Stahl Polymers

Wood coatings

October 2016

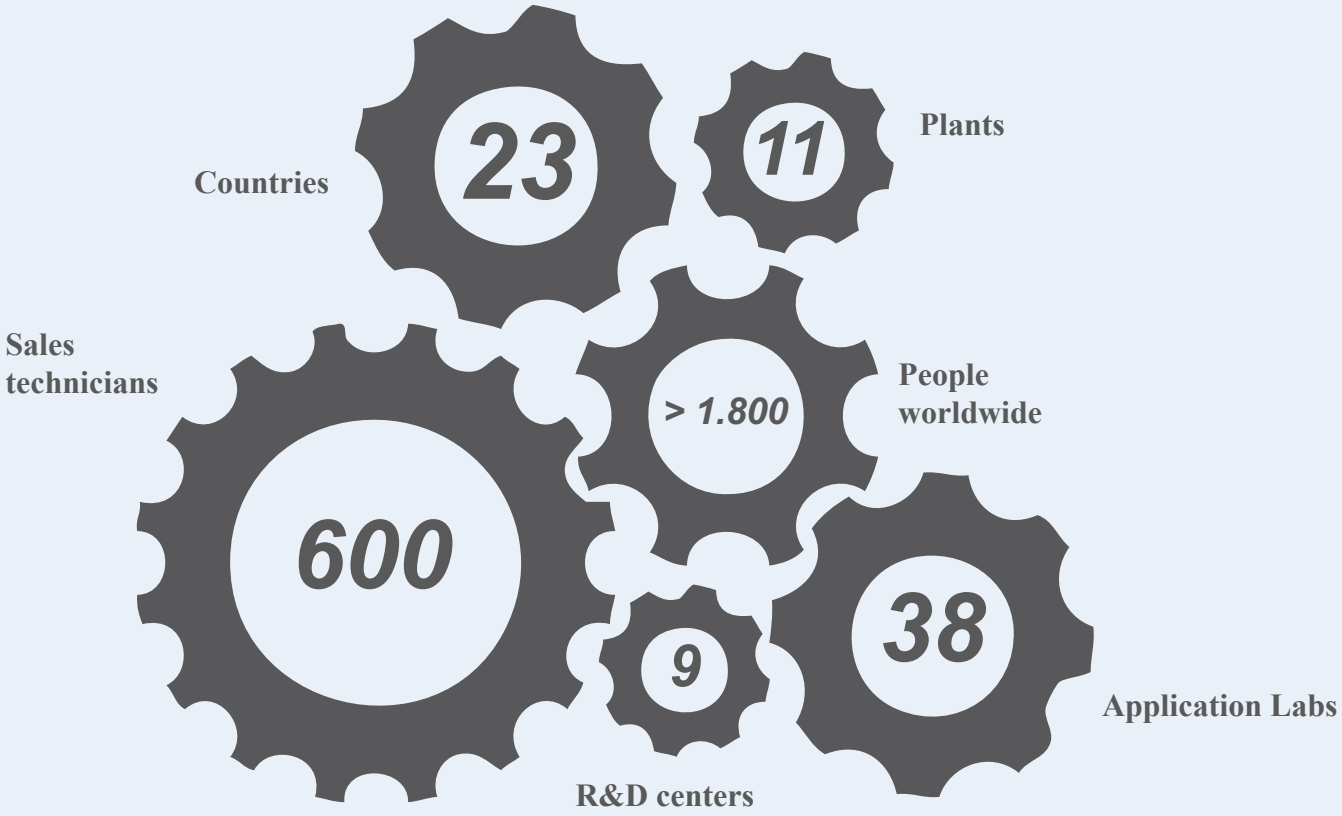
Content

- Stahl Polymers general presentation
  - Worldwide coverage - Operational excellence
  - Stahl business units – Stahl Polymers
- Type of technologies
- Binders for wood coatings
  - Acrylic for outdoor wood coatings
  - Acrylics for interior wood coatings
  - Polyurethanes for parquet flooring
- Our Carbodiimide Crosslinkers
- How can we be of service?

