



Speaker info

Robert Skarvan

Global Marketing Director for allnex's Liquid Resins & Additives Business

Robert.Skarvan@allnex.com



Bart Noordover

Lab Leader Synthesis (EMEA R&D) & Global ACURE™ Synthesis Lead

Bart.Noordover@allnex.com



**SUSTAINABLE, NON-ISOCYANATE SYSTEMS BASED ON ACURE™ TOPCOATS
OVER KETAC AND EASY CURE PRIMERS
LIQUID RESINS & ADDITIVES**



Bart Noordover
Robert Skarvan

www.allnex.com

allnex
The Coating Resins Company

INTRODUCTION

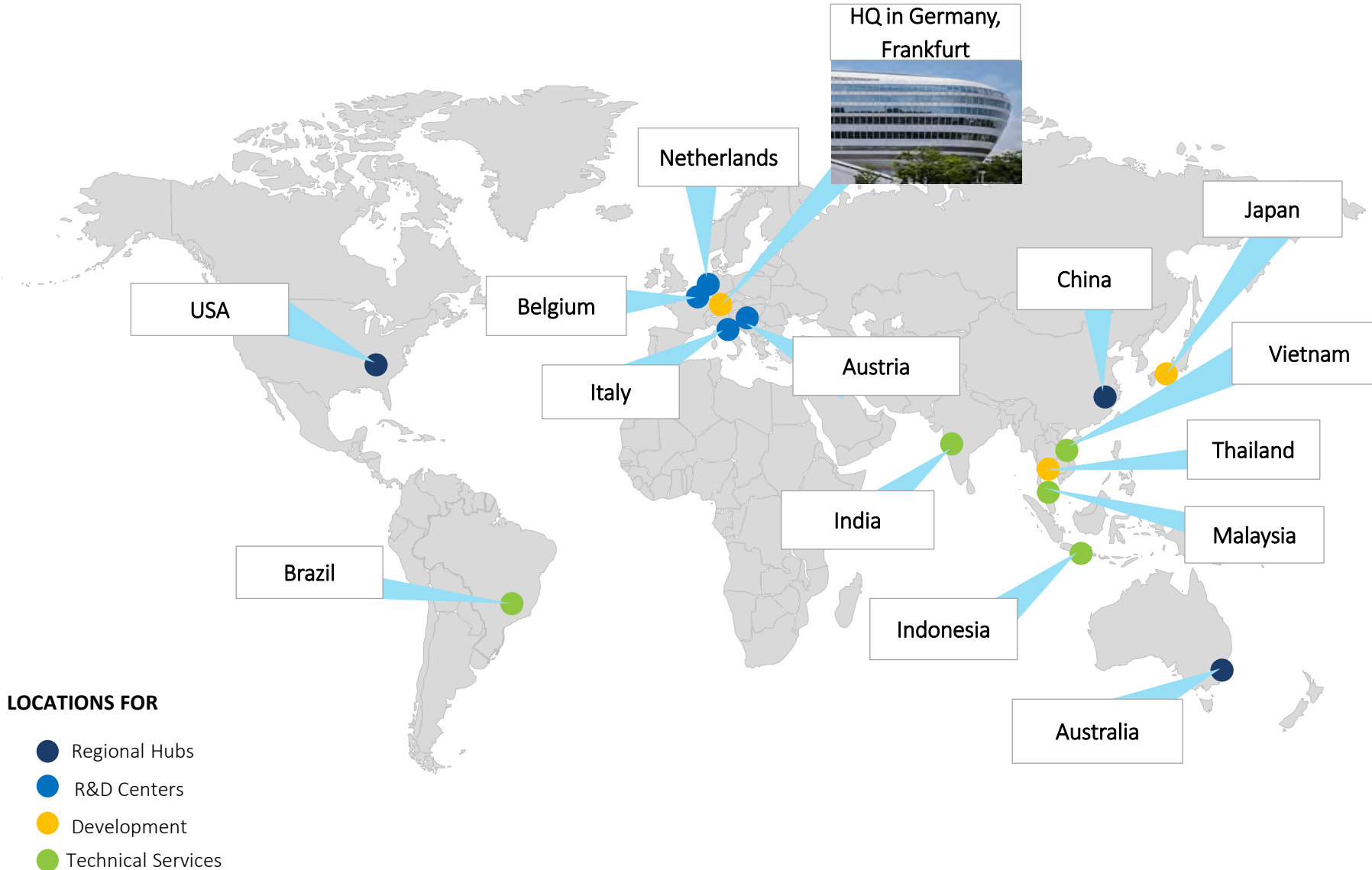
our company

our sustainability pillars

ACURE™



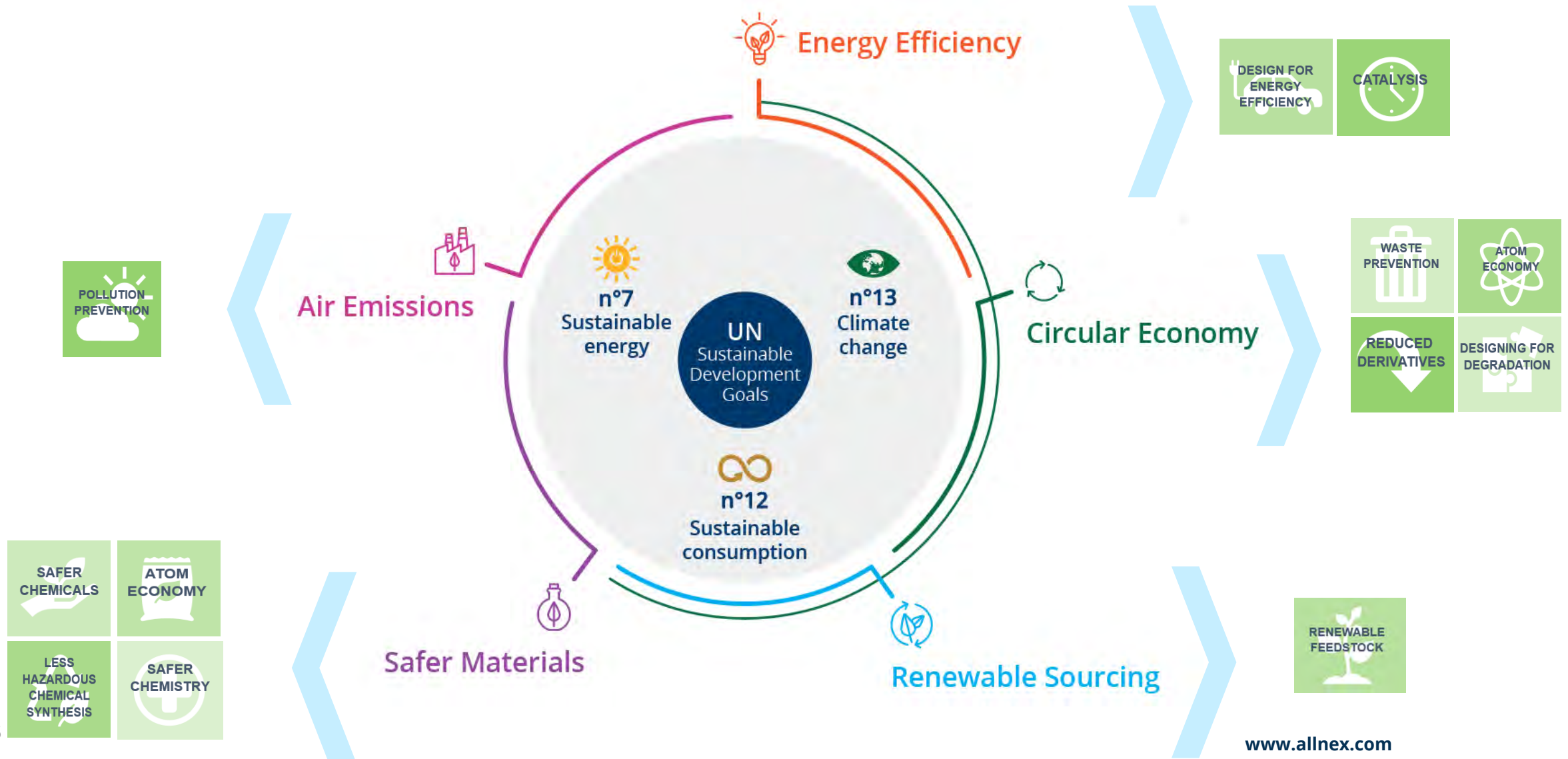
Allnex – The Global Leader in Industrial Coating Resins



23	32
R&D centers across the Globe (incl.JVs)	Production sites
>400	2.2
Scientists & Technicians	€Billion sales
 Technical service close to customers	
 Strong analytical capabilities	
 IP department	



Allnex sustainability pillars are aligned with the 12 principles of green chemistry



Game changing new resin chemistry with an unparalleled sustainability profile

ACURE™ DELIVERS ON ALL FIVE SUSTAINABILITY PILLARS!



