

TOP-COATING OF LEATHER WITH AN EFFECTIVE UV-CURABLE WATERBORNE POLYURETHANE DISPERSION TECHNOLOGY.

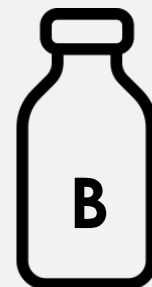
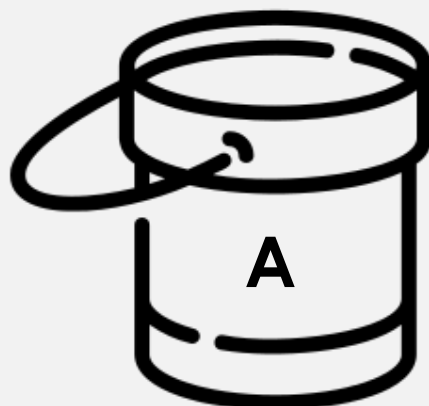
Giovanni Dalla Valle, Massimo Cariolato, Giancarlo Lovato



State of the Art: Top coating of leather Two-component systems

Component A:

A resin composed
of an aqueous
dispersion of a
polymer

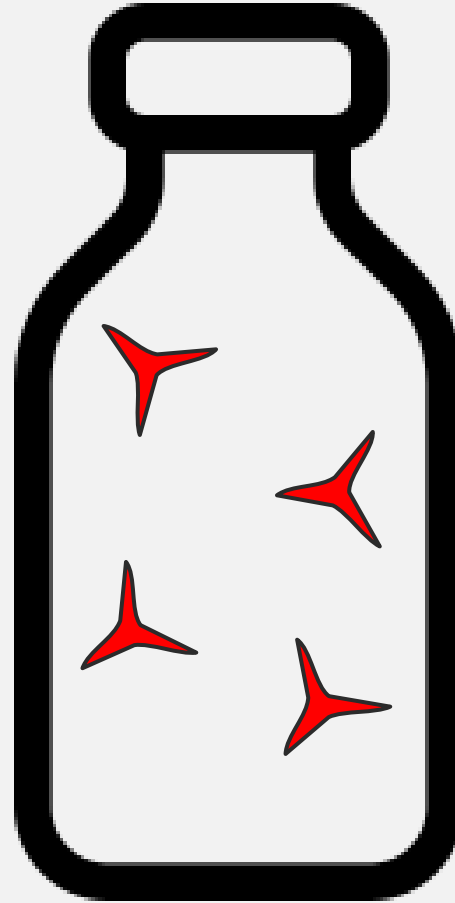
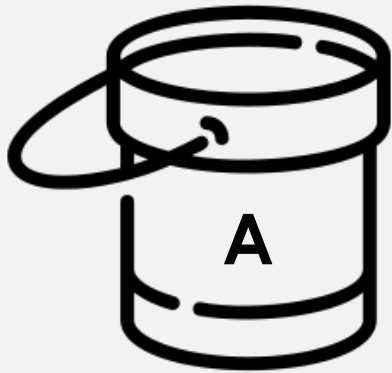


Component B:

A curing agent, capable
of chemically linking
polymer chains together:

- polyisocyanate
- Polyaziridine
- Polyurea
- ...

State of the Art: Top coating of leather Two-component systems

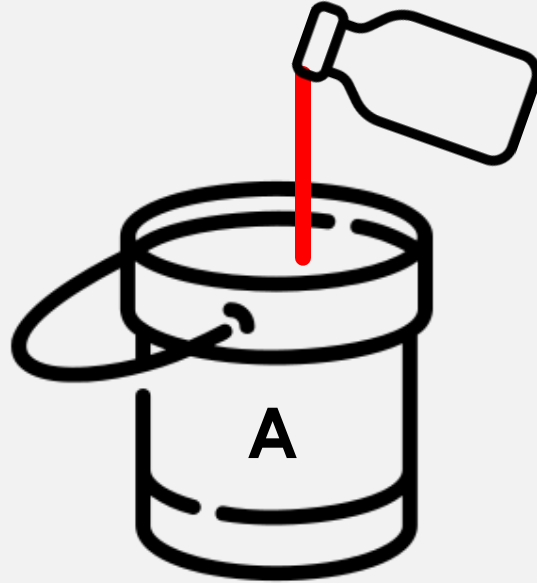


Common curing agents have three or more function capable to form bonds with polymer macromolecules.

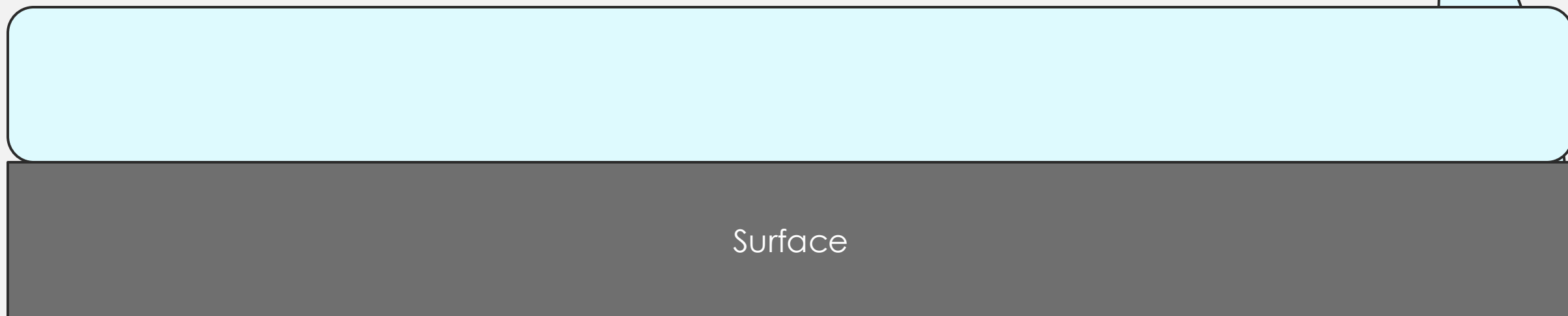
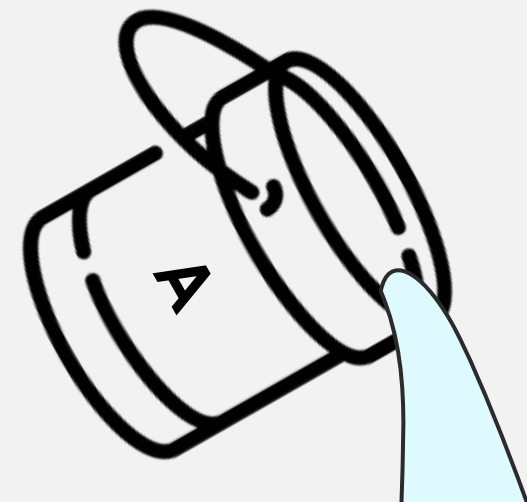
These products often have a bad toxicological profile:

- May cause an allergic skin reaction
- Harmful if inhaled
- Harmful to aquatic organisms
- Causes serious eye irritation
- Suspected of causing cancer
- May cause damage to organs