Worldwide coverage

- One headquarters
- 9 R&D centers
- 11 Manufacturing sites
- 38 Application labs in 23 countries
- 1800+ Employees

Operational Excellence



Stahl Business Units

Stahl
Management Team

Stahl
Business Services

Central General Services

Wet-End

Leather Finish
Automotive
Leather chemicals

PielColor

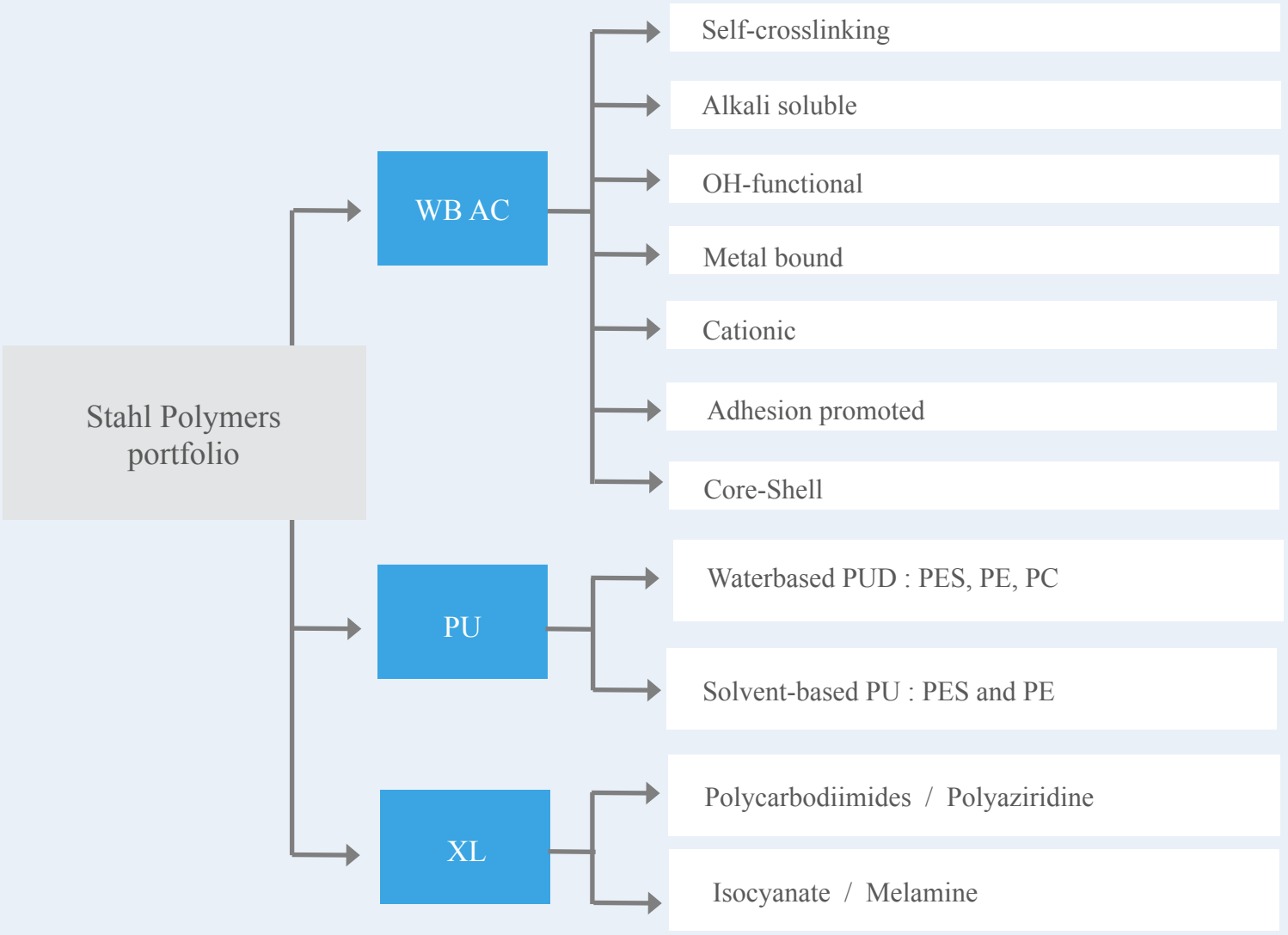
Performance Coatings

Stahl Polymers

Stahl Polymers

High-quality, better service.
We constantly challenge ourselves to developing
high-quality coatings that have less impact on the environment.