ENERGY EFFICIENCY

50% REDUCTION IN CURING ENERGY derived from the speed of Michael addition



CIRCULAR ECONOMY

REDUCED PAINT WASTE from longer potlives, enabled by ACURE's unique blocked catalyst



AIR EMISSIONS

VOC levels 200G/L LOWER than incumbent systems



SAFER MATERIALS

ACURE systems DON'T CONTAIN ISOCYANATE, TIN, FORMALDEHYDE OR OTHER MATERIALS OF CONCERN



RENEWABLE SOURCING

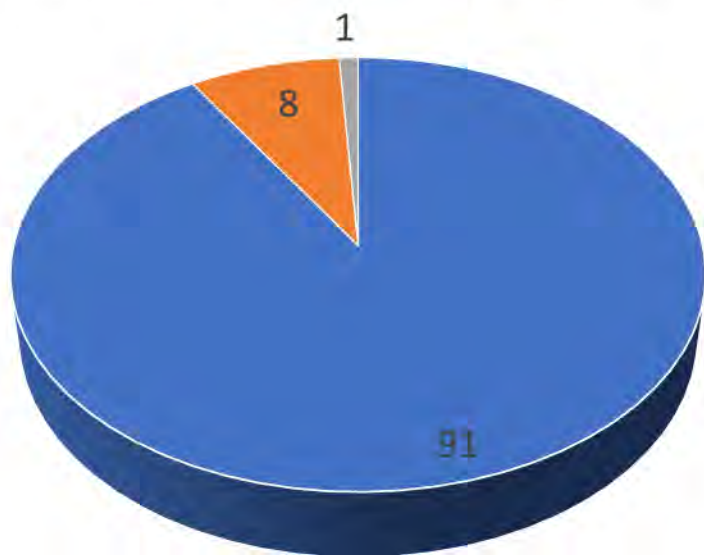
BIO CONTENT POTENTIAL OVER 80% within three years



TOPCOAT and PRIMER TECHNOLOGIES
ACURE™, KETAC and EASY CURE

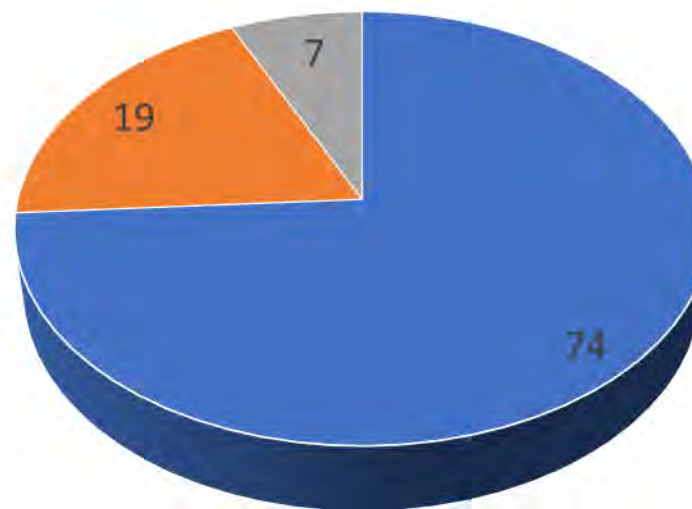
Your feedback on isocyanate-free and biobased systems

isocyanate-free primer / TC system



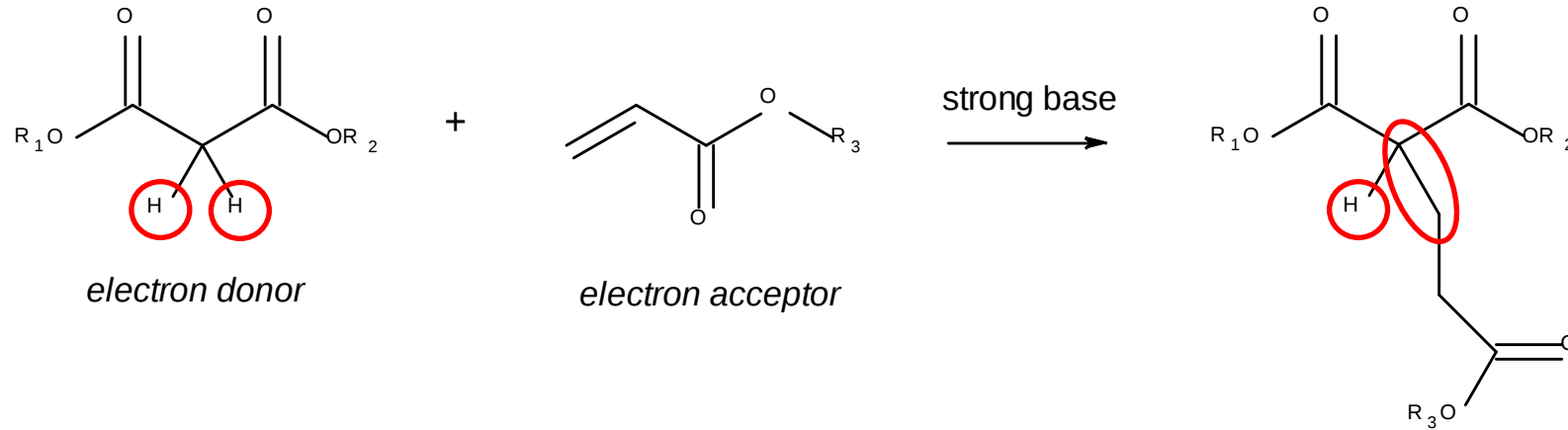
- (very) interested
- moderately interested / not sure
- not interested

biobased resin options

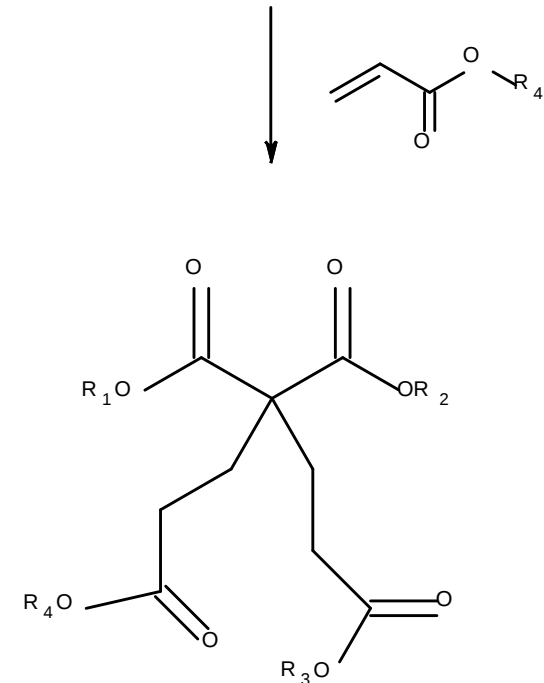


- (very) interested
- moderately interested / not sure
- not interested

ACURE chemistry: Real Michael Addition topcoats

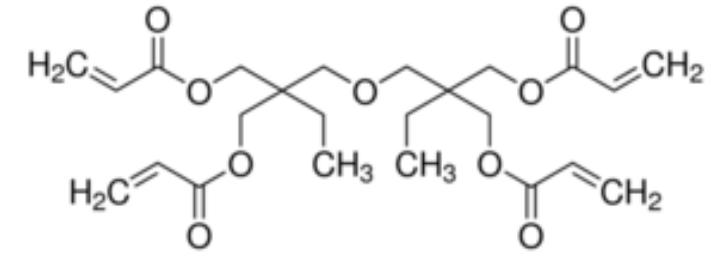


- Malonate functional polyester (pKa $\approx$ 13)
- Acrylate functional oligomer
- Strong base required (pKa $>$ 13)
- Creating C-C bond (robust)
- Few polar functional groups (OH, NH): low viscosity and VOC



