specific uses
- Water vapor permeability
- Water absorbency /uptake
- Light weight (impact on carbon foot print)

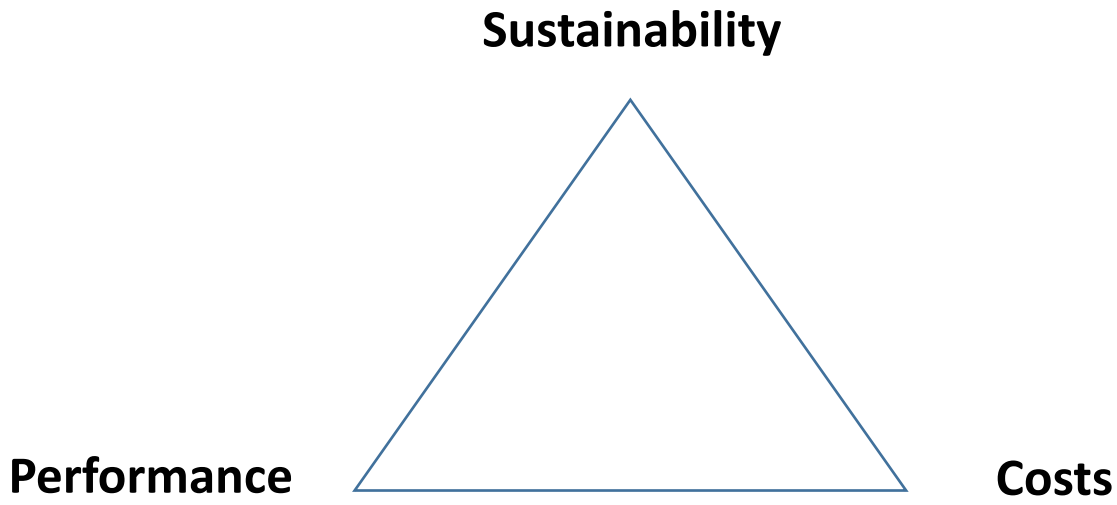
Focus coating

Goal: Coating thickness should be as thin as possible and depends on

- Degree of desired protection (water , mechanical wear ,….)
- Design (colors, surface effects)
- Degree of comfort
- Substrate (coverage of fibers)



What is the most ‘sustainable’ coating?



- There is no ideal systems serving all needs
- Part of Sustainability discussion focuses on DMF which has inferior eco-tox profile
- Alternatives are water based PU systems as well as high solid PU and 2K - PU systems
- Use of renewable resources and recyclability of materials will be key
- Biggest impact can be made with suitable carrier (substrate)

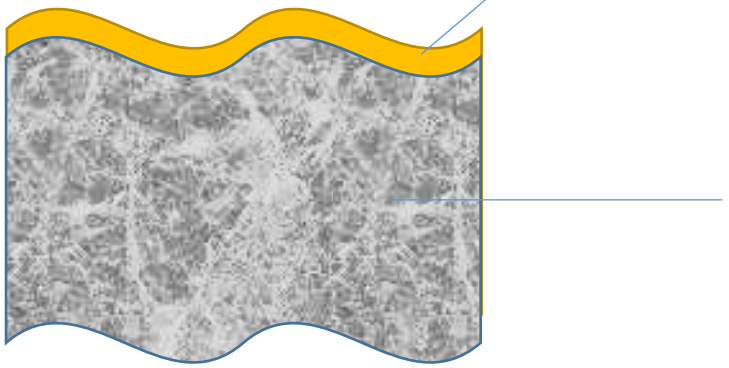
Focus : DMF

- DMF is a hazardous solvent , strong liver toxin, potentially reprotoxic, flammable
- DMF is used as solvent for making coagulated PU synthetics but also in regular PU coatings
- DMF based PU process are well established , robust, easy to implement and yield good performing final products
- Problems are with emissions and exposure to workers in production
- Allowable levels of DMF in consumer goods (synthetics) surprisingly quite high (AAFA / EU REACH : ≤ 1000pppm, CADS: 500 ppm, ZDHC – none , some brands much lower …)
- ZDHC runs program with selected manufacturers to eliminate DMF from production

Hydro PU Technology

- Water based PU and acrylic (TPE) polymer dispersions with very, low VOC content
- Free of DMF and any other hazardous components
- All **Hydro PU** products , pigments and additives fully comply with ZDHC MRSL requirements for textiles
- Polymer dispersions are selected for performance to enable thin coating thicknesses (textile support mainly contributes to article thickness)
- **HYDRO PU** Technology involves the use of selected cross linkers
- **HYDRO PU** Technology can be applied by transfer and direct coating processes
- Hydro PU offers many design possibilities