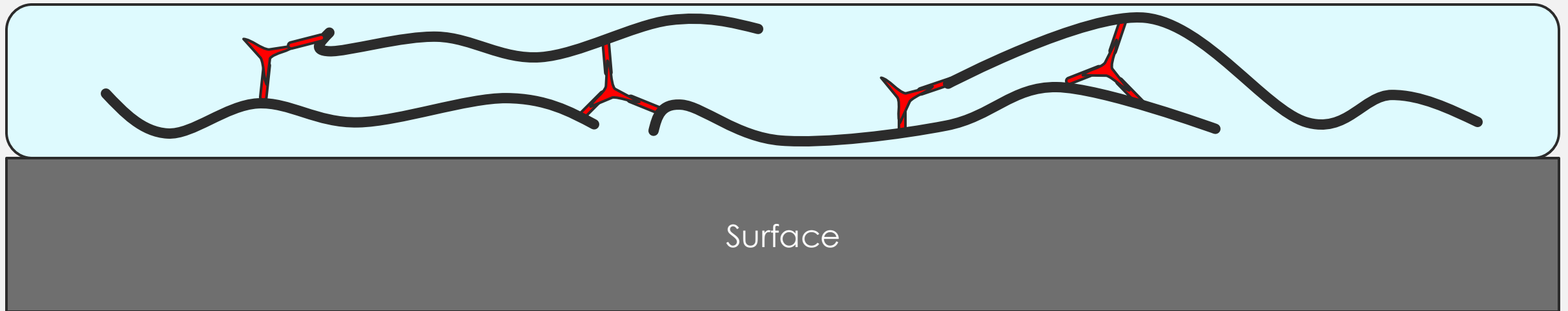
State of the Art: Top coating of leather Two-component systems



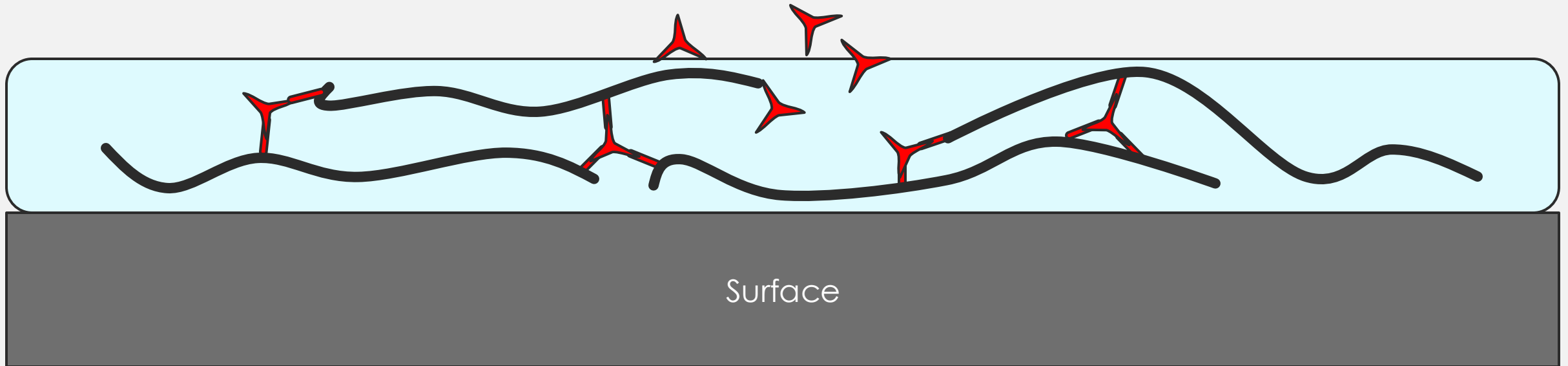
State of the Art: Top coating of leather Two-component systems



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This means that there is a limited time frame in which the product can be applied. This is: POT LIFE

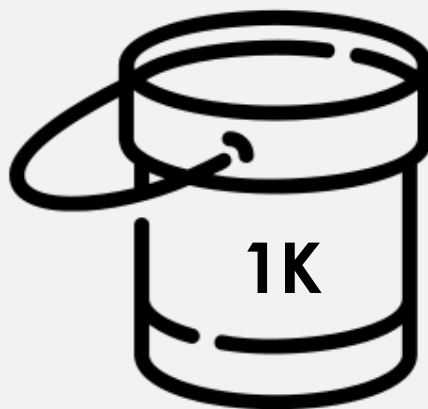
State of the Art: Top coating of leather Two-component systems

State of the Art: Topocatalysis Two-component systems

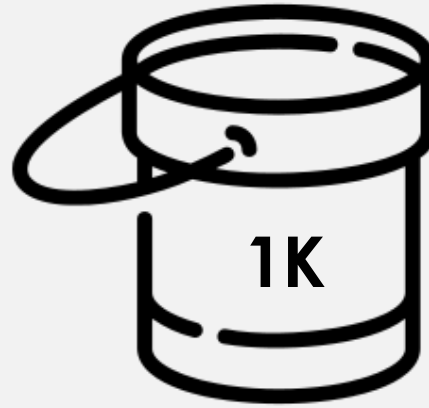


One solution is to eliminate component B.

One-component systems:



One-component systems:

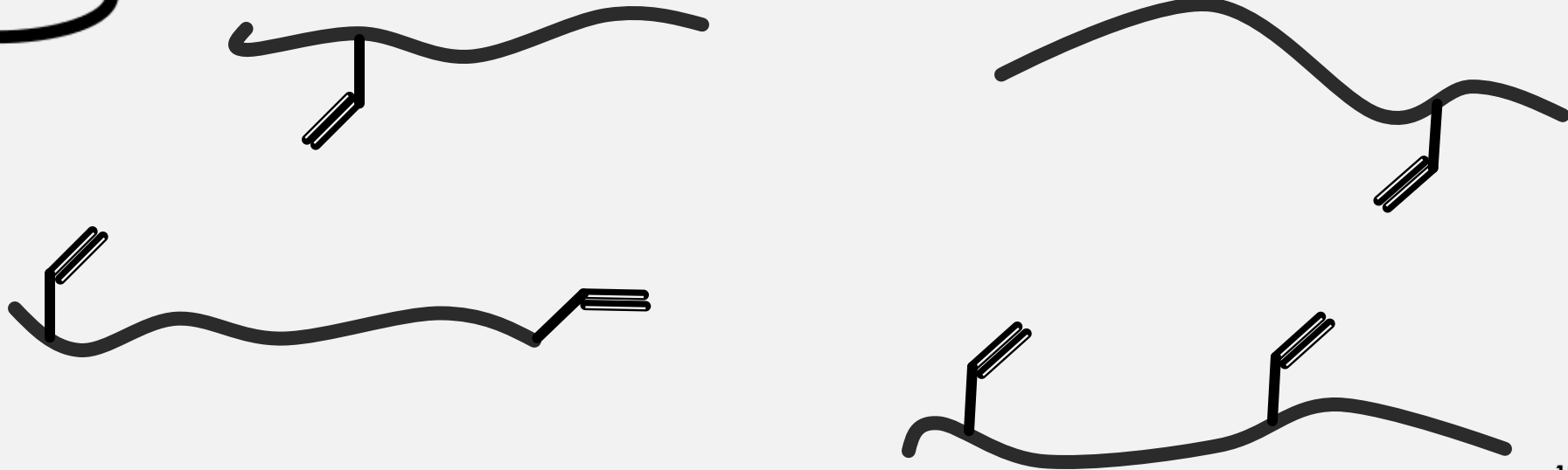
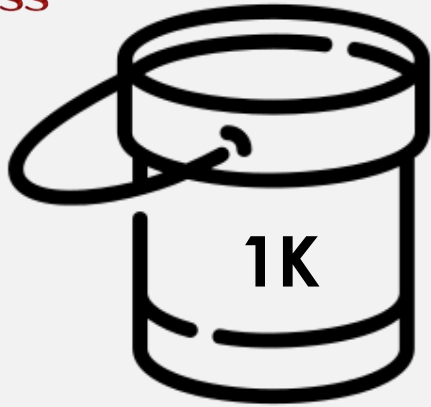