ACURE resin components

- Malonate functional polyester
- Acrylate functional oligomer, e.g. DiTMPTA

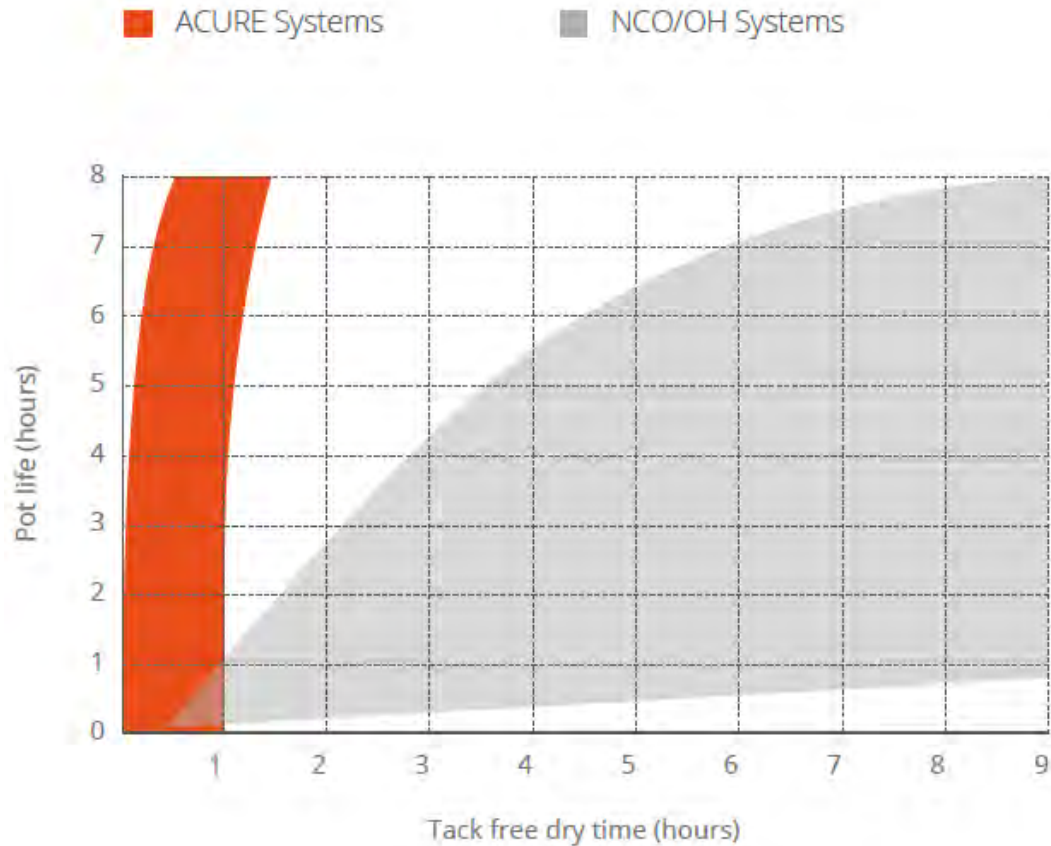


Di(trimethylolpropane) tetra-acrylate, DiTMPTA

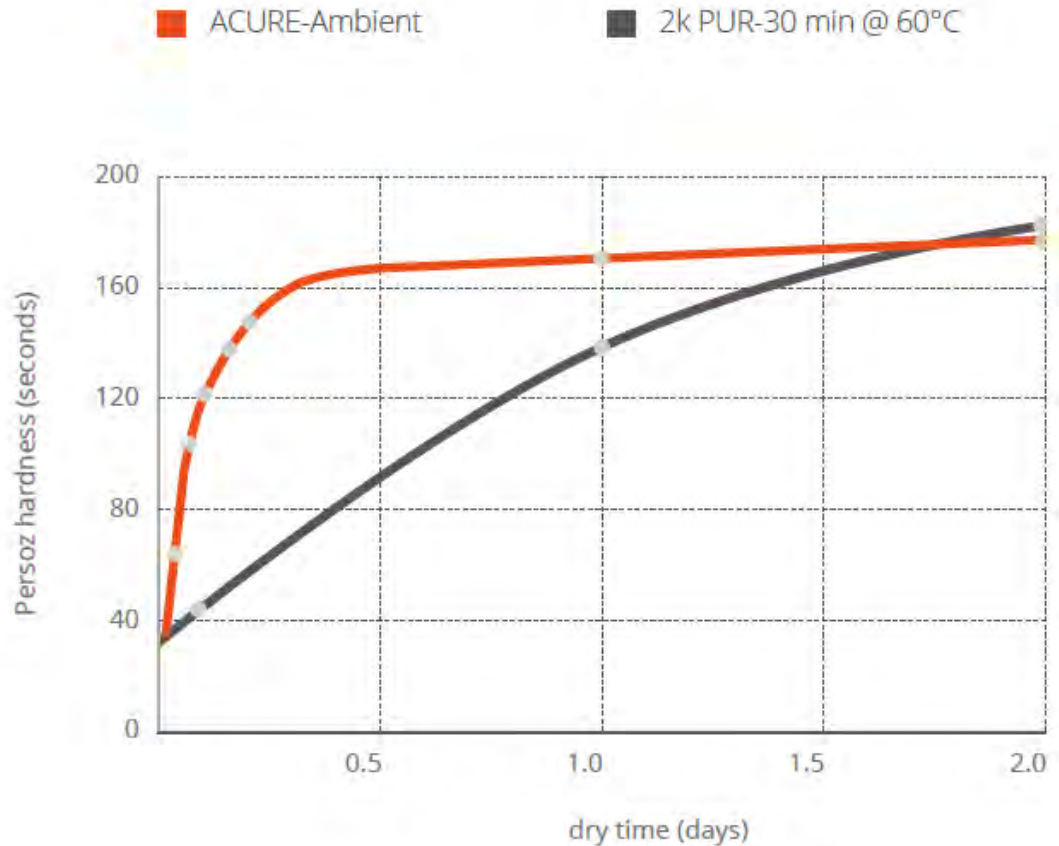
- ACURE uses a special blocked base catalyst combined with kinetic additives
 - *decoupling between pot life and dry time*
 - *excellent control of open time*
- Donor and acceptor form stable, non-reactive mixtures
- Acidic species in resin and paint formulation should be avoided