Hydro PU : a composite approach for sustainable shoe upper



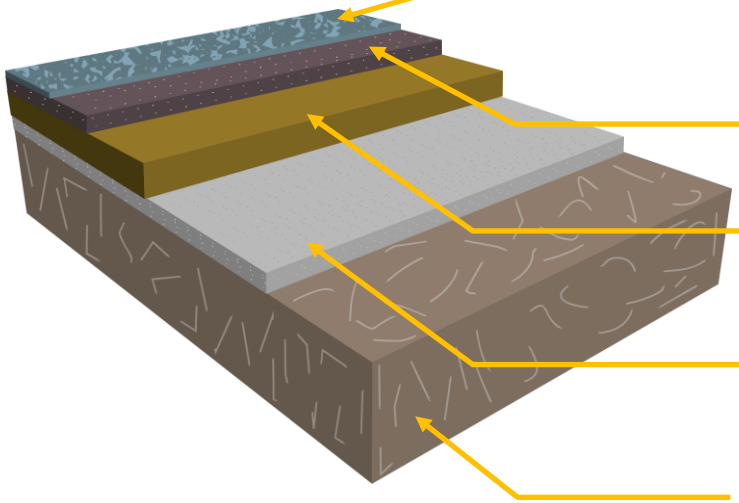
Coating

Thin
strong
Design flexibility

Fabric:

Low weight,
Strong
biodegradable,
renewable
recyclable fibers

Hydro PU operation metrics



Top Finish
(optional)

Topskin

Skin

Adhesive Impregnation

Backing fabric
(textile, microfibre)

Embossing
(grain design)

Printing Chemicals

Transfer Coating Chemicals

Average chemical consumption/m² (PU & additives)

10-50 gr/m²

150-450 gr/m²

Critical for

- Appearance
- Physic. Mech properties

Hydro PU performs

parameter	* Tests done on Hydro PU coated Microfiber (PES) , 1,2 mm ; coating thickness appr. 50 µm
Flexibility	Very high passes 300 000 flexes (RT) , 100 000 at -10° C
Resistance to water / humidity	In general very good ; 168 hr. at 70°C , 95 % rel. humidity
Adhesion (dry/wet)	good; to be adjusted individually to substrate; can pass 10% caustic soda sol. test
Rub fastness (wet/dry/ethanol)	Passes all major requirements
Abrasion	Passes H 22 Taber test, 1kg load , 200 cycles
Water vapor permeability	1.3-1. 5 mg /cm^2/hr by using proprietary technology; physicals reduced but still meet basic specs (substrate & lining material are key)
dynamic scuffing	Very good when right substrate selected

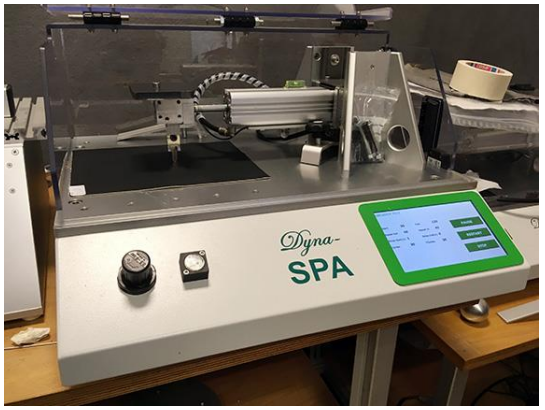
Issues encountered with water based technology

Problem	Comment
Levels DMF found	Contamination: use dedicated production lines
Spots	Contamination; chemicals need homogenous stirring before use
Embossing pattern	Adjust temperature; selection of PU and substrate
Failed flexing, aging, yellowing tests	Selection of coating chemicals to be adjusted
Vulcanization, bonding	Selection of chemicals, adjust conditions
Creases, shrinkage, etc.	Adjustment of substrate, backing material
Marks on high gloss (patent) finishes	Selection of chemicals (too 'soft') , possible use of solvent PU (non DMF)
Poor flexing	Problem related to poor adhesion ; adjust adhesive and application

Strength of coating (3 dimensional scuffing test)

