



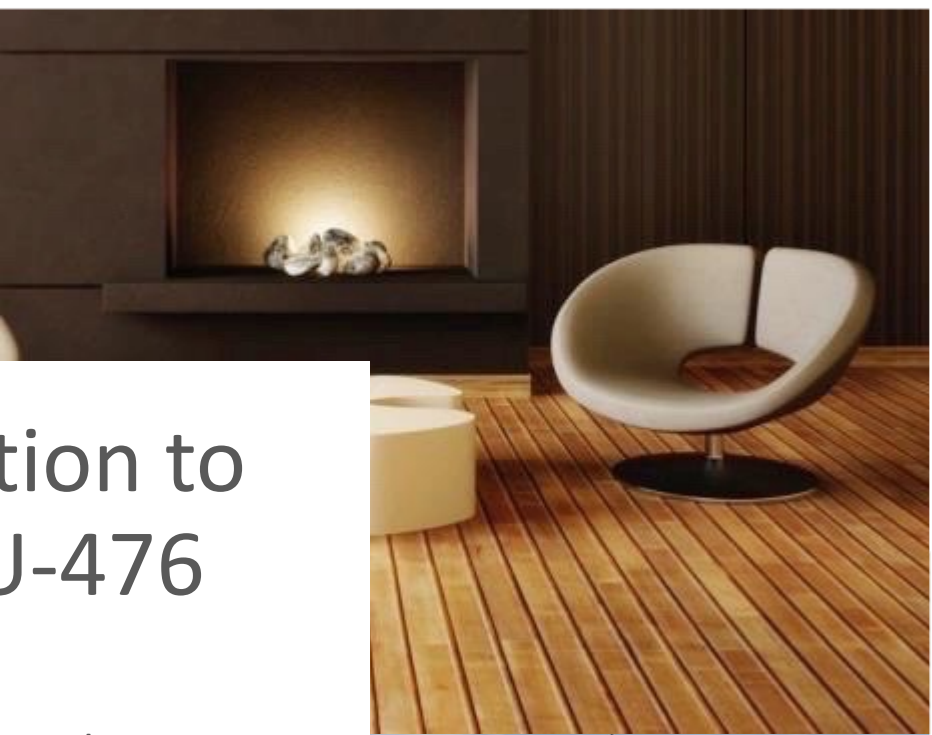
1K and 2K water-based systems for wood coatings based on renewable resources

Ramspec Milano October 2018

Edgar Alarcón

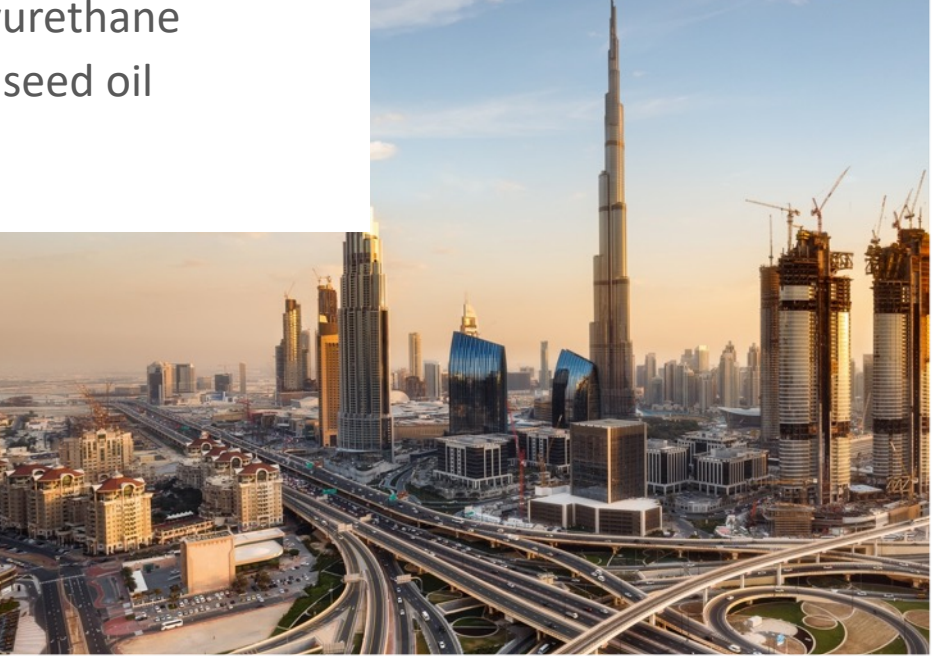
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Introduction to Relca[®] PU-476