ACURE performance profile

The de-coupling of dry time and pot life



ACURE's exceptional hardness development



note: tack free time corresponds to Stage 3 dry

ACURE KEY FEATURES

Faster Dry

Much Longer Pot life

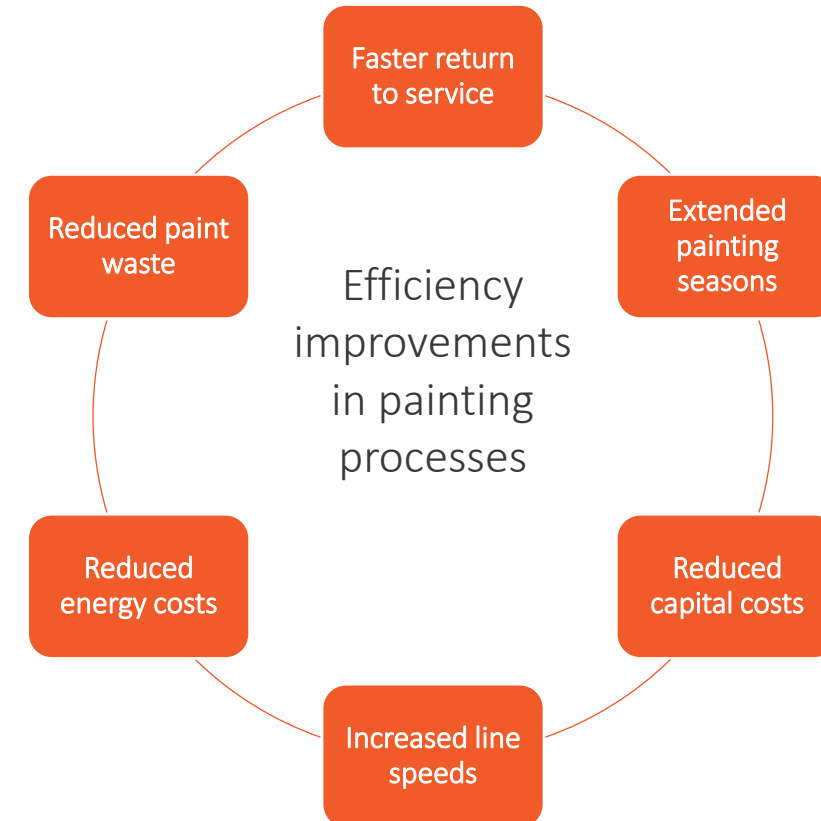
Cures at lower temperatures

Thicker films per application

Isocyanate, BPA and formaldehyde free

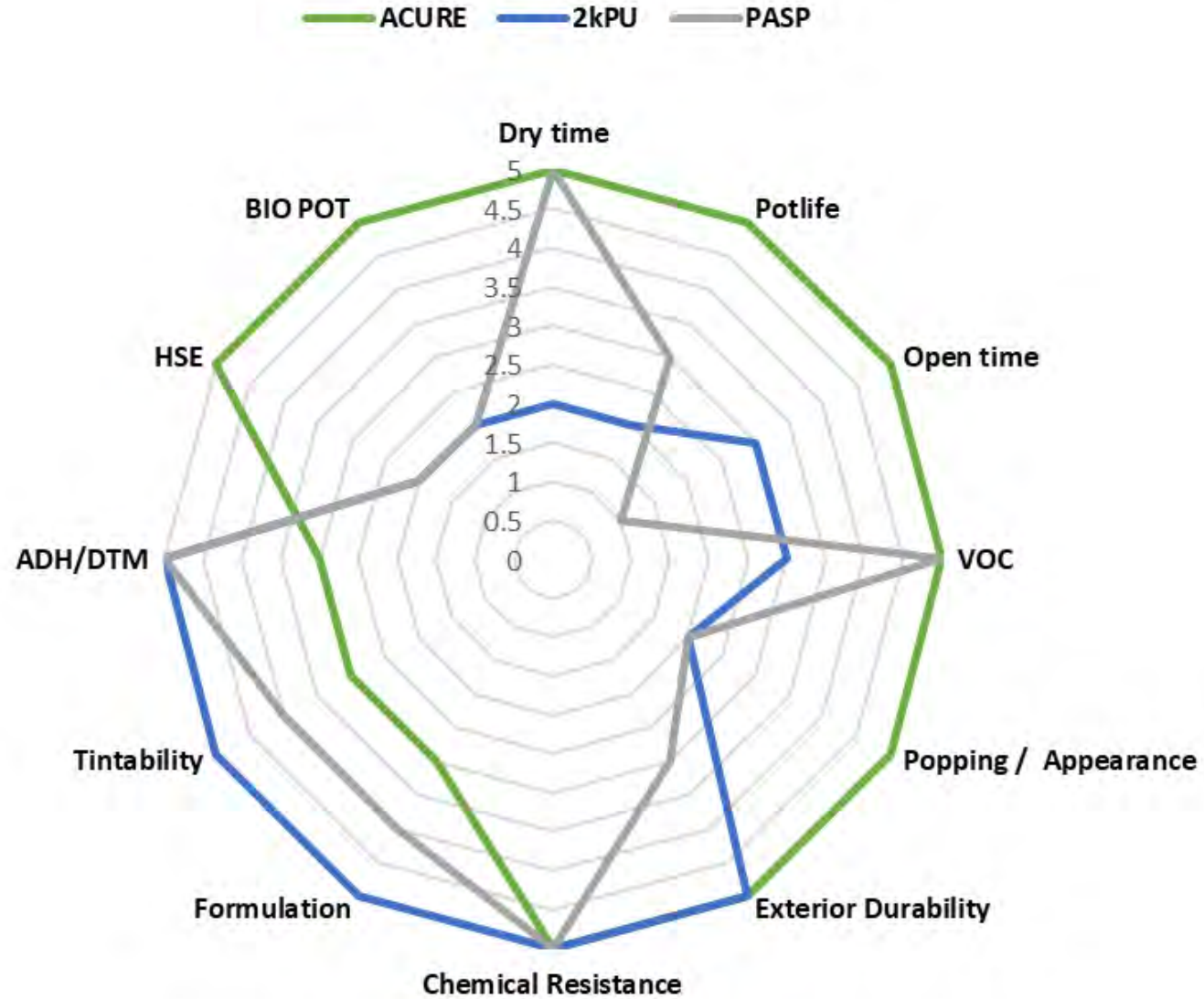
Very low VOC potential

CUSTOMER BENEFITS



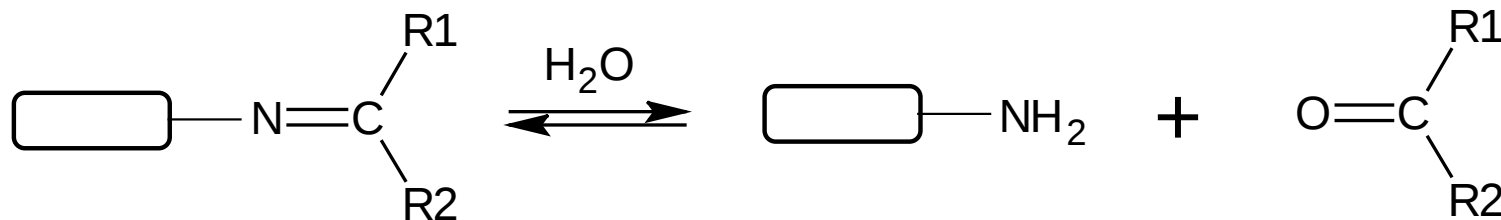
Easier on the environment with increased worker comfort

Topcoat performance comparison

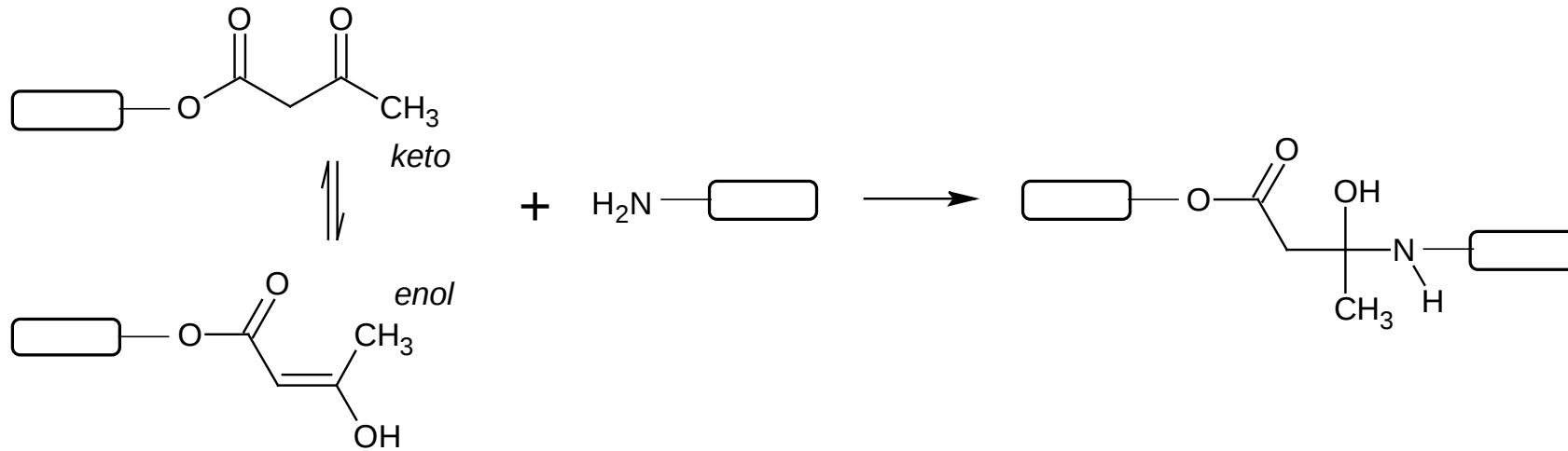


KETAC chemistry: ketimine-acetoacetate

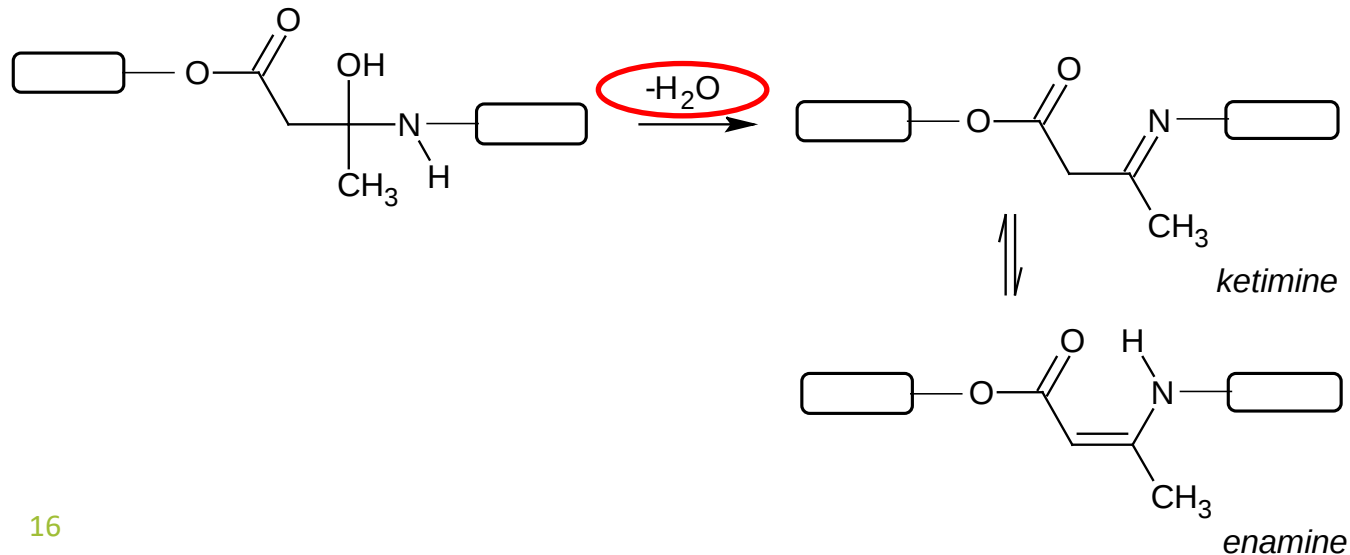
- ketone-blocked primary amine: ketimine
- multiple ketimine groups on a polymeric backbone
- deblocks under the influence of water
 - *liberates the amine and the ketone blocking agent*



KETAC chemistry: ketimine-acetoacetate



Curing reaction



- water is generated during curing
- excellent drying, even at low RH

KETAC: ketimine-acetoacetate primer system

SETAL® 7205 BA-86

- acetoacetate-functional polyester resin for extremely fast RT drying primers
- excellent adhesion and mechanical properties, good chemical resistance and overcoatability