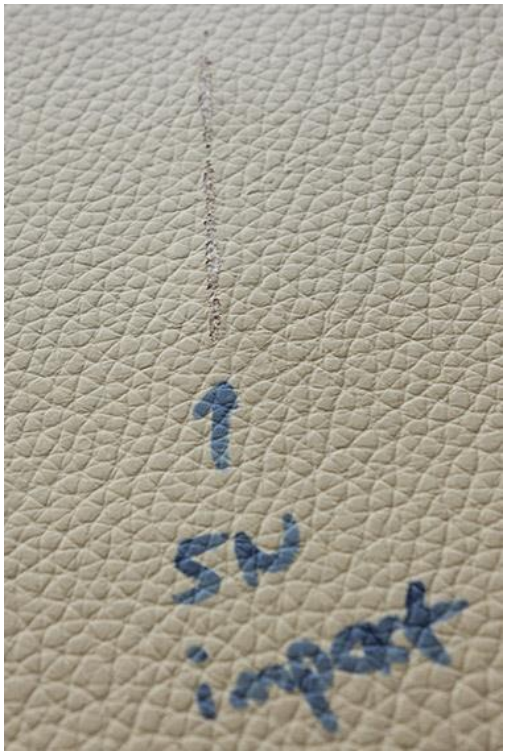
Article	Number of strokes * for visible damage	Comment
PU leather (DMF coag.)	3	Complete damage of coating after 7 strokes
Hydro PU textile	18	Visible damage but not cut through
Hydro PU microfiber	30	damage visible

* 5 N load , extension 15cm



3 dimensional dynamic impact testing

Coagulated PU
3 strokes



Hydro PU microfiber
30 strokes

Automotive natural
Leather -30 strokes

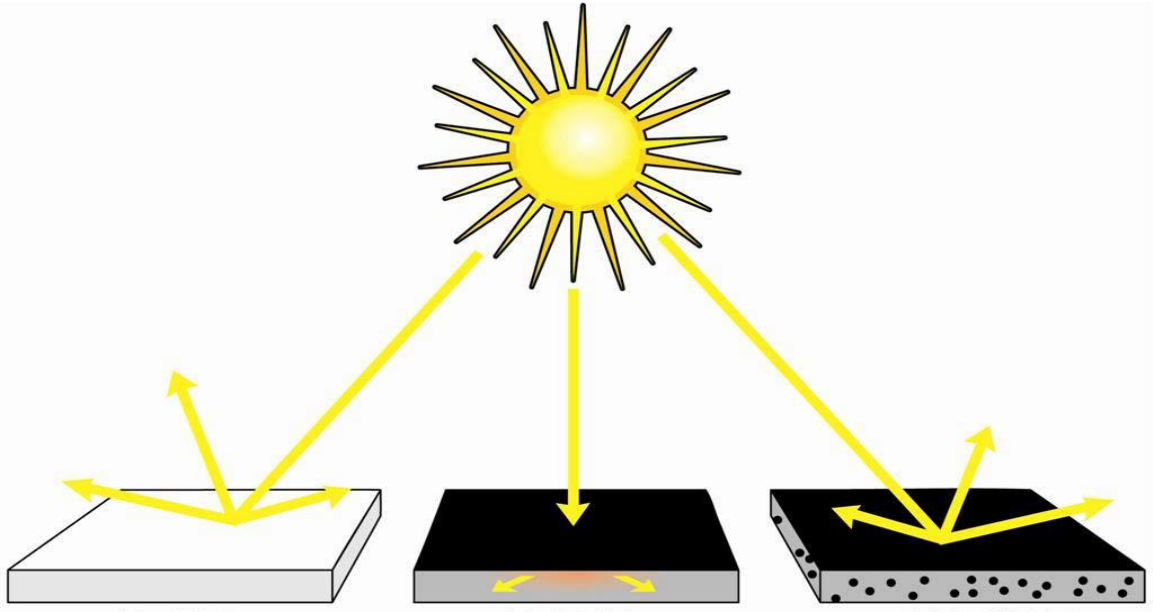
Comfort is key

- Cushioning design
- Texture of inner sole/ lining
- Moisture management (water vapor permeability , absorption / release of moisture …)
- Temperature management

- Woven and non woven fabrics have best water vapor permeability (breathability)
- Any coating is reducing water vapor permeability
- Water vapor permeability is in direct relation to coating thickness (exemption fomed PU)

Keep COOL : Patented **TFL COOL ®** technology

- Proprietary pigment technology used in HYDRO PU coating allows NIR rays to pass
- Fiber networks (leather,textile dyed with NIR reflective dyes) reflects NIR rays
- Temperature differences of 20°C can be achieved