Solvent-free polyurethane
modified with linseed oil



Relca[®] PU-476

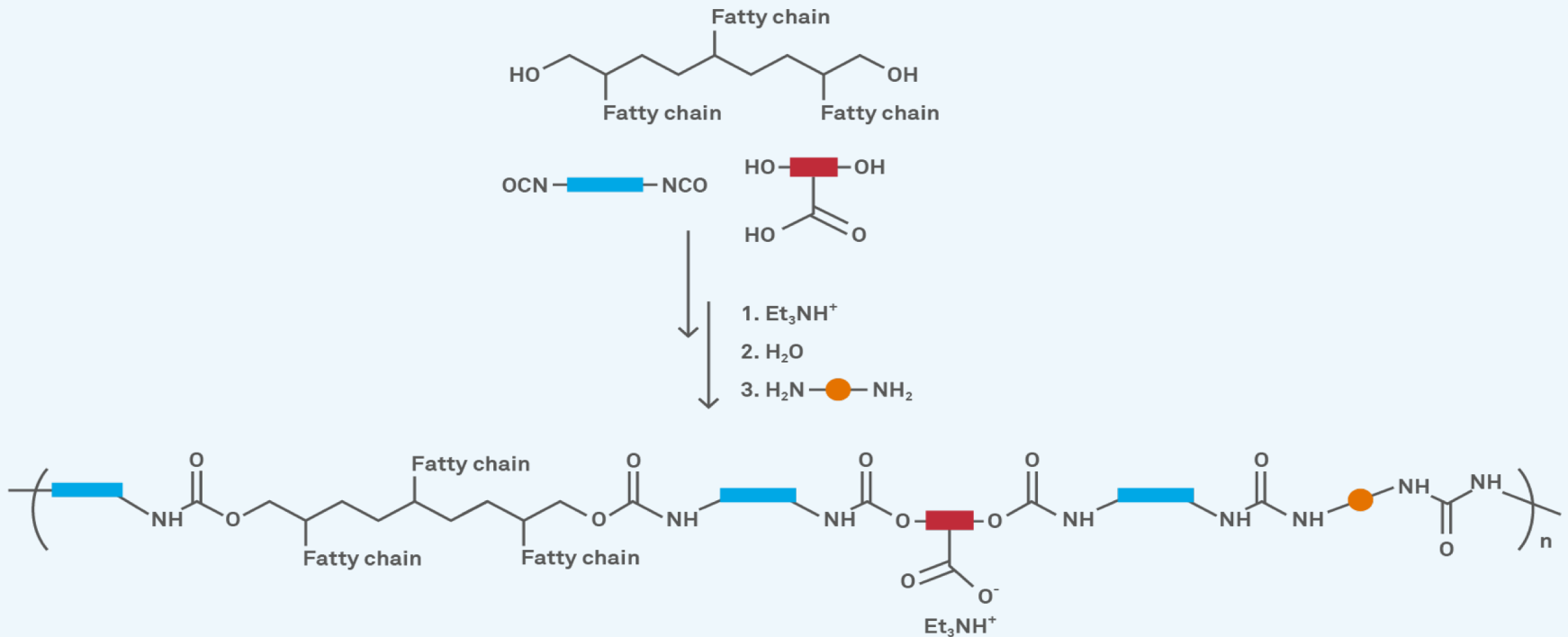
Product properties

Fatty acid	Linseed oil
Renewable content	42% (on solids)
MFFT	40 °C
Solid content	36 %
König hardness	160 seconds
Key property	Excellent “anfeuerung” and Very good chemical resistances
Application	Parquet flooring



Relca[®] PU-476

Chemical reaction



Relca[®] PU-476

Benefits

- Water-based and cosolvent-free
- 42% of the solid content is based on renewable resources
- Does not need driers
- Very good chemical resistances without the addition of crosslinkers
- Very good wood wetting
- Excellent “anfeuerung”
- High hardness
- Very good leveling
- Outstanding scratch and black heel mark resistance