Types of technologies



Acrylics for outdoor wood coatings

Picassian® AC-290 APEO-free, self-crosslinking acrylic emulsion:

- Adhesion on old alkyd and acrylic paints, PVC, aluminium and zinc
- Good blocking resistance at high coating thickness
- Low water absorption
- High water vapour permeability
- Easy and quick sandability
- High gloss and transparency
- Non yellowing after UV exposure
- High impact resistance
- Low dirt pickup
- Compatibility with pigment pastes
- High flexibility

Acrylics for outdoor wood coatings

Picassian® AC-290	
Solids (%)	44
pH	8,5
MFFT (ºC)	< 5
Hardness (König, s)	57
Elongation (%)	210
UTS / Mod 100% (MPa)	11 / 7,5
Blocking resistance (N)	1,1
Early water resistance	5

Acrylics for interior wood coatings

Picassian® AC-169 APEO-free, self-crosslinking acrylic emulsion:

- Fast drying
- Easy sanding. Sandable after 30 minutes at room temperature
- Outstanding blocking resistance (face to face test)
- Self-crosslinking for optimum surface properties
- Excellent scratch resistance

Acrylics for interior wood coatings

Picassian® AC-169	
Solids (%)	40
pH	8
MFFT (ºC)	20
Hardness (König, s)	73
Blocking resistance (N)	0,3
White spot (water resistance)	5

Acrylics for interior wood coatings

Picassian® AC-192 APEO-free, self-crosslinking and OH-functional acrylic emulsion for 1K and 2K systems:

- Fast drying and easy sanding
- Self-crosslinking for optimum surface properties
- Can be crosslinked with isocyanates to improve properties
- Excellent chemical resistances
- Very good transparency

Acrylics for interior wood coatings

Picassian® AC-192	
Solids (%)	40
pH	7
MFFT (ºC)	39
Hardness (König, s)	127
OH number (mg KOH/g):	60
Elongation (%)	100
UTS / Mod 100% (MPa)	9 / 9
White spot (water resistance)	5

Solvent-free polyurethane dispersions

Relca® PU-476 cosolvent-free, alkyd modified polyurethane dispersion:

- 42% of the solid content is based on renewable resources (based on plant-based materials)
- Outstanding resistance to stains and cleaning solvents
- Very high hardness
- Excellent abrasion resistance
- Very good scratch and black heel mar resistance

Solvent-free polyurethane dispersions

Relca® PU-476	
Solids (%)	36
pH	7,5
MFFT (ºC)	40
Hardness (König, s)	160
Type of oil	Linseed
Taber abrasion (mg)	26
Ethanol resistance	5
White spot (water resistance)	5