- Energy curing

One-component systems: Energy curing, UV curing

In energy curing, the polymer already has functional groups in its structure capable of cross-link.

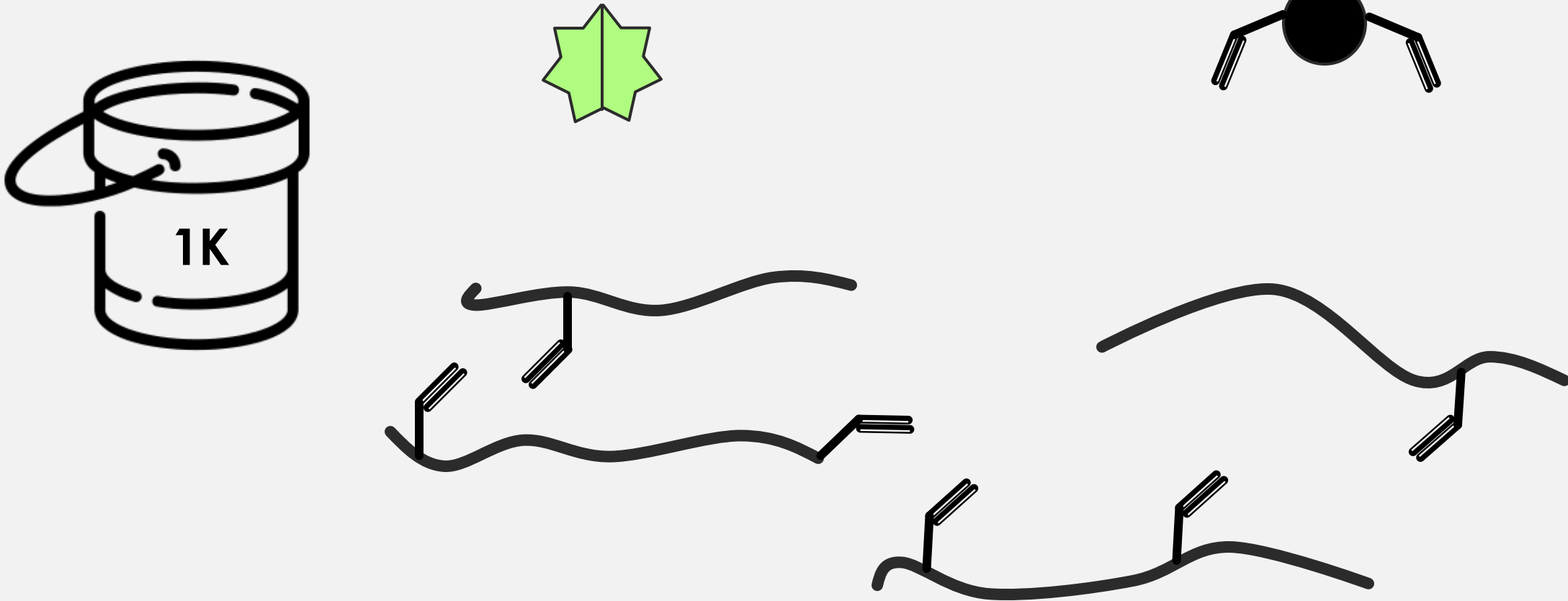
In our case, acrylated polyurethanes have acrylic functions attached to the polymer chain.



One-component systems: Energy curing, UV curing

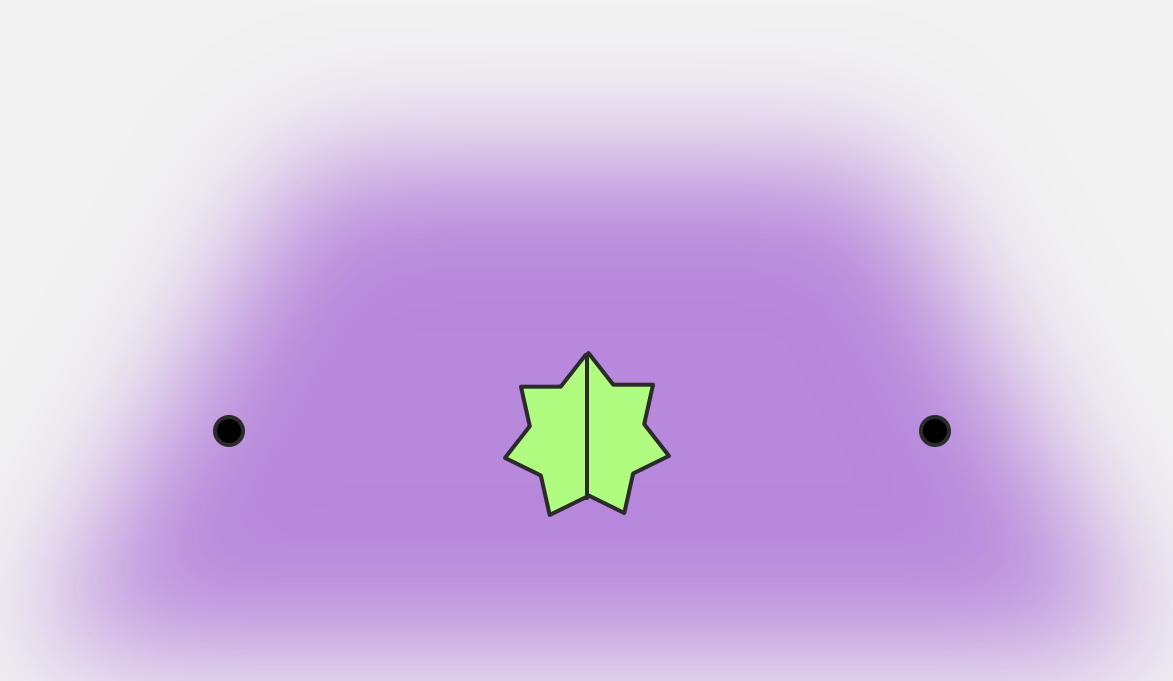
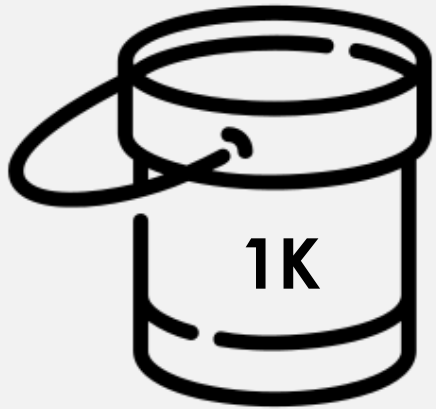
Photoinitiators