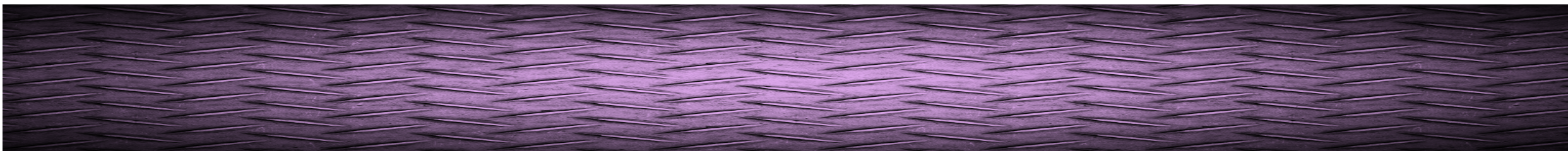
SETALUX® 7006 SS-65

- ketimine-functional resin for use in combination with acetoacetate-functional binders
- very fast drying of isocyanate-free 2K industrial metal and VR primers

Product data	7205 BA-86	7006 SS-65
equivalent weight (on solids)	516 g/eq	347 g/eq
solids content	84-88%	65%
viscosity (25 / 250 1/s; 23°C)	5000-12000 mPa.s	3000-4000 mPa.s

Key properties

Enables very fast drying at RT and Wet-on-Wet overcoatability
Excellent adhesion and mechanical performance
Advantageous HSE profile



EASY CURE: SB HS 2K Epoxy Amine primer system

BECKOPOX™ EP 2688/80MEK

- internally flexibilized solid epoxy resin for very high solid primers
- excellent adhesion and very good anti-corrosion properties

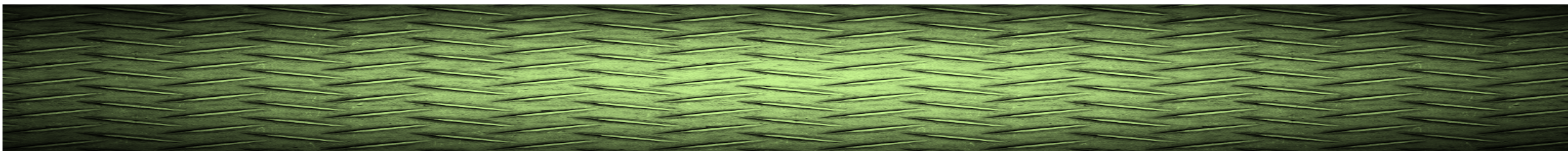
BECKOCURE™ EH 2240/70MP

- modified polyamine adduct hardener for high solid anti-corrosion primer in combination with liquid or solid epoxy resins, very low free residual amines

Product data	EP 2688/80MEK	EH 2240/70MP
equivalent weight (on solids)	640 g/eq	244 g/eq
solids content	78-82%	68-72%
viscosity (25 1/s; 23°C)	3000-5000 mPa.s	8000-12500 mPa.s

Key properties

Enables high solid formulations
Excellent anti-corrosion performance
No residual free amines



Standard SB 2K Epoxy Amine primer system

BECKOPOX™ EP 301/75X

- Type 1, unmodified epoxy resin with rel. low melting interval for use in anti-corrosion primers, zinc galvanizing paints and high durability coatings
- mainly used in cold curing, SB coating systems

BECKOPOX™ EH 651/70X

- polyamidoamine hardener with long processing time for anti-corrosion primers in combination with solid epoxy resins

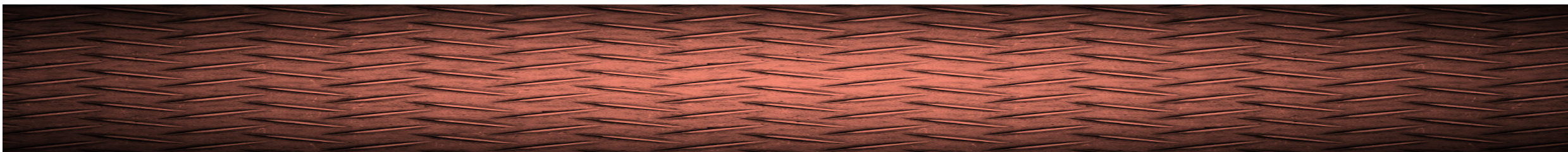
Product data	EP 301/75X	EH 651/70X
equivalent weight (on solids)	450-525 g/eq	178 g/eq
solids content	73-77%	68-72%
viscosity (100 / 500 1/s; 23°C)	7800-13000 mPa.s	550-1700 mPa.s