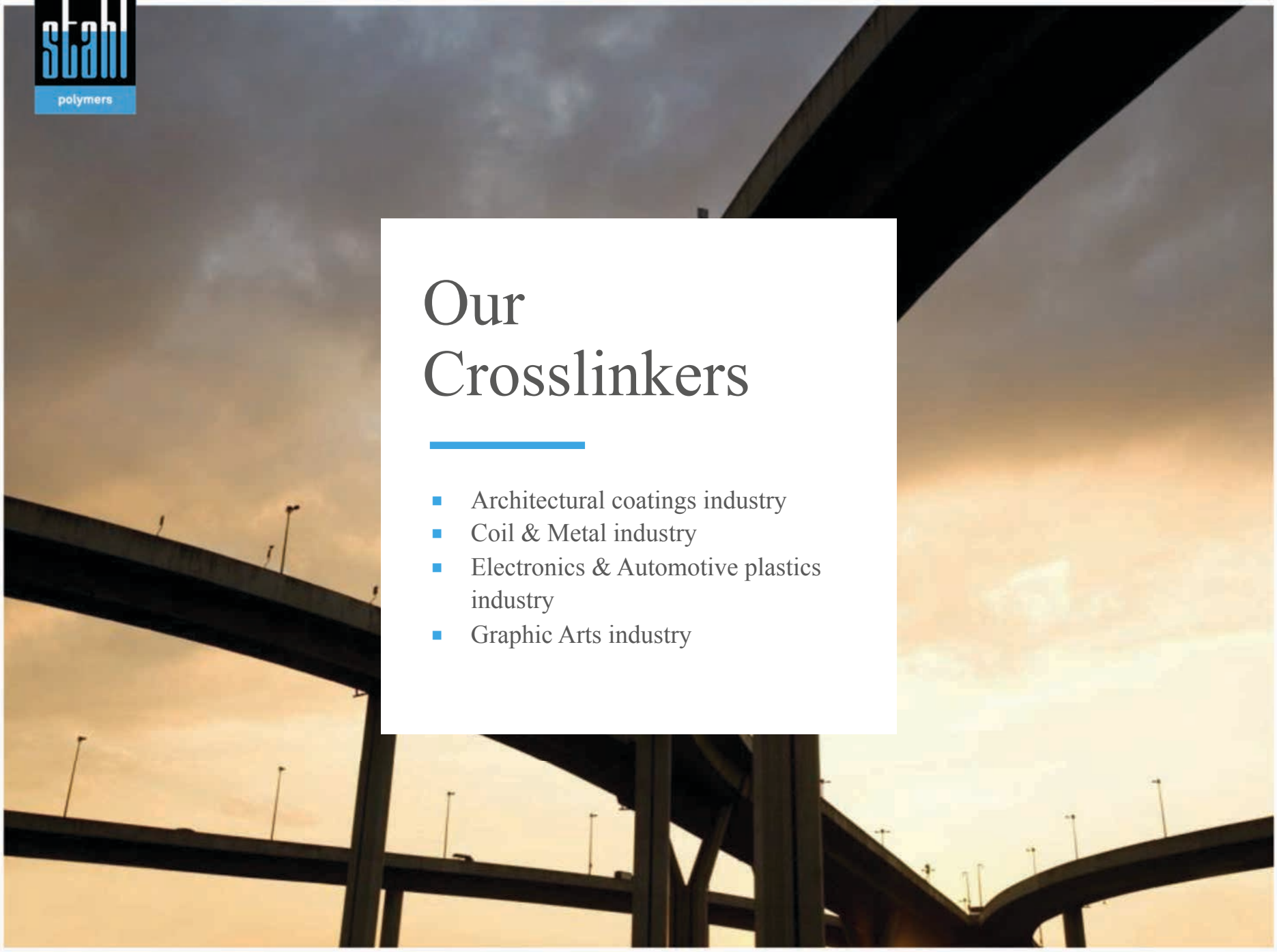
Solvent-free polyurethane dispersions

Relca® PU-625 cosolvent-free, polyester based polyurethane dispersion:

- Excellent, durable appearance on wood
- Low coalescent demand
- Very high hardness
- High elongation
- Outstanding abrasion resistance
- Very good scratch resistance

Solvent-free polyurethane dispersions

Relca® PU-625	
Solids (%)	40
pH	7,5
MFFT (ºC)	10
Hardness (König, s)	120
Elongation (%)	210
UTS / Mod 100% (MPa)	25 / 21
Taber abrasion (mg)	11
White spot (water resistance)	5



Our Crosslinkers

- Architectural coatings industry
- Coil & Metal industry
- Electronics & Automotive plastics industry
- Graphic Arts industry

Crosslinker Portfolio

Are two mechanisms by crosslinkers react: by reacting with a polymer or by reacting with itself forming a so called interpenetrating network with the polymer binder. The result:

A much denser network, which helps to modify or improve the following

- Increased strength and hardness
- Improved abrasion resistance
- Improved chemical resistance
- Improved hydrolytical resistance (degradation by water)
- Increased adhesion to substrates.