stahl

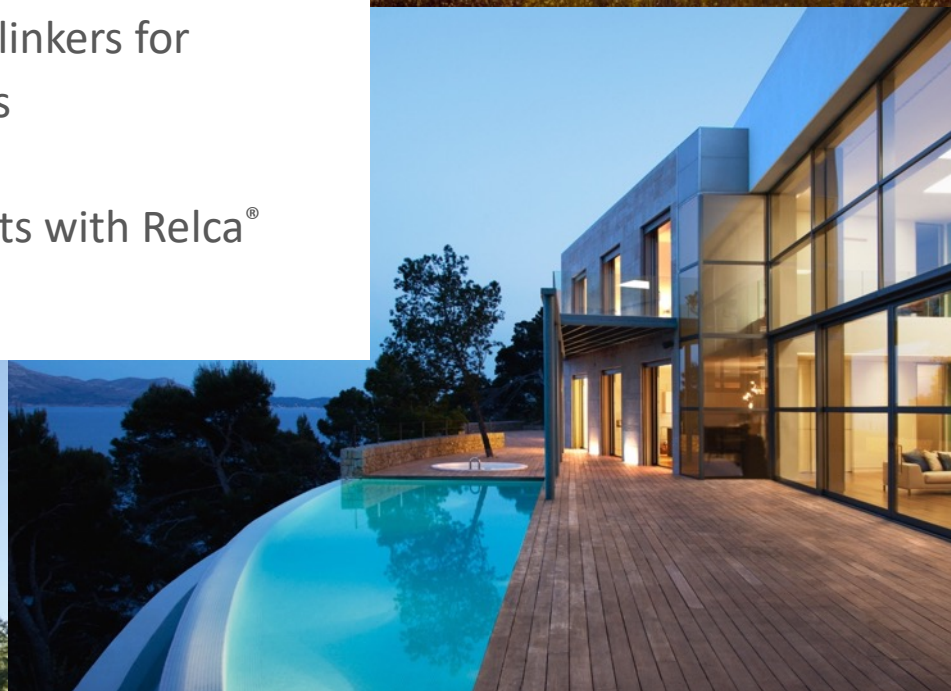
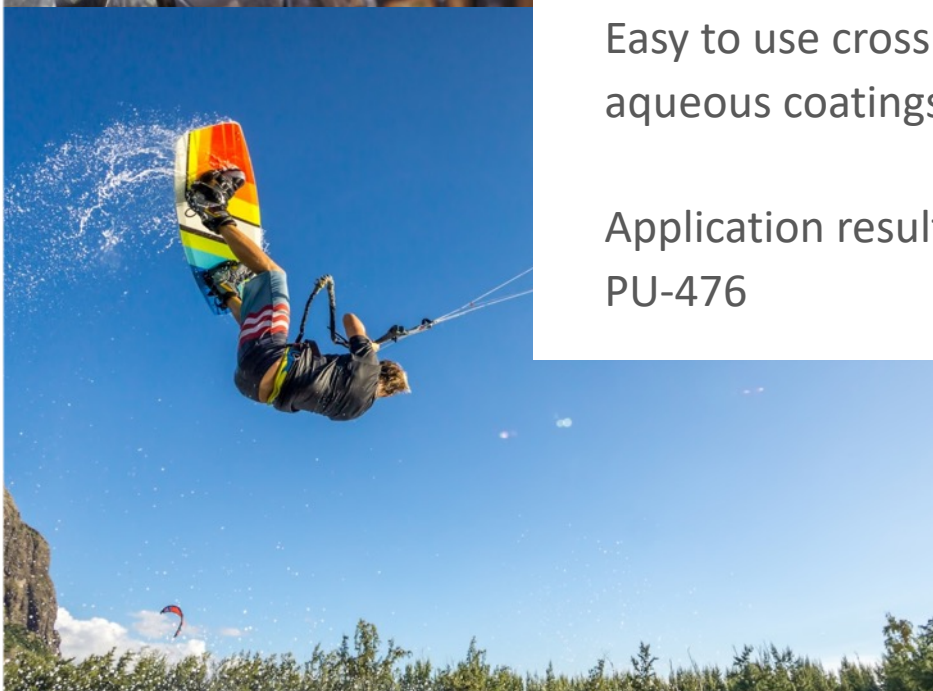
polymers



Carbodiimide crosslinkers

Easy to use crosslinkers for aqueous coatings

Application results with Relca[®] PU-476



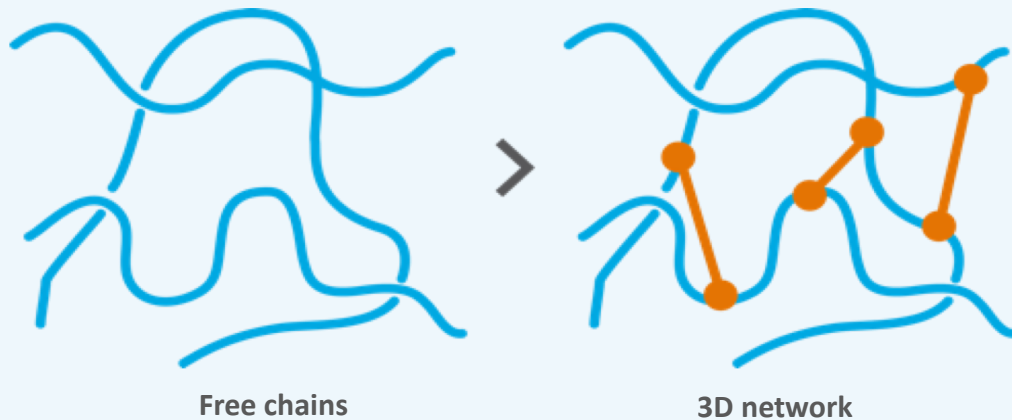
Crosslinking

- **2K**

In a “real 2K system” the binder is synthesized during application, by means of a reaction between a polyol and an isocyanate crosslinker. In this case, if there is no crosslinker there is no binder.

- **Polymer + Crosslinker**

Stahl Polymers binders are already polymerized and film forming. Function of the crosslinker is to improve specific characteristics (mechanical properties, chemical resistance,...).