104 ° C

140°
Regular coating

104° F
TFL COOL coating

Making shoes with Hydro PU leather

- Hydro PU material was successfully used in AGO shoe production process
- Care has to be taken at the stage of roughing process (depends on thickness of HYDR PU coating layer)
- Obviously all synthetic materials have in common ´that uptake of steam is different (less) than leather and the process (lasting) has to be adjusted (visible mainly in the ´Strobel’ process)
- Other processes (i.e. vulcanization) do not give problems

Easy Care : TFL Anti-soiling® technology

- HYDRO PU coatings can be equipped with special anti-soiling properties
- surfaces becomes more resistant to dirt pick up
- Prevents dirt/ dyes from penetrating into surface

Regular PU coating

HYDRO PU coating
Anti-soiling

HYDRO PU coating
after cleaning

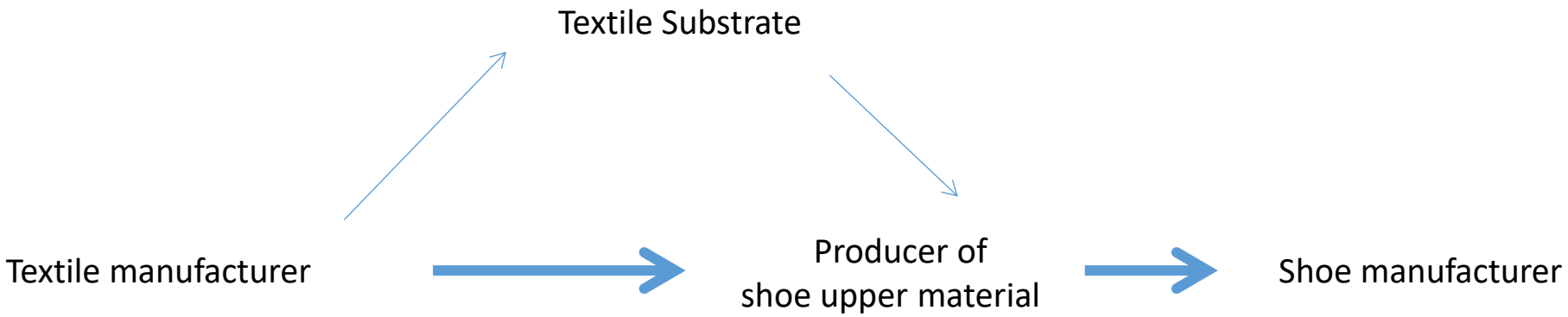
Nothing is perfect , but most is …

	TFL Hydro PU	Solvent Base	100 % solid systems (incl. 2 K PU)
Quality consistency	xxxxx	xxxxx	xxx
Ease of operation and implementation	xxx	xxxxx	xx
Phys. Performance	xxxxx	xxxxx	xxxxx
Environmental impact	x	xxxxx	xx
Safety (transport, storage, operation)	xxxxx	xx	xx
Carbon Foot Print *	xx	xxx	xxx
Design flexibility	xxxxx	xxx	x
Cost per meter of end material	xxxx	xxx	xxx

xxxxx = highest; x= lowest

* Considering production and amount of resources used (chemicals, energies, e.g. drying, etc)

Control of supply chain



- Control of RSL issues
- Article variety (flexibility)
- Response times

Restricted Substances

Hydro PU Technology products are

- Free of DMF
- Low in VOC
- Comply with ZDHC –MRSL requirements for textiles
- Compliant with all EU –REACH directives for restricted substances Incl. the REACH –SVHC list (substances of very high concern)
- Compliant with other major regulations like Prop. 65 (USA), CADS , etc.

Summary- it is a matter of the right choices

- **Hydro PU** technology comprises water based PU coating technology in combination with biodegradable textile substrates which are preferably recyclable and renewable
- Textiles coated with **Hydro PU** provide good physical performance and allow a high variety of design options
- **Hydro PU** coatings have a low environmental impact and toxicity while providing safety in transport, storage and operation
- High performance of **Hydro PU** materials offer longer life of use option (articles we like and do not go bad we do not throw away that early)
- **Hydro PU** coatings are by trend higher in costs than DMF based coatings systems and some of the high solids PU systems
- **Hydro PU** articles are geared to address consumers which appreciate innovative and sustainable articles and willed to pay an adequate price for it (this *applies also for sustainable manufactured natural leather*)