Key properties

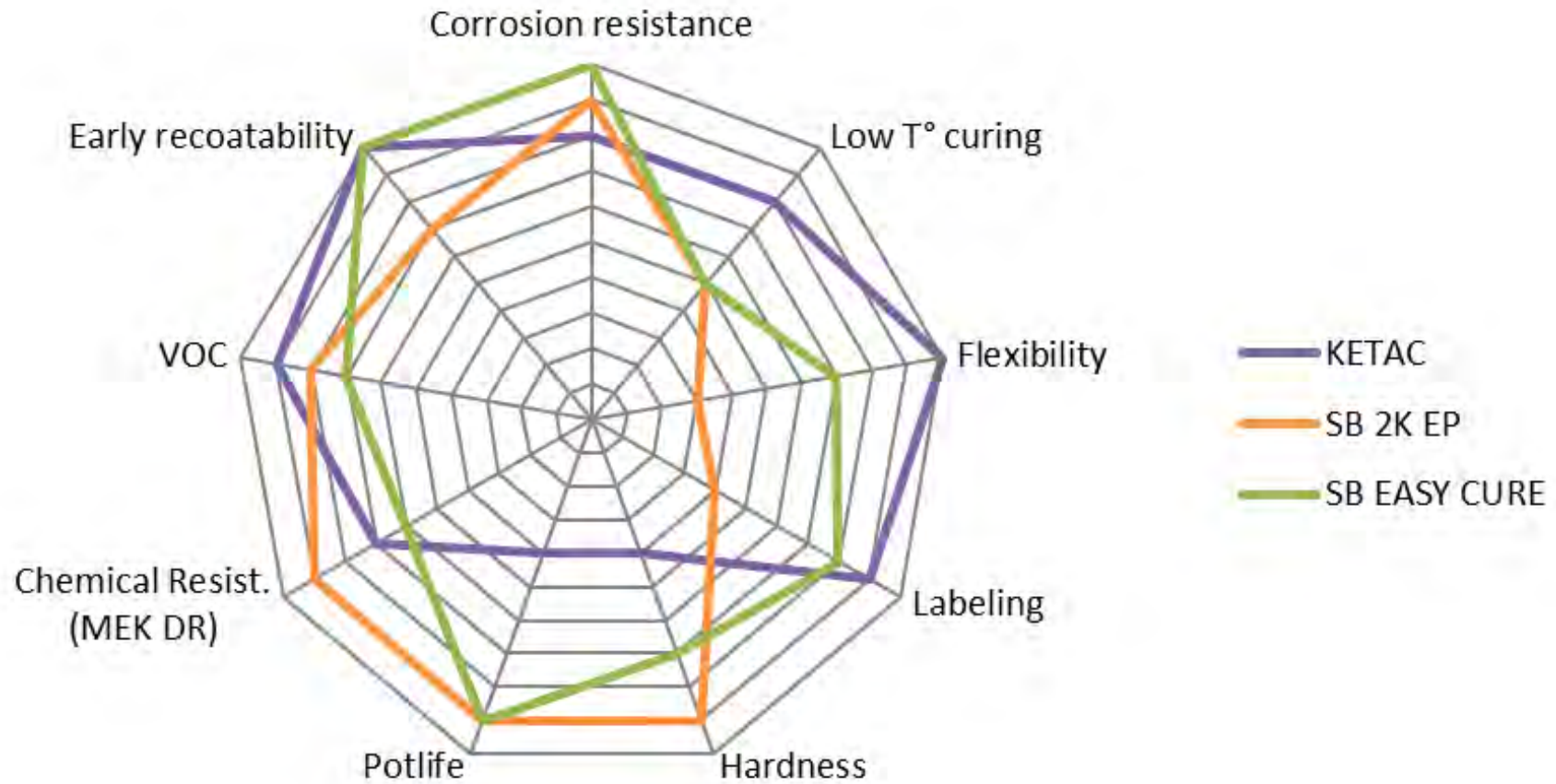
Good adhesion

Excellent anti-corrosion performance

Most commonly used solid epoxy resin



Primer performance comparison





LAYER SYSTEMS
speed and performance

Overview of primer formulations tested

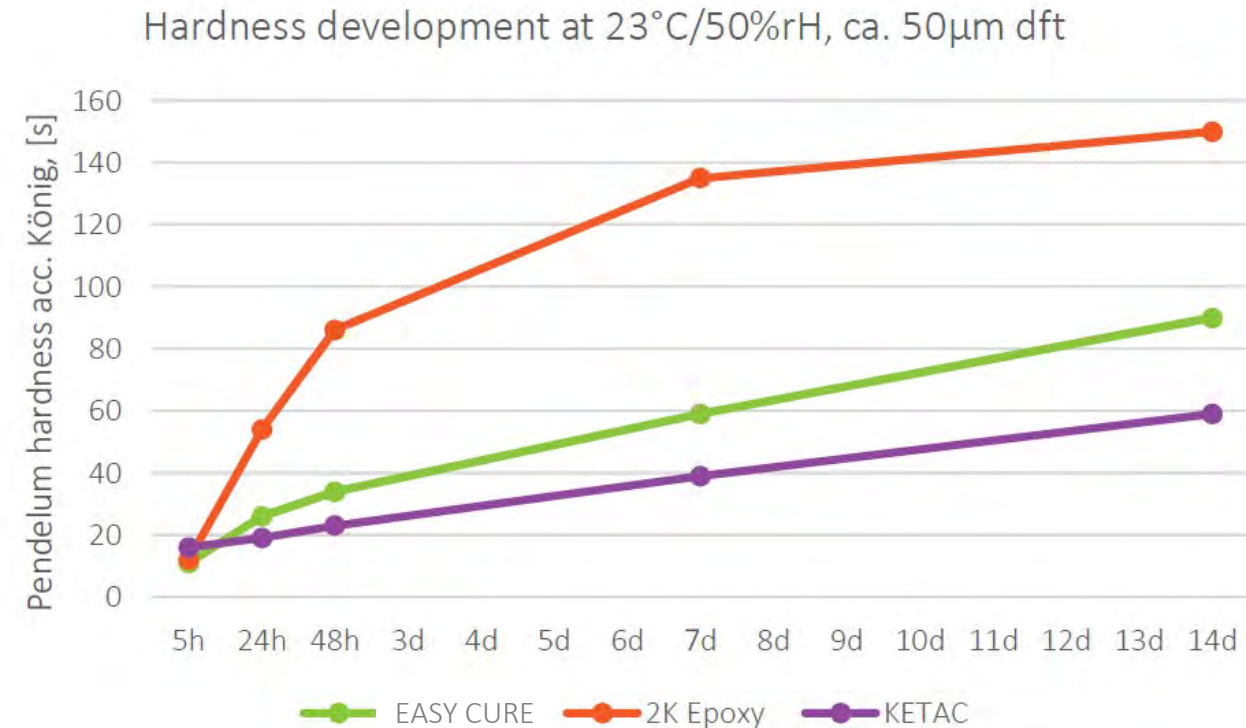
Primer formulations	1 SB EASY CURE	2 Standard 2K Epoxy	3 KETAC
BECKOPOX™ EP 2688/80MEK	50		
BECKOPOX™ EP 301/75X		50	
SETAL® 7205 BA-86			50
Aerosil R 200	0.15	0.15	0.23
Crayvallac extra	0.25	0.25	0.38
ADDITOL® VXW 6208/60	1.11	1.03	1.61
Tronox CR-828	18.88	17.48	27.53
EWO	66.23	61.33	96.58
Heucophos ZPA	16.11	14.91	23.48
Plustalc H05	6.66	6.17	9.72
Winnofil SPM	2.78	2.57	4.05
MEK/X (1:1)	27.5	32.5	45
BECKOCURE® EH 2240/70MP	21.9		
BECKOPOX™ EH 651/70X		19.62	
SETALUX® 7006 SS-65			75.7
<i>viscosity adjusted to 25 s (DIN-4 mm) with MEK/X (1:1)</i>			
pigment/binder ratio	2	2	2
PVC	37.6	36.2	34.5
exp. NV content at 25 s (DIN-4 mm)	70.70%	71.10%	71.40%
exp. VOC at 25 s (DIN-4 mm)	416 g/l	406 g/l	396 g/l

* 1h / 125 °C

Primer performance overview

Paint properties on Gardobond OC after 7d/23°C/50rH:

Spray applied on Gardobond OC		EASY CURE	2K Epoxy	KETAC
Primer dry film thickness	[μm]	90	116	102
Pendulum hardness (König)	[s]	33	97	15
Gloss (20°)	[g.u.]	32	75	8
Gloss (60°)	[g.u.]	81	95	48
Cross-hatch adhesion	Gt [0-5]	Gt 0	Gt 0	Gt 0
Impact (front)	[iP]	50	10	60
Impact (back)	[iP]	0	0	10
Erichsen cupping	[mm]	5,7	1	9,3
Conical mandrel	[mm]	9	>105	0
MEK-DR (1kg) [double rubs]		150	200	168



- standard epoxy high in hardness, but brittle
- KETAC rather soft but very flexible

Primer performance overview

1440 h humidity

- substrates:
 - Gardobond OC (smooth steel)
 - CRS R-46
 - Sandblasted steel
 - Gardobond OF aluminium
 - Gardobond OE HDG
- excellent dry adhesion (all primers)
- humidity resistance:
 - KETAC > EASY CURE > Std Epoxy
- salt spray resistance:
 - EASY CURE > KETAC ~ Std Epoxy
 - depends on steel type



REC19017 white paint (benchmark)

Key attributes

TFT: 50-60 min.

König 7 days: 82 s

Potlife: 4 h

%NV: 83.5%

VOC (theor.): 232 g/l

excellent adhesion robustness over epoxy primers and KETAC

	Weight	Function	Supplier
Mill base			
ACURE 550-105	300.6	acryloyl functional resin	<i>allnex</i>
ADDITOL® XL 6583	13.5	dispersing additive	<i>allnex</i>
ADDITOL VXL 4951 N	6.7	defoamer	<i>allnex</i>
ADDITOL XL 6531	3.4	air release additive	<i>allnex</i>
Kronos 2310	675.8	pigment	Kronos
<i>grind until < 10 µm, keep temperature < 40°C</i>			
	1000.0		
Component 1			
ACURE 510-200	219.8	malonate functional resin	<i>allnex</i>
ACURE 510-270 *	68.3	malonate functional resin	<i>allnex</i>
Mill base	650.4		
n-propanol	22.0		
Butyl acetate	8.8		
<i>Mix and add:</i>			
ADDITOL XL 123 N	2.6	surface additive	<i>allnex</i>
Tinuvin 292	4.4	light stabilizer	BASF
Component 2			
ACURE 500	23.7	catalyst	<i>allnex</i>
Total	1000.0		
Butyl acetate until spray viscosity	± 80		

Topcoated primers: drying and performance

Spray applied on Gardobond OC Topcoated after 24h/23°C/50%rH : ACURE		EASY CURE	2K Epoxy	KETAC
Primer thickness (dft)	[μ m]	75	86	67
Topcoat thickness (dft)	[μ m]	65	66	70
Pendulum hardness (König)	[s]	46	62	30
Gloss (20°)	[g.u.]	80	80	80
Gloss (60°)	[g.u.]	87	87	87
Cross-hatch adhesion	Gt [0-5]	Gt 0	Gt 1	Gt 0
Impact (front)	[iP]	80	30	80
Impact (back)	[iP]	80	0	50
Erichsen cupping	[mm]	7,3	4	7,2
Conical mandrel	[mm]	0	80	0
MEK-DR (1kg) [double rubs]		200	200	200

- ACURE™ REC19017 white TC
- excellent drying of ACURE over all primers, even at 15 min. overcoat interval
- KETAC and EASY CURE rather soft but flexible
- system hardness can be significantly increased by a mild baking step at e.g. 40°C

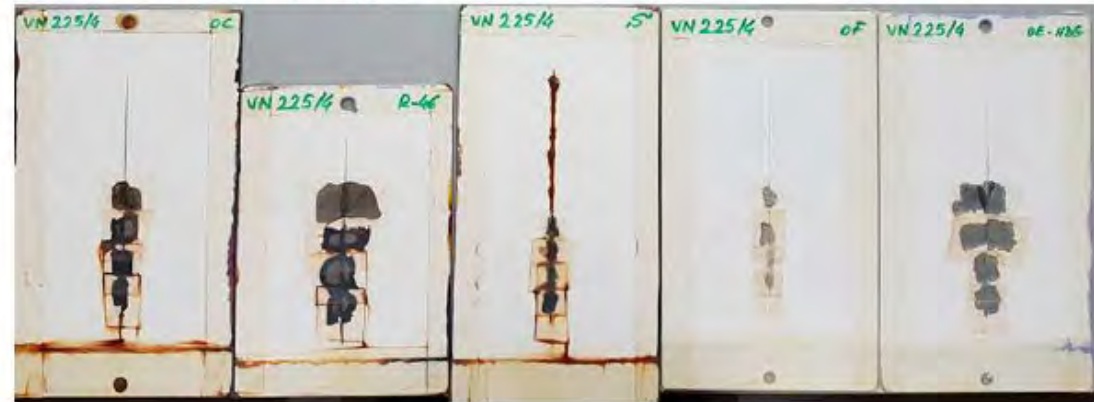
Topcoated primers: salt spray

- 1440 h exposure
- substrates:
 - Gardobond OC
 - CRS R-46
 - Sandblasted steel
 - Gardobond OF aluminium
 - Gardobond OE HDG
- testing after 240, 480, 720 and 1440 h:
 - wet adhesion
 - delamination