Main types of crosslinkers

- Aziridines
- Isocyanates
- Polycarbodiimides
- Melamines



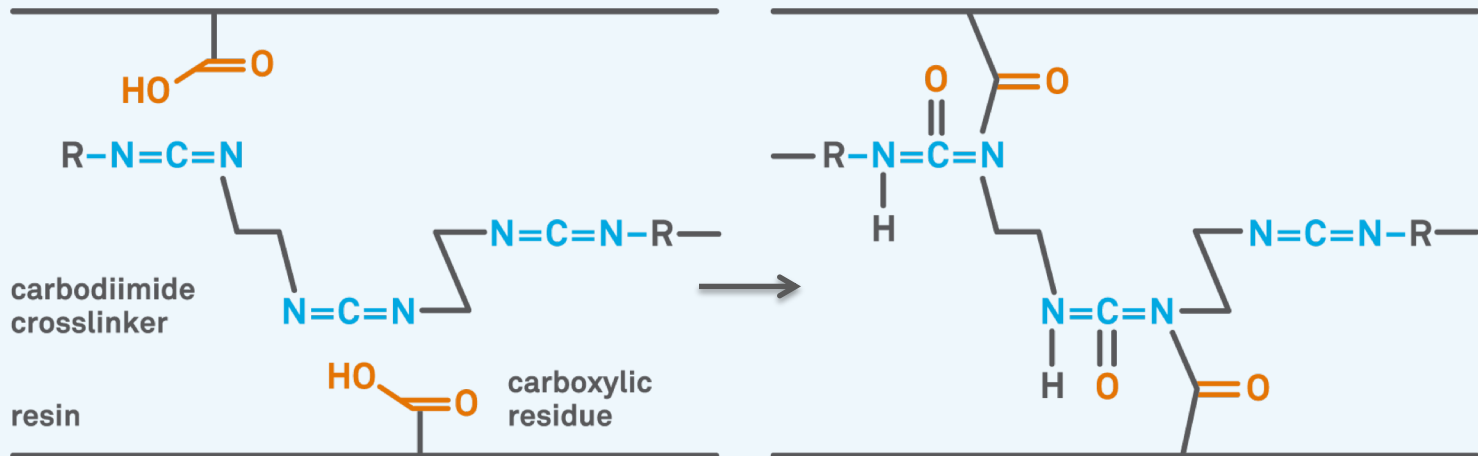
Crosslinkers comparison

	Carbodiimide*	Isocyanate	Aziridine	Melamine
Reacts with	-COOH	-OH, NH, Water	-COOH	-OH
Pot life	Up to several weeks	1 to 6 hours	12 hours	Very long
VOC	0% - 50%	0% - 20%	0%	
GHS Symbols	None			
R-phrases	None	R43, R52/53	Muta Cat. 3, R68, R43, R41, R38	Carc. Cat 2 R43/45/52/53

Moisture sensitivity	Low	Very high	High	Low
Yellowing	Low	Low	High	Low
Gas release	None	CO ₂	None	None
Viscosity	Low	Low - high	Low	Low

* Not all products have all properties

Polycarbodiimide crosslinking



Carbodiimide groups (N=C=N) react with carboxylic acid residues (COOH)

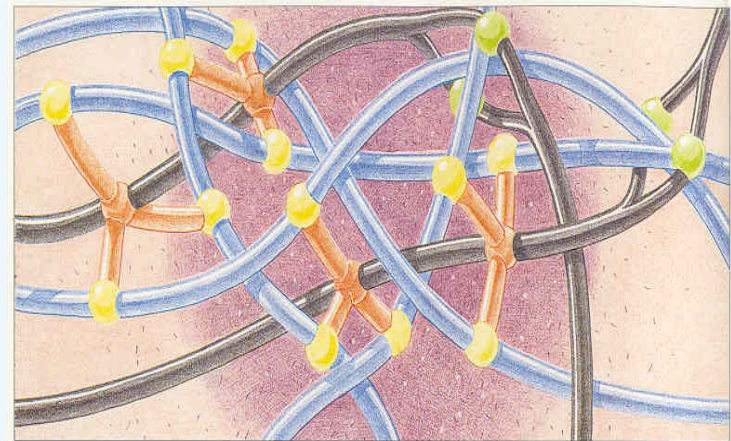
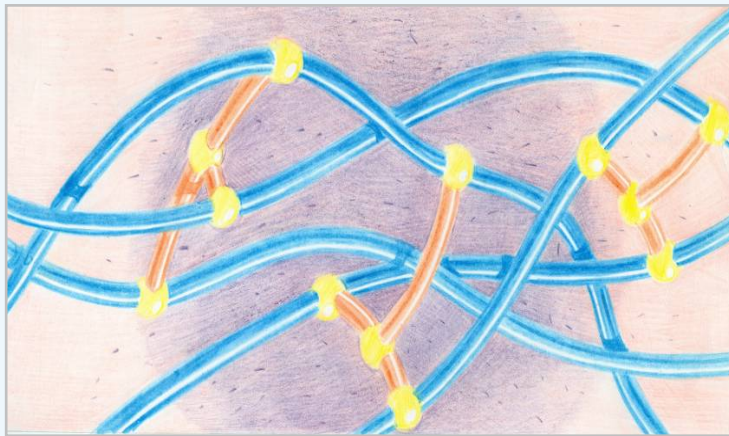
SHE aspects:

“Defined as non-hazardous by OSHA under 29 CFR 1910.1200(d).”

Benefits:

(very) effective due to unique multifunctionality, long pot life, low/no VOC

Multifunctional CDIs



Stahl holds patents on multifunctional polycarbodiimides.

These products contain a 2nd reactive group that creates an extra crosslinking network and helps to achieve even better performance.

Summary of Stahl CDIs

Product	Physical State	Type	Active matter (%)	g/eq (on act matter)
Picassian® XL-701	Fluid liquid	Multifunctional	50	590
Picassian® XL-702	Fluid liquid	Waterborne	40	540
Picassian® XL-725	Viscous liquid	Multifunctional	100	700
Picassian® XL-732	Fluid liquid	Waterborne	40	460