Acrylic monomers

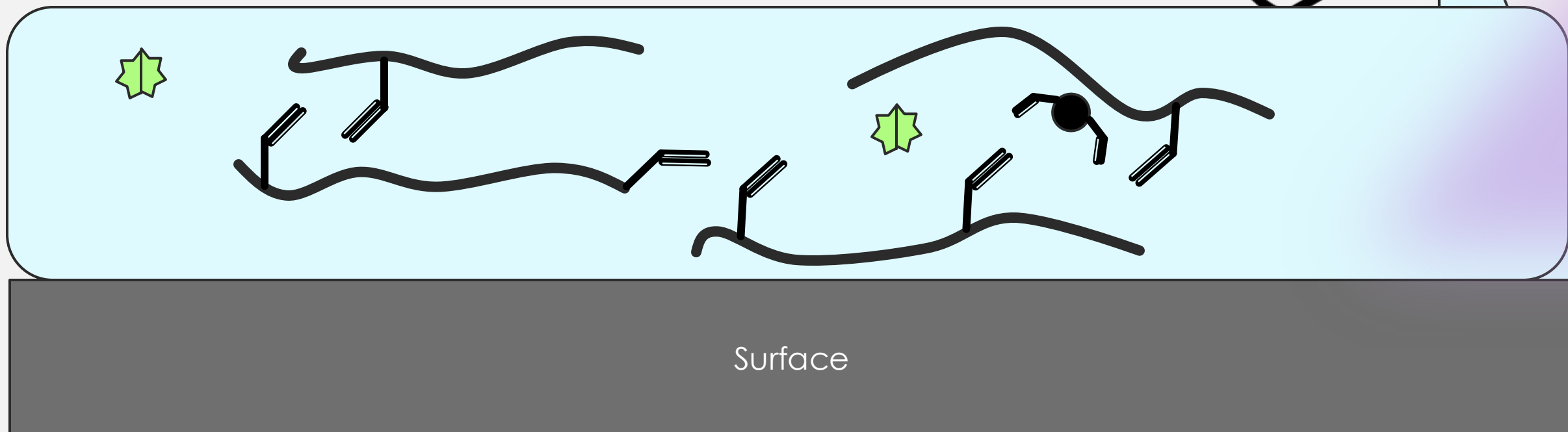


One-component systems: Energy curing, UV curing

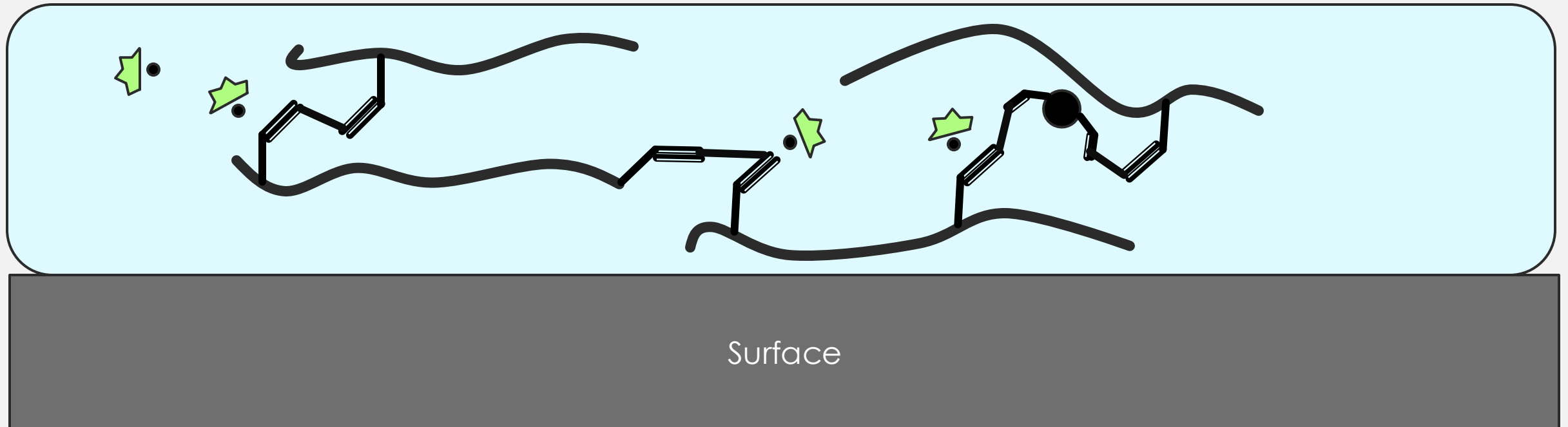
Photoinitiators



One-component systems: UV curing



One-component systems: UV curing



One-component systems: UV curing

Why not in leather?

1989. EP0181486B1 Basf

2002. Khan et al.

1997. K. M. Idriss

2003 Mubarak A



Most published works are limited to the formulation of products intended for other sectors (wood, metals, etc.) and testing on leather.

One-component systems: UV curing

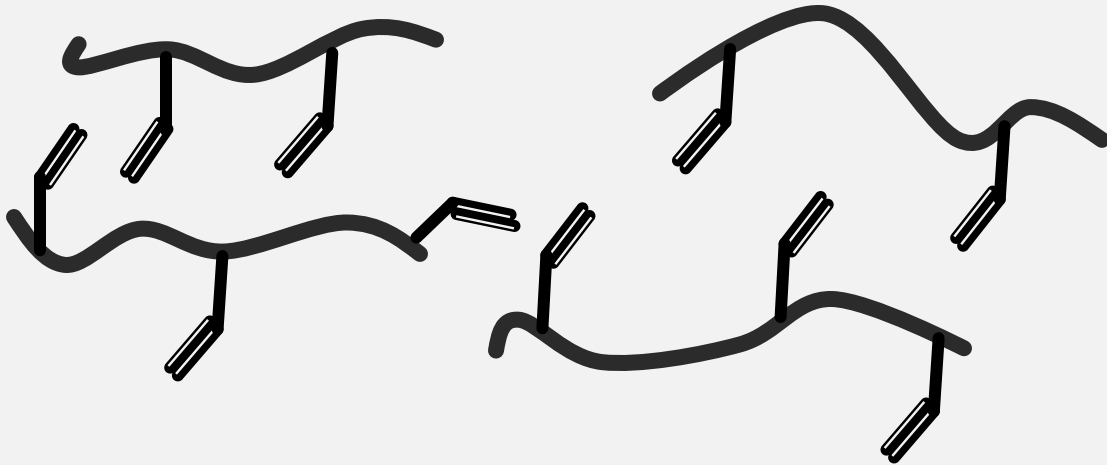
Why not in leather?