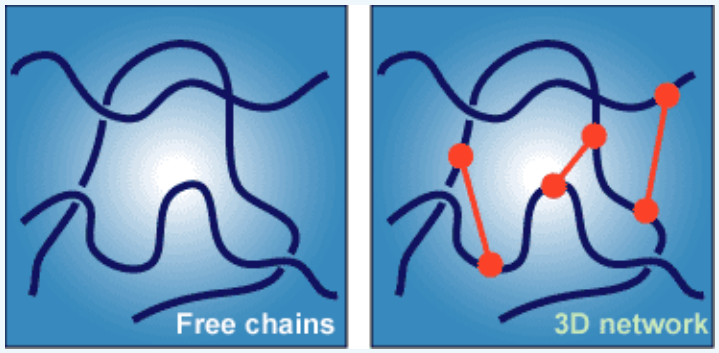
Crosslinking

2K systems

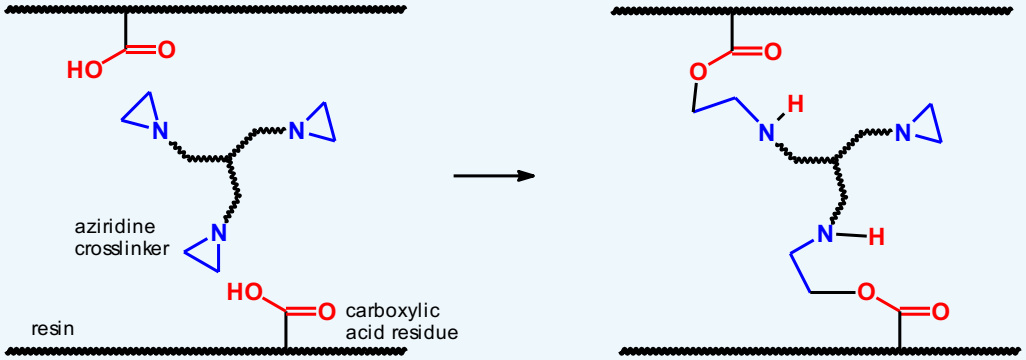
In a “real 2K system” the binder is synthesized during application, by means of a reaction between a polyol and an isocyanate crosslinker. In this case, if there is no crosslinker there is no binder.

Polymer + crosslinker

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

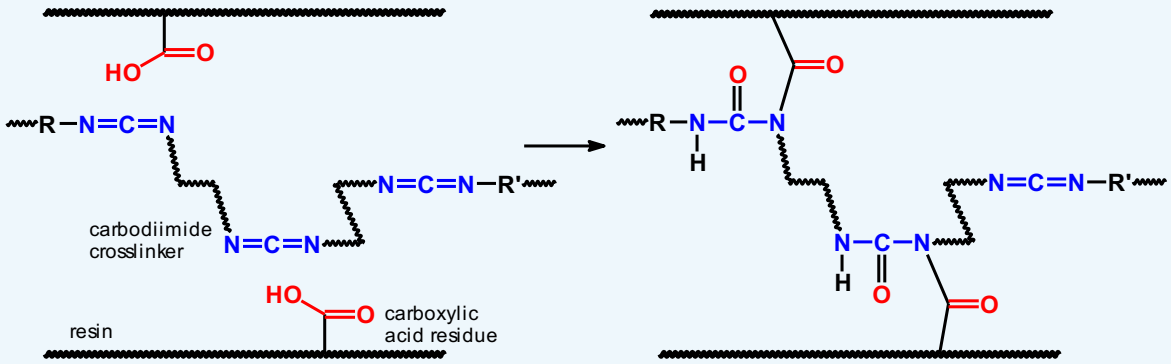


Aziridine



Aziridines are very effective... but they are hazardous chemicals!

Polycarbodiimide (CDI)



Carbodiimide groups –N=C=N- react with carboxylic groups –COOH at room temperature. Polycarbodiimide crosslinkers are label-free and allow to achieve long pot lives.