Registration status

Country	Australia	Canada	China	Europe	Japan	Korea	Philippines	USA
Inventory	AICS	DSL/NDSL	IECSC		ENCS	ECL	PICCS	TSCA
Picassian® XL-701	u.p.	Y (max 21 MT/y)	Y	Exempt	Y (max 1 MT/y)	u.p.	no	Y
Picassian® XL-702	Y	Y (max 25 MT/y)	u.p.	Exempt	Y	u.p.	no	Y
Picassian® XL-725	u.p.	no	u.p.	Exempt	Y (max 1 MT/y)	u.p.	no	Y
Picassian® XL-732	u.p.	Y (max 25 MT/y)	u.p.	Exempt	Y	u.p.	no	Y

u.p. = under preparation

Y = yes, compliant

Application Tips

- CDIs react with carboxylic groups. At $\text{pH} > 8.5$ carboxylic groups are in the inert carboxylate form, therefore: binder formulation at $\text{pH} > 8.5 \rightarrow$ LONG POT LIFE
- Reaction takes place at room temperature
- Once the coating is applied, volatile amines evaporate, pH drops and crosslinking reaction starts
- Second reactive group of multifunctional CDIs is sensitive to water, in this case pot life is up to 12 h. These products should be stored under protective atmosphere
- Optimum quantity CDI to be found via lab work; usually 3 to 7% on binder formulation
- Crosslinking effectivity is evaluated by means of chemical resistance test

Examples of application

Binder	Carbodiimide crosslinker	Chemical	Resistance without CDI	Resistance with CDI
Relca® PU-476	3% Picassian® XL-725	Ethanol 48%	3	5
Picassian® AC-126	6% Picassian® XL-701	Ethanol 48%	3	5
Relca® HY-460	3% Picassian® XL-725	Ethanol 48%	1-2	4
Relca® PU-477	2.5% Picassian® XL-725	Ink	3	5
Relca® PU-674	7% Picassian® XL-732	Acetone	3	5
Relca® PU-625	6% Picassian® XL-701	Ethanol 48%	1	5

Chemical resistance test

Resin = Relca® PU-476

Evaluated according to DIN 12720 (1 = bad; 5 = good)

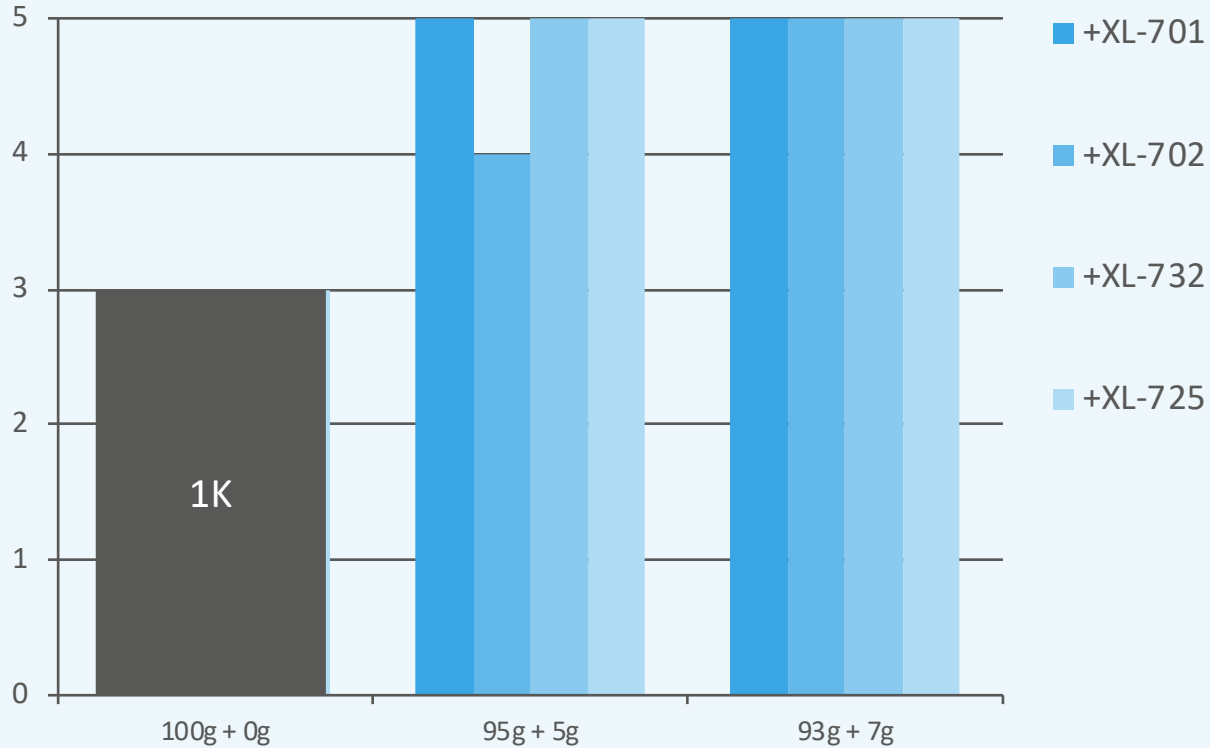
Chemical	without XL	+ 5% XL-701	+ 7% XL-702	+ 3% XL-725	+ 7% XL-732
Ethanol 48% 1h	3	5	4	5	5
Ammonia 10% 2min	5	5	5	5	5
Acetone 10''	4	5	5	5	4
Ink 16h	5	5	5	5	5
Sun tan lotion 16h	2	3,5	3	3,5	3,5
Hand cream (Nivea) 16h	3	4	3,5	3,5	3,5
Hot coffee 16h	2	3	3	3	3
Water 16h	5	5	5	5	5