Most published works are limited to the formulation of products intended for other sectors (wood, metals, etc.) and their testing on skin.

These substrates are rigid and require rigid coatings with high abrasion resistance.

As a result, they have poor resistance to repeated bending (< 50 cycles).

One-component systems: UV curing

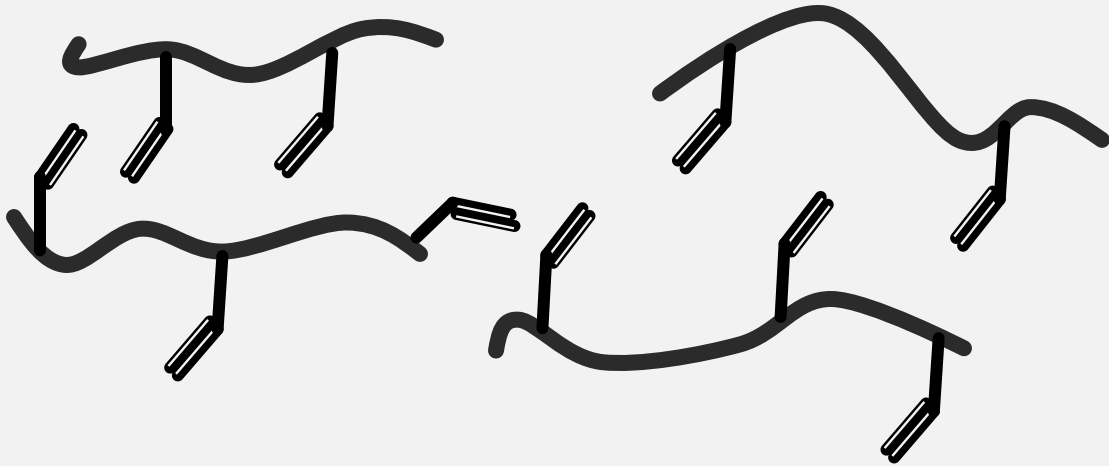


These types of products have a high density of double bonds.

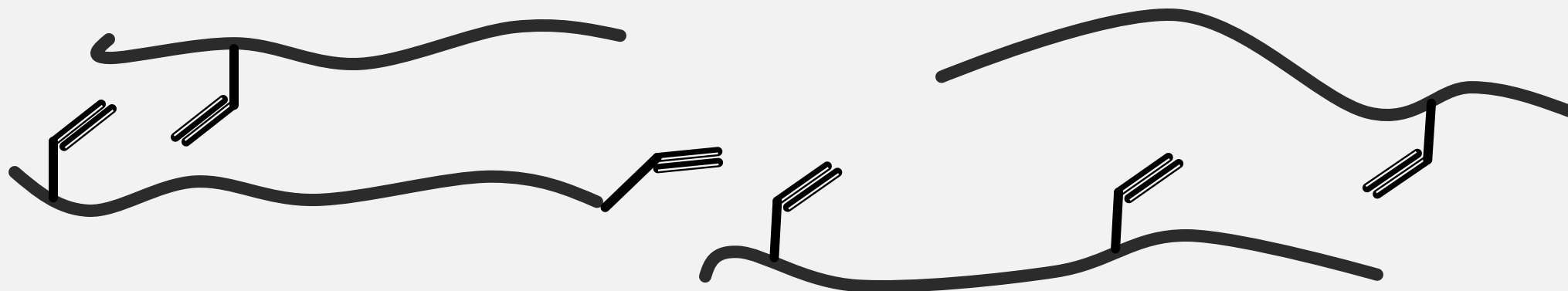
In commercial products, on average it is between 4 and 8 mmol/g

This means a high degree of cross-linking.

One-component systems: UV curing



One-component systems: UV curing



The products presented here have double bond densities between 0.18 and 0.80 mmol/g

One-component systems: UV curing

UV as an enhancer, not as the film creator

A second point is to obtain a product that has excellent film-forming power before irradiation.

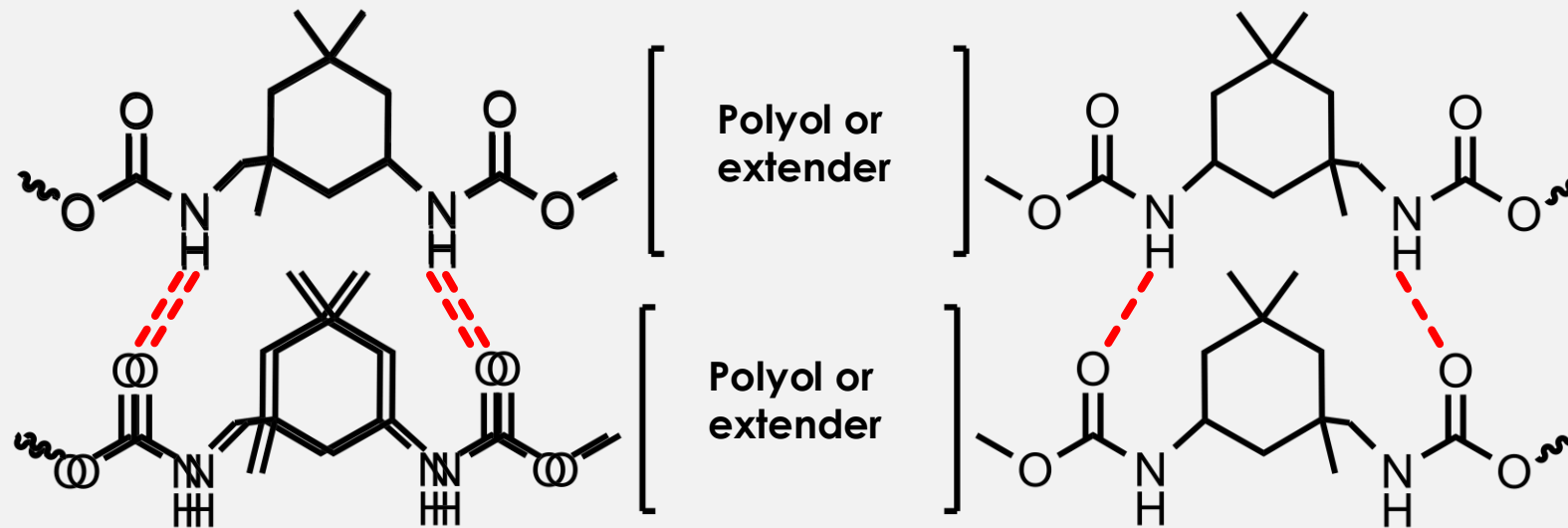
This means obtaining a film in which secondary interactions are prevalent over radical cross-linking.

In these products, suitable for leather, we only need the finish to improve its performance under the lamp and not for it to solidify.