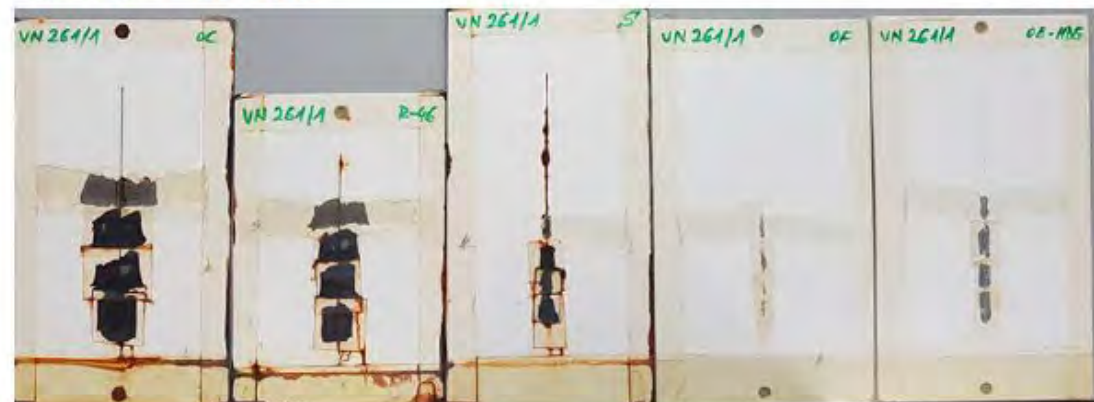
SB EASY CURE + ACURE™



Standard 2K epoxy + ACURE



KETAC + ACURE



New ACURE™ topcoat

new topcoat formulation with increased XLD
(replacing part of ACURE 510-270 by the new low
EQW binder ACURE 510-174)

Selected for testing: 50% ACURE 510-174 on
donor resin

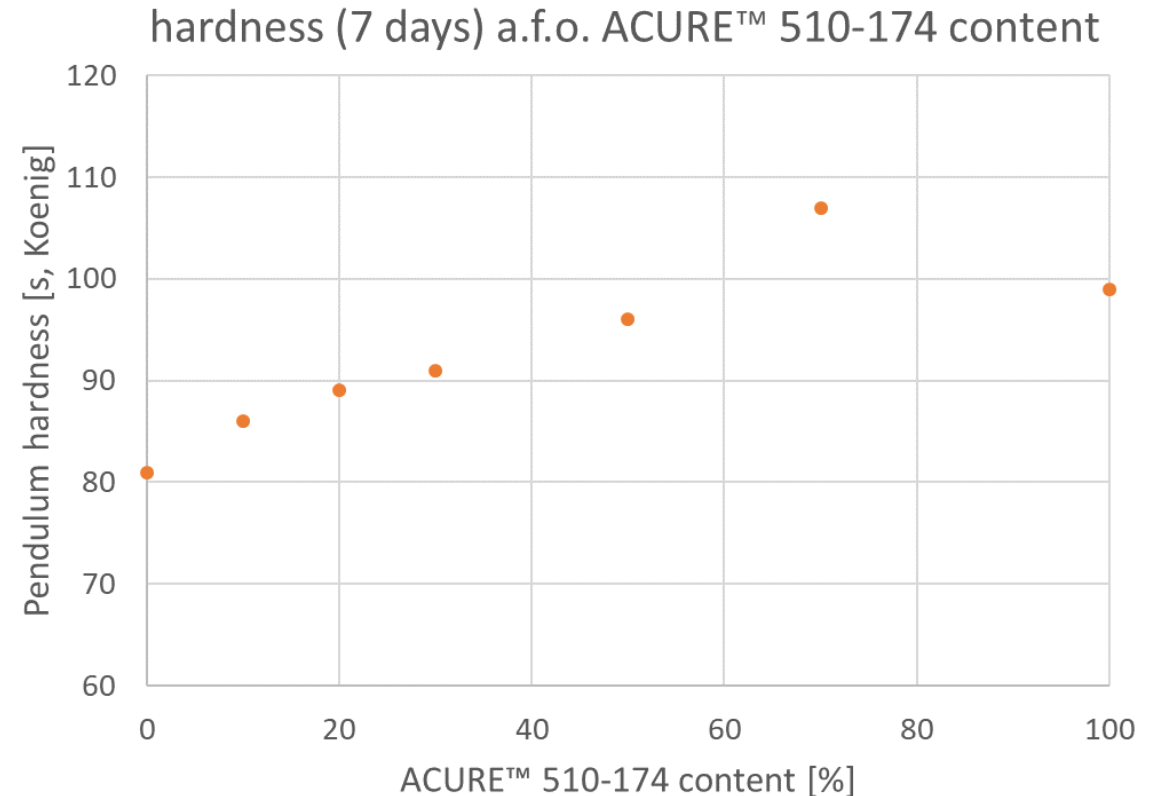
Key attributes

faster drying (TFT: 35-45 min.)

higher hardness (König 7 days: 96 s)

improved imprinting resistance

improved mechanical and chemical resistance



New ACURE™ topcoat – adhesion performance

- Compared to ACURE REC19017 benchmark
- Robust dry and QCT adhesion of both TCs on EASY CURE and KETAC

topcoat / primer	dry adhesion [ISO score]					7d QCT wet adhesion [ISO score]				
	Std 2k Epoxy		EASY CURE	KETAC		Std 2k Epoxy*		EASY CURE	KETAC	
	RT	30 min 80 °C		RT	30 min 80 °C	RT	30 min 80 °C		RT	30 min 80 °C
REC19017	0	0	0	0	0	0	1	0	0	0
New ACURE™ TC	0	0	0	0	0	0	3	0	0	0

** note: both REC19017 and the new ACURE TC show excellent dry and QCT wet adhesion on phenalkamine-cured, baked epoxy primers*