Ethanol resistance (50%, 1h) |



Resin = Relca® PU-476

Evaluated according to DIN 12720 (1 = bad; 5 = good)



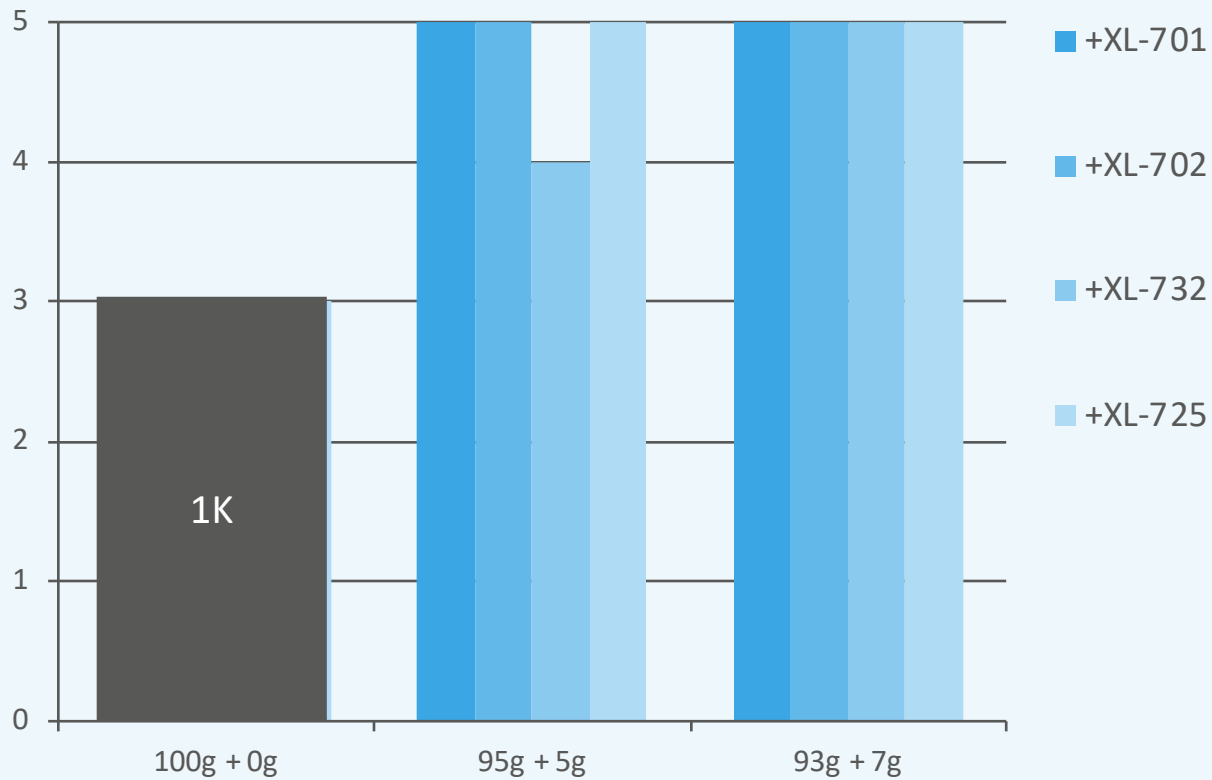
Acetone resistance (2 min) |



Wood

Resin = Relca® PU-476

Evaluated according to DIN 12720 (1 = bad; 5 = good)