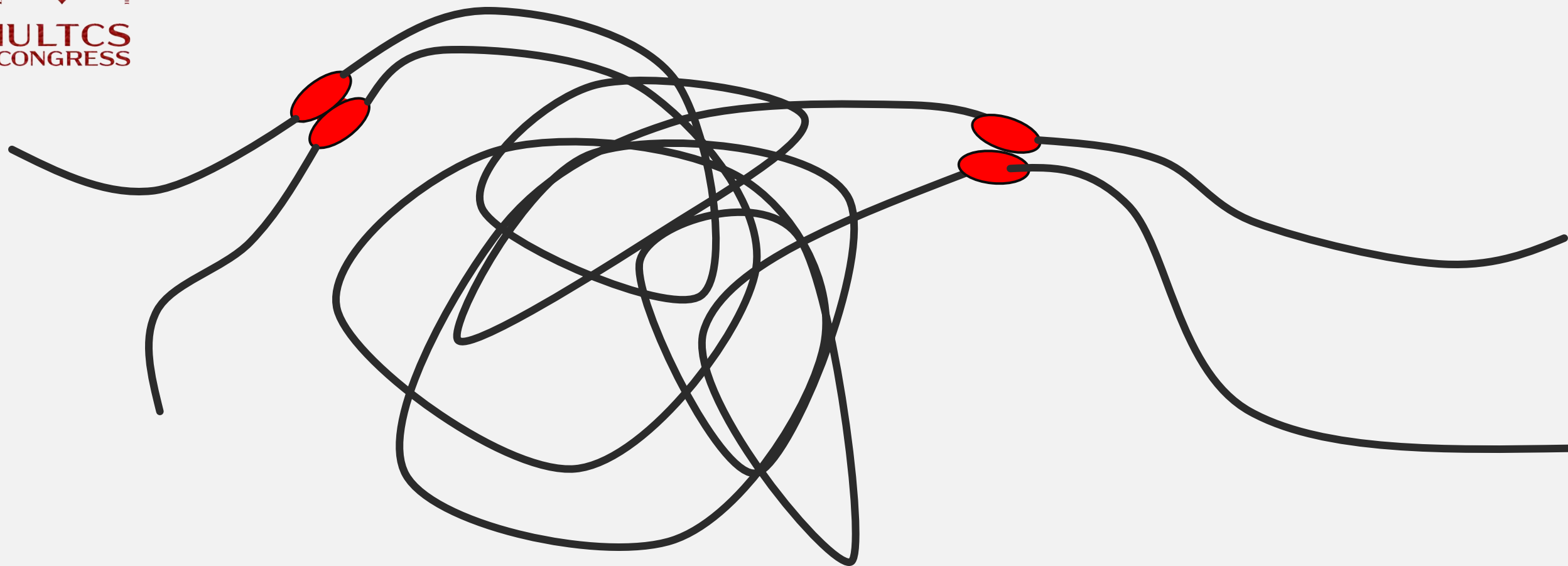
This way, better elastomeric properties are achieved.

One-component systems: UV curing

Hard segments can increase elastic properties due to the formation of hydrogen bonds.



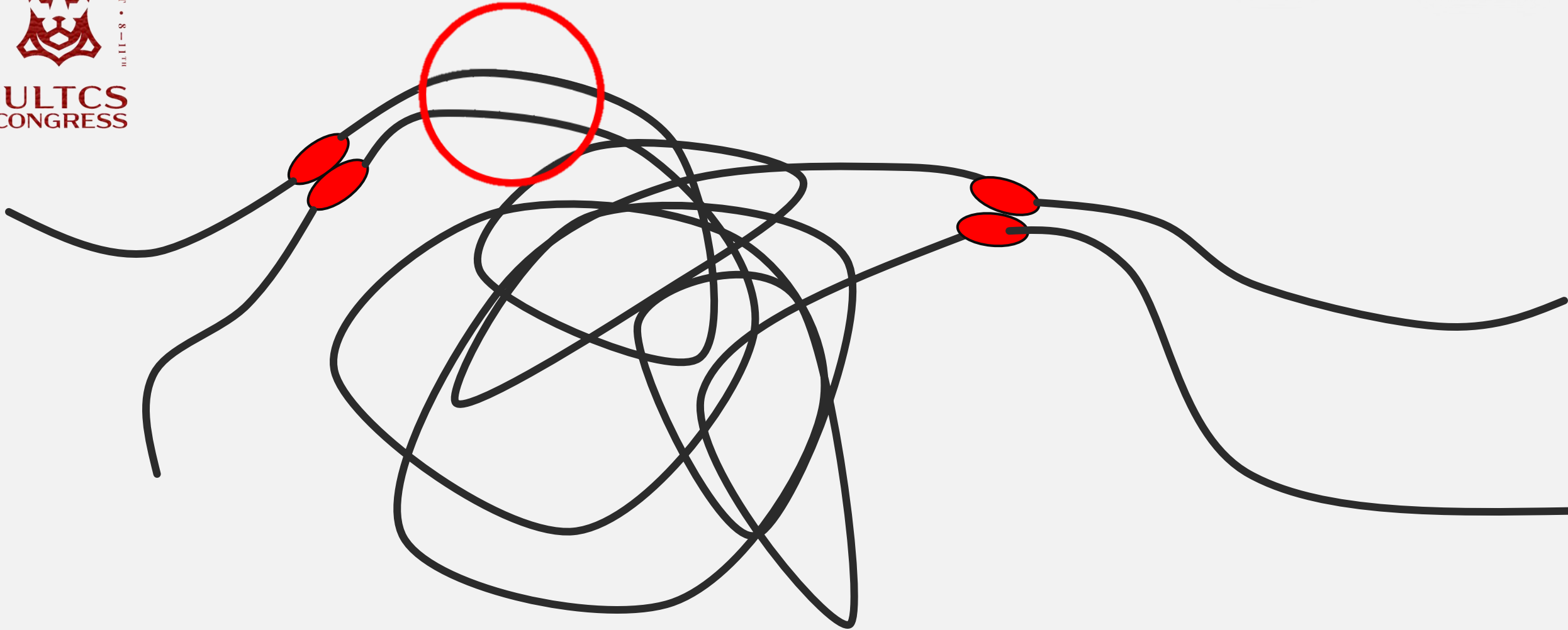
One-component systems: UV curing



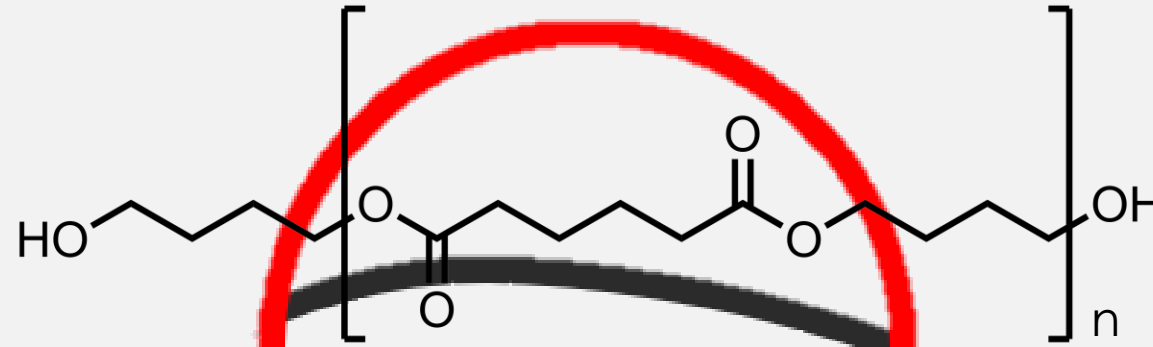
One-component systems: UV curing



One-component systems: UV curing



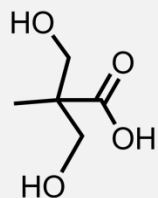
One-component systems: UV curing



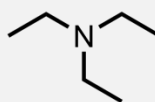
Polyester polyols are preferable due to their higher Young's modulus.