Crosslinkers comparison

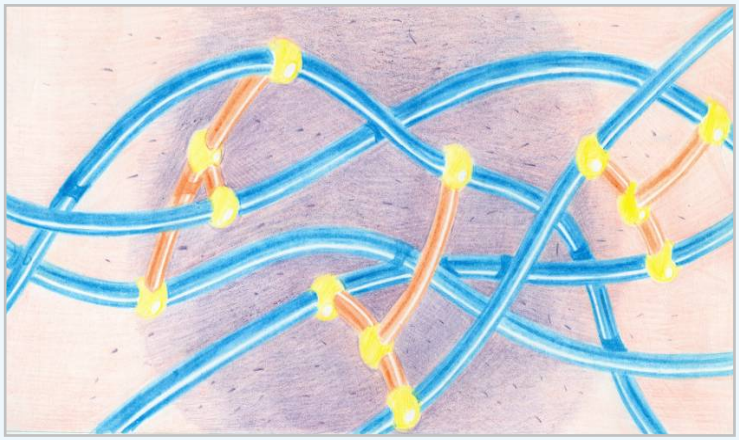
	Polycarbodiimide *		Aziridine
Reactivity	-COOH		-COOH
Pot life	Up to weeks		12 h
VOC (%)	0		0
GHS symbols	none		
R-phrases	none		Muta. Cat 3, R22/38/41/43/68
Moisture sensitivity	low		high
Gas release	none		none

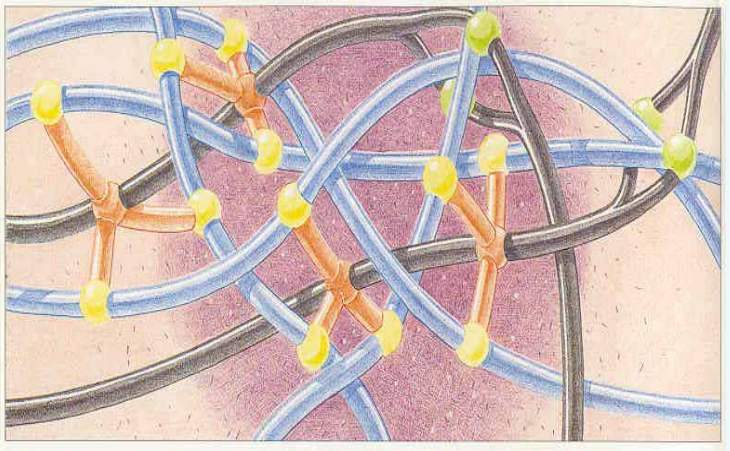
(*) Not all products have all properties

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

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.

Registration status

Country	Australia	Canada	China	Europe	Japan	Korea	Philippines	USA
Inventory	AICS	DSL/NDSL	IECSC	EINECS/ELINCS	ENCS	ECL	PICCS	TSCA
XL-701	–	✓ max 10 MT	✓	+	✓	–	✗	✓
XL-702	–	✓ max 10 MT	–	+	✓	–	✗	✓
XL-725	–	✗	–	+	✓	–	✗	✓
XL-732	–	✗	–	+	✓	–	✗	✓

✓ Compliant

– under preparation

\+ Exemption

✗ not yet planned to comply

Tips for application

- CDIs react with carboxylic groups. At pH ≥ 8.5 carboxylic groups are in the inert carboxylate form, therefore: binder formulation at pH ≥ 8.5 → LONG POT LIFE
- Reaction takes place at room temperature
- Once the coating is applied, volatile amines evaporate, pH drops and crosslinking reaction starts
- 2nd 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 of CDI must be found out through lab work, but it is usually 3 to 7% on binder formulation
- Crosslinking effectivity is evaluated by means of chemical resistance test

Examples of application

Binder	CDI	Chemical	Resistance without CDI	Resistance with CDI
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

Summary of CDIs

- Polycarbodiimides are a good alternative to isocyanate and aziridine crosslinkers
- They react with the carboxylic groups in the binder
- 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