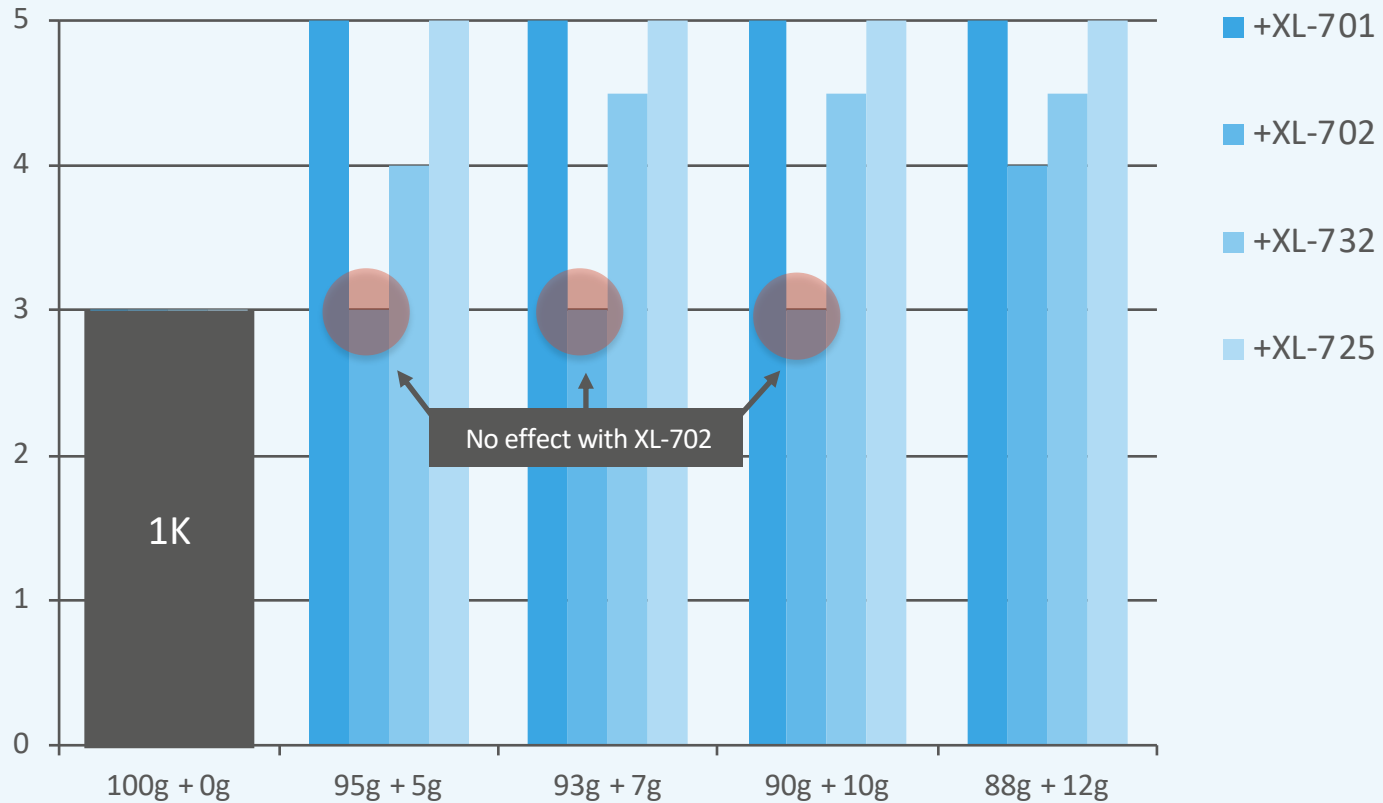


Ammonia resistance (10%, 1h) |



Resin = Relca® PU-476

Evaluated according to DIN 12720 (1 = bad; 5 = good)



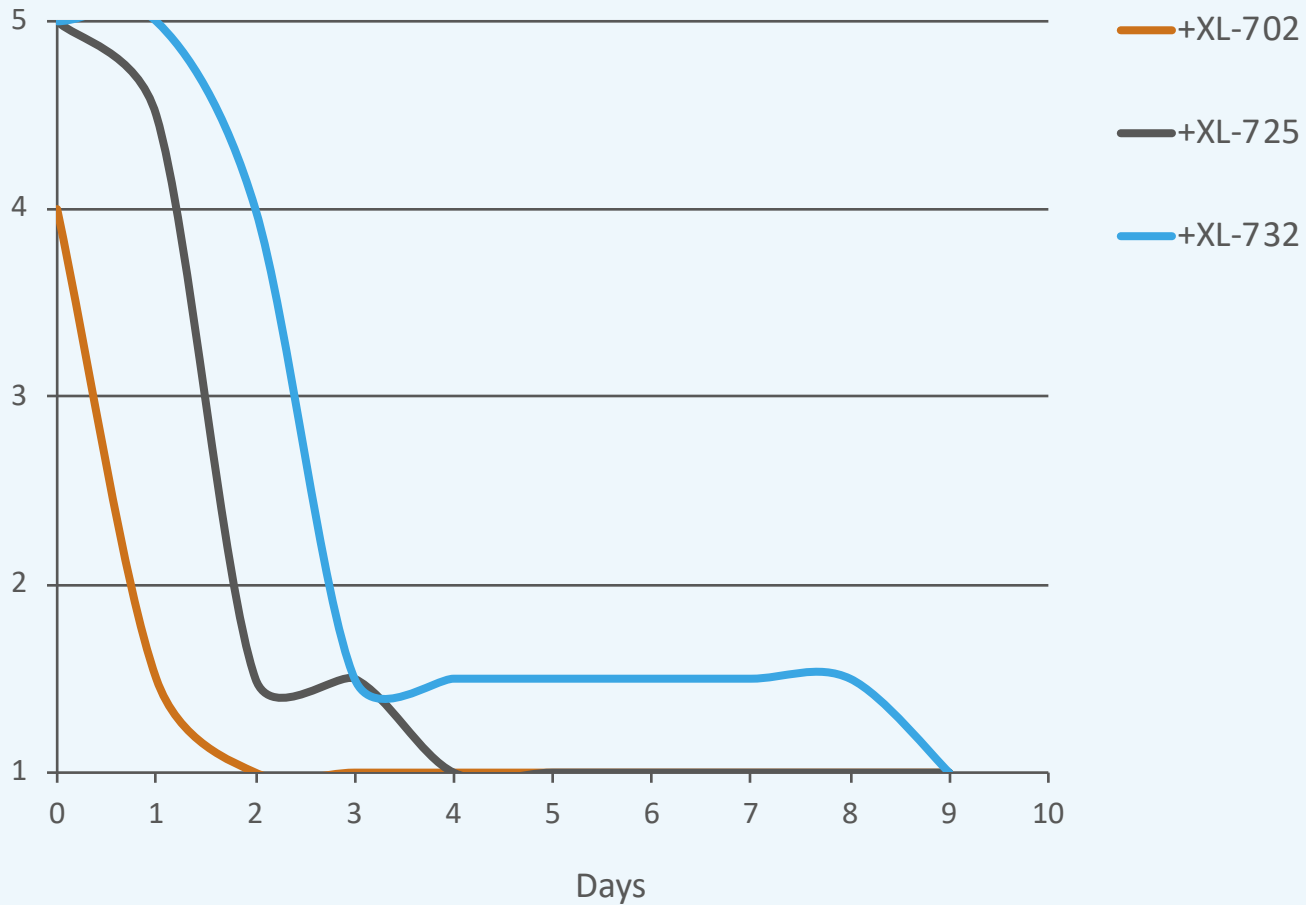
Pot life – Ethanol resistance (50%, 1h) |