One-component systems: UV curing

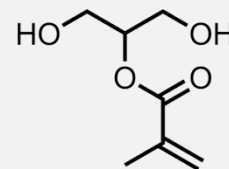
IONOMER
DMPA



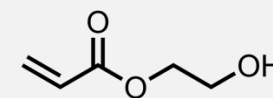
COUNTERION
TEA



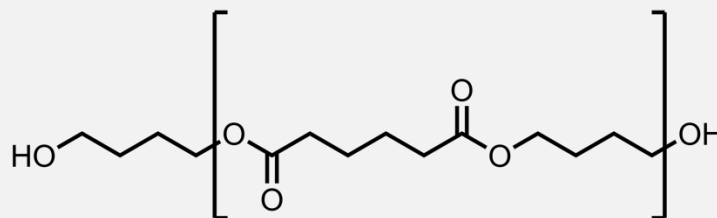
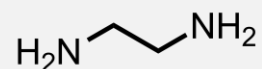
UV
CHAIN EXTENDER
GMMA



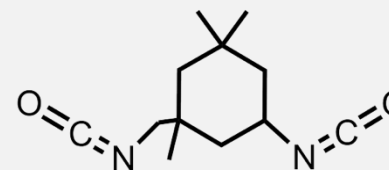
UV
TERMINATOR
2-HEA



CHAIN EXTENDER
EDA

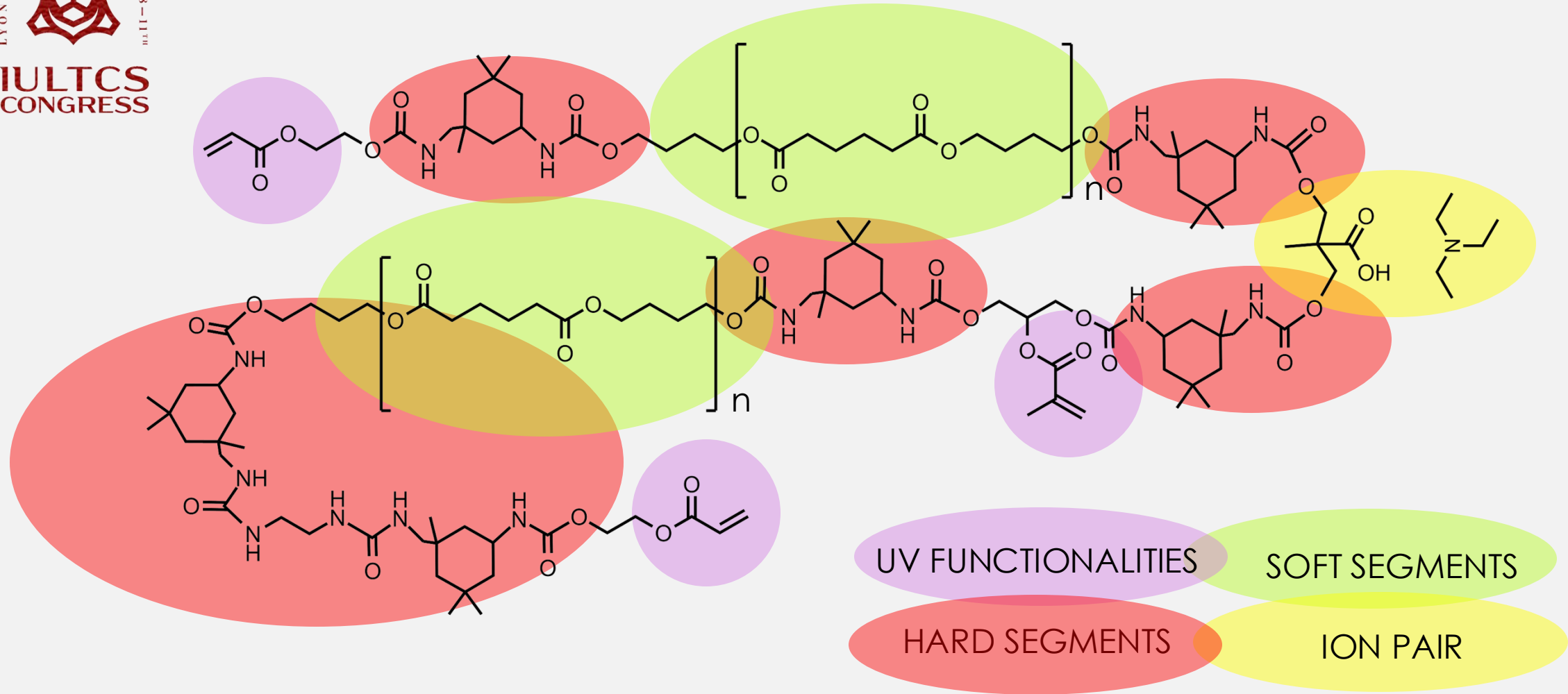


POLYOLE
BIO



DIISOCYANATE
IPDI

One-component systems: UV curing

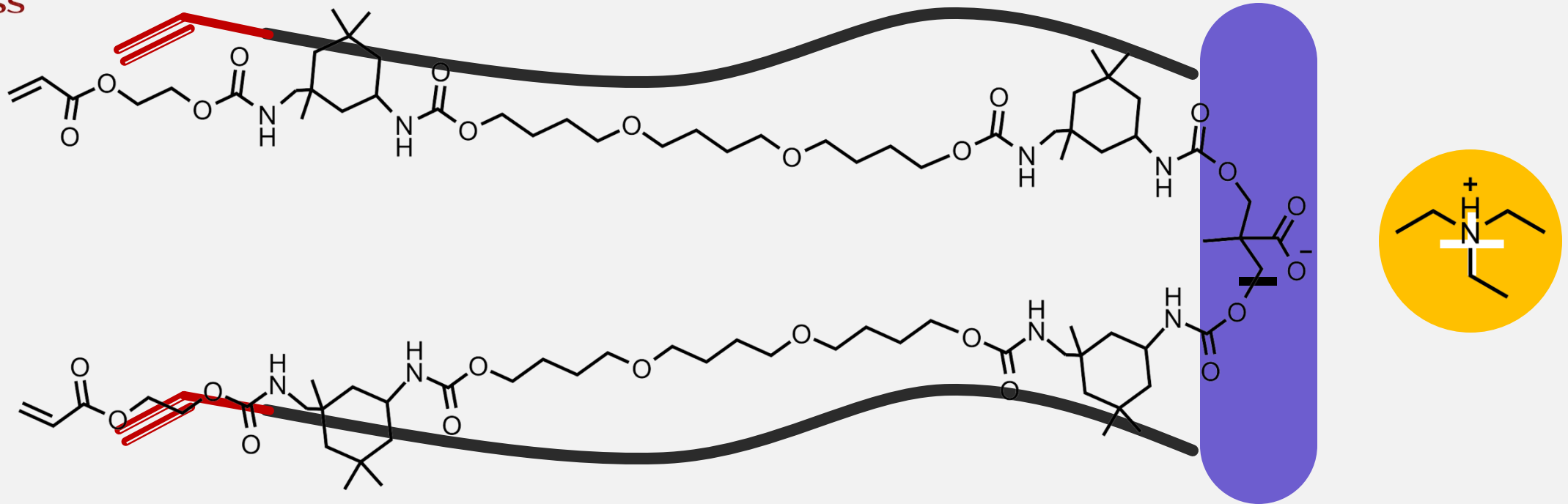


UV curing on Leather

UV-PUD's Features

Name	Features
UV-PUD 1	Bio-based 64% solution extension
UV-PUD 2	Bio-based 36% UV surfactants
UV-PUD 3	Solution extension
UV-PUD 4	Solution extension
UV-PUD 5	PTMEG emulsion extension

UV curing on Leather



UV-TC's Features

NameC	Appearance	Elastic modulus [MPa]	Elongation at break [%]	Stress at break [MPa]
UV-TC 1	Glossy	7.20	200.53	7.40
UV-TC 2	Matt	12.50	240.53	10.16
UV-TC 3	Glossy	8.45	360.14	8.95
UV-TC 4	Matt	10.51	301.19	9.66
UV-TC 5	Glossy	13.50	312.21	11.18

UV curing on Leather

UV-TC's Features

Name	<i>Rubbing cycles after curing</i>	<i>Rubbing cycles after one day</i>	<i>Flex cycles</i>
UV-TC 1	410	460	>100'000
UV-TC 2	680	710	>100'000
UV-TC 3	430	450	>100'000
UV-TC 4	880	900	>100'000
UV-TC 5	510	540	>100'000

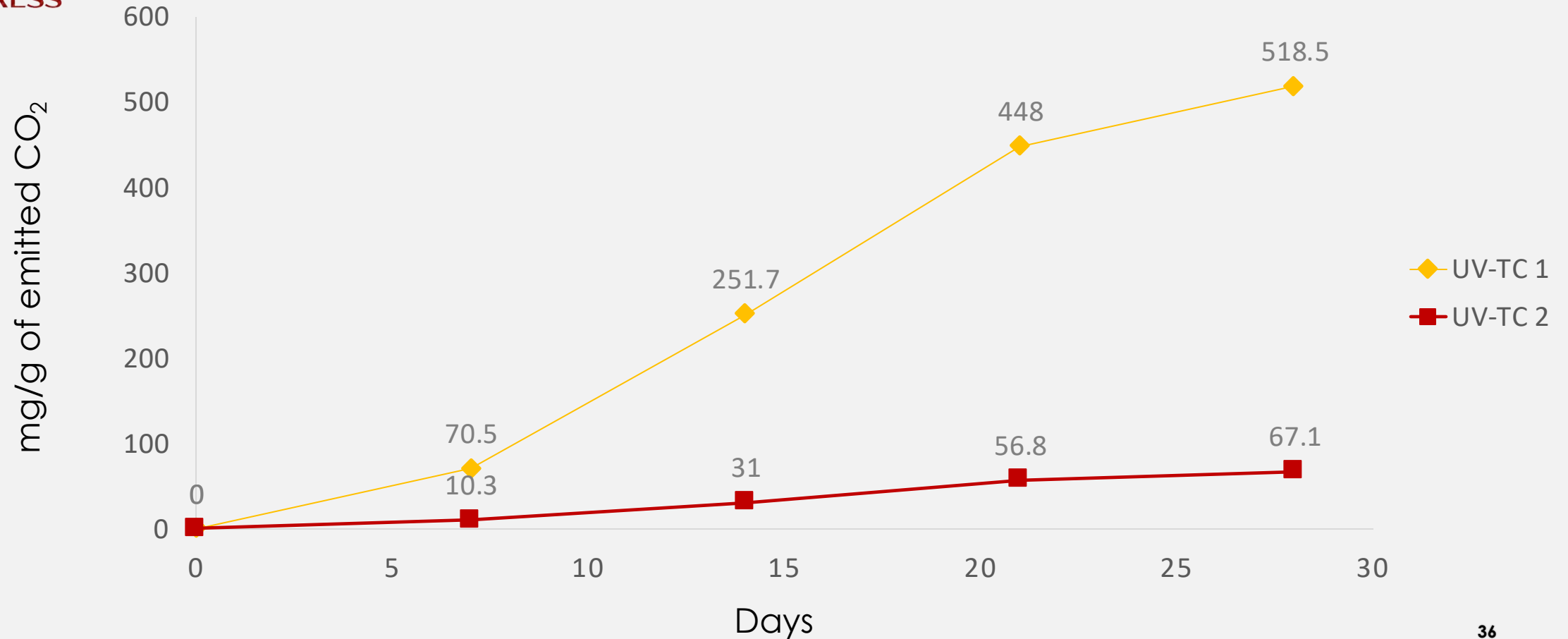
UV curing on Leather