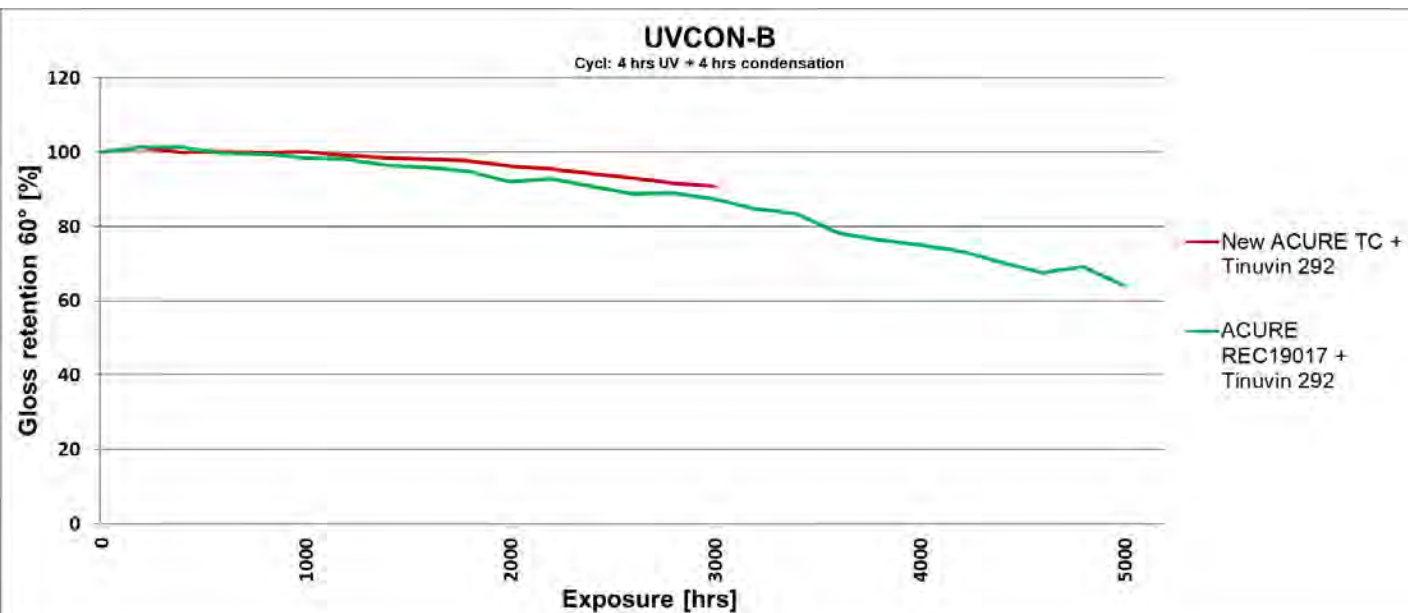
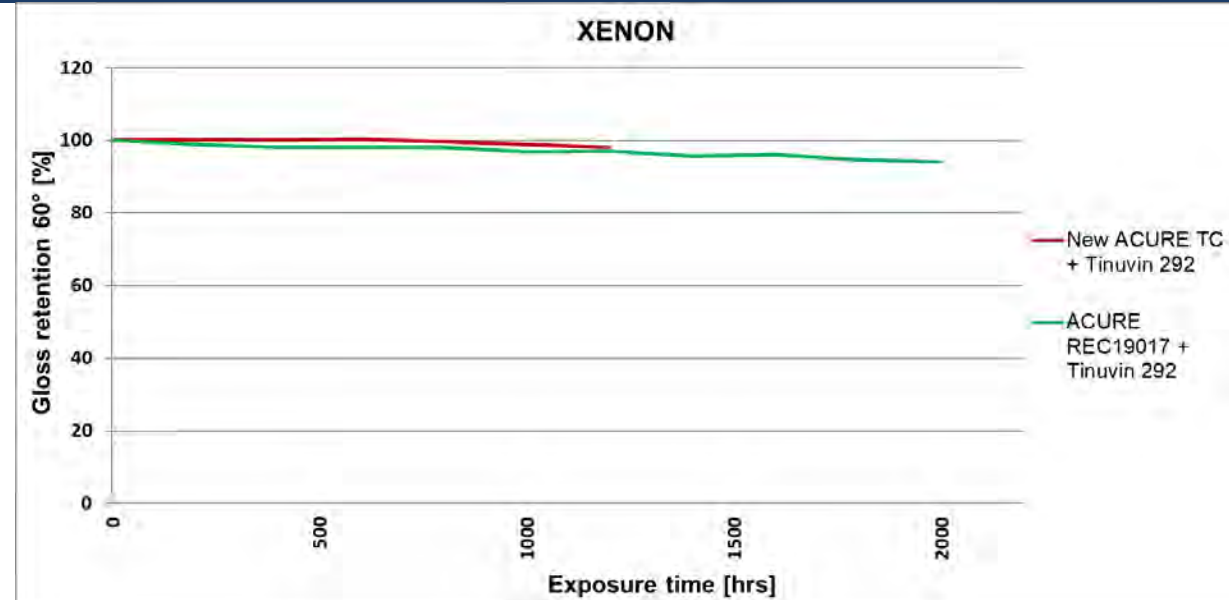
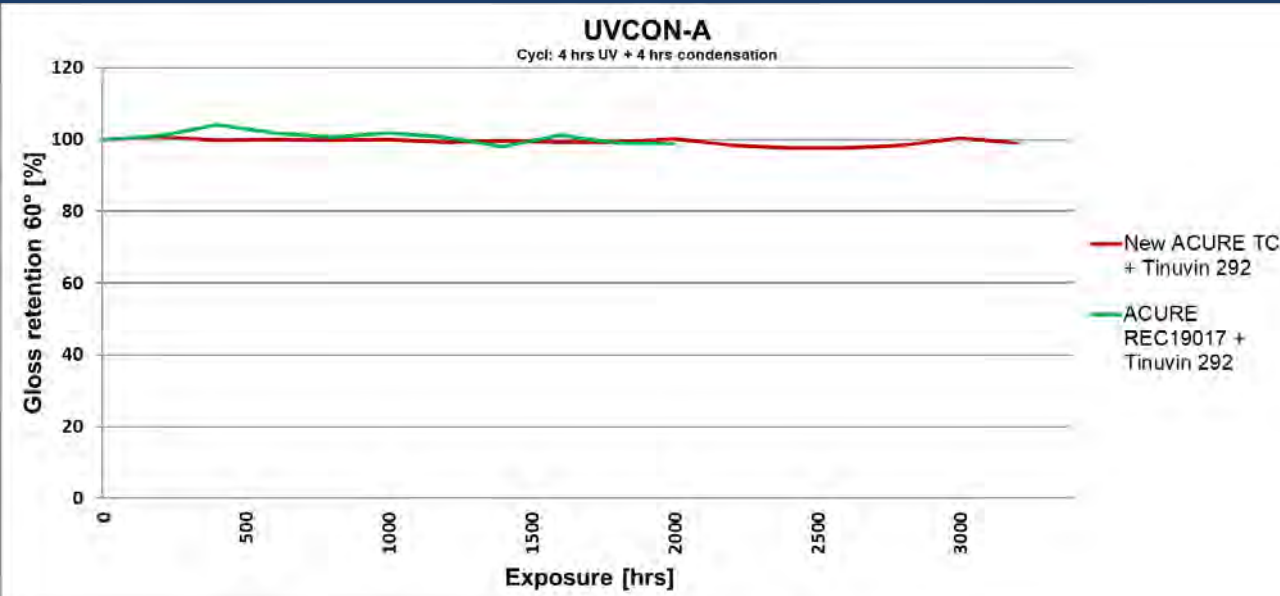
New ACURE™ topcoat – mechanical performance

topcoat / primer	Erichsen indentation [mm]		Conical mandrel [mm]		Face impact [cm]		Reverse impact [cm]	
	Std Epoxy	KETAC	Std Epoxy	KETAC	Std Epoxy	KETAC	Std Epoxy	KETAC
ref ACURE™ TC	5.5	8.6	55	7	50	80	0	40
new ACURE™ TC	4.8	8	25	4	70	100	0	70

topcoat / primer	Crock test: gloss retention [%]				Taber test: mass loss [mg]	
	Std Epoxy		KETAC		Std Epoxy	KETAC
	20°	60°	20°	60°		
ref ACURE™ TC	32	44	45	59	91	97
new ACURE™ TC	77	85	43	56	87	86

- superior flexibility of KETAC/ACURE over Std Epoxy/ACURE systems
- improved impact resistance of new ACURE TC
- Crock test: improved gloss retention on harder Epoxy primer, similar on KETAC
- Taber test: less mass loss of higher XLD ACURE TC

New ACURE™ topcoat – weathering resistance



- new ACURE TC vs benchmark REC19017
- similar performance for both TCs
- in general: ACURE weathering resistance on par with 2K PU

HSE profile comparison

	ACURE™ DiTMPTA	ACURE TMPTA*	2K PU	Std Epoxy	KETAC
Package Labelling ⁺					
Worker Exposure					
H315 Causes skin irritation		X	X	X	
H317 May cause an allergic skin reaction		X	X	X	
H319 - Causes serious eye irritation	X	X		X	
H335 May cause respiratory irritation				X	
H314 Causes severe skin burns and eye damage				X	
Employee protection typical [^] (not including solvent)					
Additional employee protection required (including solvents)					

* TMPTA is an IARC Category 2B "possible" carcinogen

⁺ all systems carry flammability pictogram triggered by solvents

[^] some isocyanates are respiratory sensitizers carrying the star man pictogram

^{^^} all isocyanates call for use of air supply and application training as a default PPE protocol

www.allnex.com

Conclusions

ACURE™ topcoats from allnex...

- are excellent, sustainable and iso-free alternatives for 2k PU and Aspartics
- offer rapid drying at RT, excellent potlife and top-notch performance profile
- new ACURE 510-104/-174 containing topcoats provide
 - even faster drying, improved early / end hardness and imprinting resistance
 - improved mechanical / chemical resistance and excellent weathering resistance

KETAC and EASY CURE primers from allnex...

- are high performance, sustainable replacement options for traditional SB epoxy systems
- provide excellent adhesion and corrosion protection
- afford flexibility and very good mechanical robustness
- are perfectly compatible substrates for ACURE topcoats

KETAC + ACURE layer systems...

- provide an outstanding, sustainable and iso-free replacement option to 2kPU/Epoxy layer systems
- offer very rapid drying, also at low T
- facilitate WoW overcoating and very good flexibility
- show excellent (interlayer) adhesion and salt spray performance on various metal substrates
- ISO 12944 C5 rating can be achieved



Thank you for your attention!
QUESTIONS?

For further information, please contact:

Robert.Skarvan@allnex.com or
Bart.Noordover@allnex.com

www.allnex.com

allnex
The Coating Resins Company



LEGAL NOTICES

Disclaimer: allnex Group companies ('allnex') exclude all liability with respect to the use made by anyone of the information contained herein. The information contained herein represents allnex's best knowledge but does not constitute any express or implied guarantee or warranty as to the accuracy, the completeness or relevance of the data set out herein. Nothing contained herein shall be construed as conferring any license or right under any patent or other intellectual property rights of allnex or of any third party. The information relating to the products is given for information purposes only. No guarantee or warranty is provided that the product and/or information is suitable for any specific use, performance or result. Any unauthorized use of the product or information may infringe the intellectual property rights of allnex, including its patent rights. The user should perform his/her own tests to determine the suitability for a particular purpose. The final choice of use of a product and/or information as well as the investigation of any possible violation of intellectual property rights or misappropriation of trade secrets of allnex and/or third parties remain the sole responsibility of the user.

Notice: Trademarks indicated with ® , TM or * as well as the allnex name and logo are registered, unregistered or pending trademarks of Allnex Netherlands B.V. or its directly or indirectly affiliated allnex Group companies.

©2021 allnex Group. All Rights Reserved.