Resin = Relca® PU-476

pH = 8.1

Evaluated according to DIN 12720 (1 = bad; 5 = good)



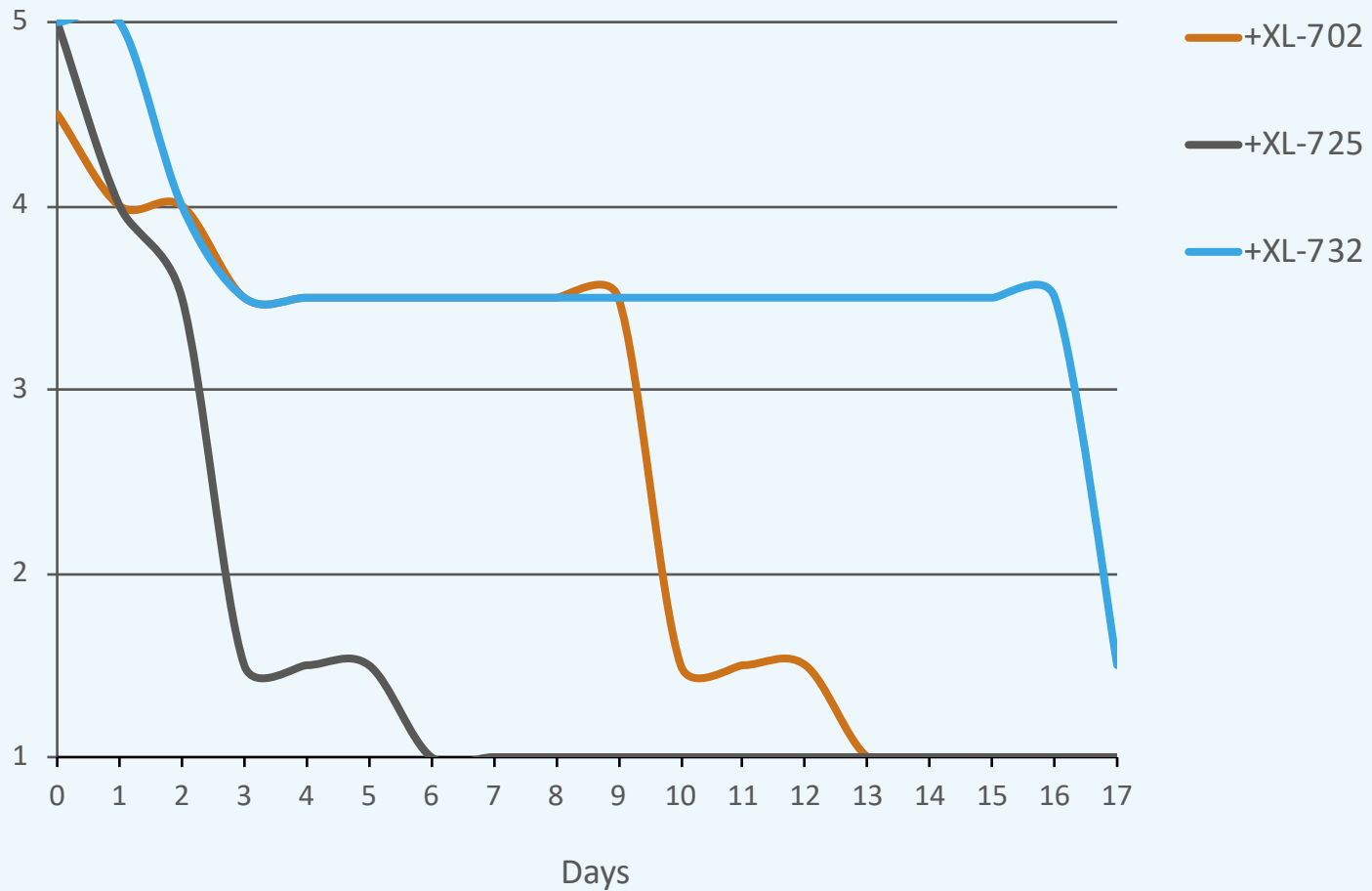
Pot life – Ethanol resistance (50%, 1h) |



Resin = Relca® PU-476

pH = 9.0

Evaluated according to DIN 12720 (1 = bad; 5 = good)



Summary

- Relca® PU-476 can be used in 1K and 2K (if we need to improve the chemical resistances)
- It gives high hardness, high scratch resistance and very good wetting properties
- Polycarbodiimides are a good alternative to isocyanate and aziridine crosslinkers
- Low VOC and low emissions coatings
- Right combination “binder – CDI” has to be found empirically (lab tests)
- Benefits of CDIs include:
 - Improved chemical resistance
 - Improved adhesion
 - No classification/labelling
 - Long pot lives
 - No gas release
 - Reaction at room temperature



www.stahlpolymers.com