UV-TC's Features

Name	Ethanol 2h [%]	Water 16h [%]	Methyl Acetate 2min [%]
UV-TC 1	51.58	9.19	56.47
UV-TC 2	53.42	4.88	72.66
UV-TC 3	56.10	10.32	40.53
UV-TC 4	48.87	7.49	35.60
UV-TC 5	55.36	11.47	38.94
Polycarbonate PUD + 8% Polyisocyanate	64.82	5.19	51.30

UV curing on Leather

UV-TC's Features : Biodegradability in soil



Conclusion

With the UV-CURING:

There is NOT handling of dangerous substances

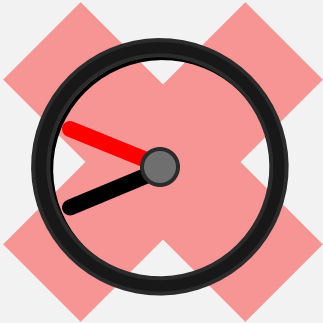
It is NOT necessary to add crosslinker before application.
Furthermore :

There is no pot life to respect

The developed UV-TCs have demonstrated mechanical properties comparable to those of two-component products on the market

Bio-based products have also been developed

The whole technological innovation presented is patent pending



Acknowledgement

Thanks to Mr. Diego Tezza (Corichem) for the assistance in the development of leather articles.

Thanks to Prof. Mammi S. of the University of Padua and the professor Honisch C. and Ruzza P. of the CNR for their contribution to the characterization of the materials.

Our thanks to Dr. Mattia Fiorasi and Dr. Anna De Rossi for their support in the laboratory work.

Thanks to the entire Corichem R&D laboratory for the support.

Thank you for your attention.

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