Waterborne 1K Epoxy Resin for Corrosion Protection

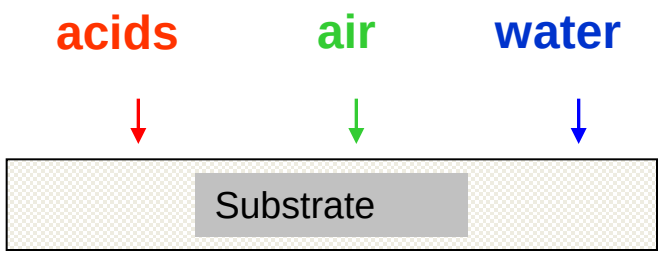
Leila Khatai
October 2009

What is

corrosion of metal ?

Atmospheric attack by

- acids / salts (rain, sea, water, ...)
- oxygen (air)
- water (humidity, sea, ...)



Corrosion protection:

Proctect the metal against these attacks by

•passivation of the substrate (pretreatment)

•covering the surface as effectively as possible

•rejecting water, acid, salts and oxygen by a compact coating film

•removal of water by diffusion in case it already penetrated to the substrate

Coatings of different performance level fulfill all the performance requirement spectrum

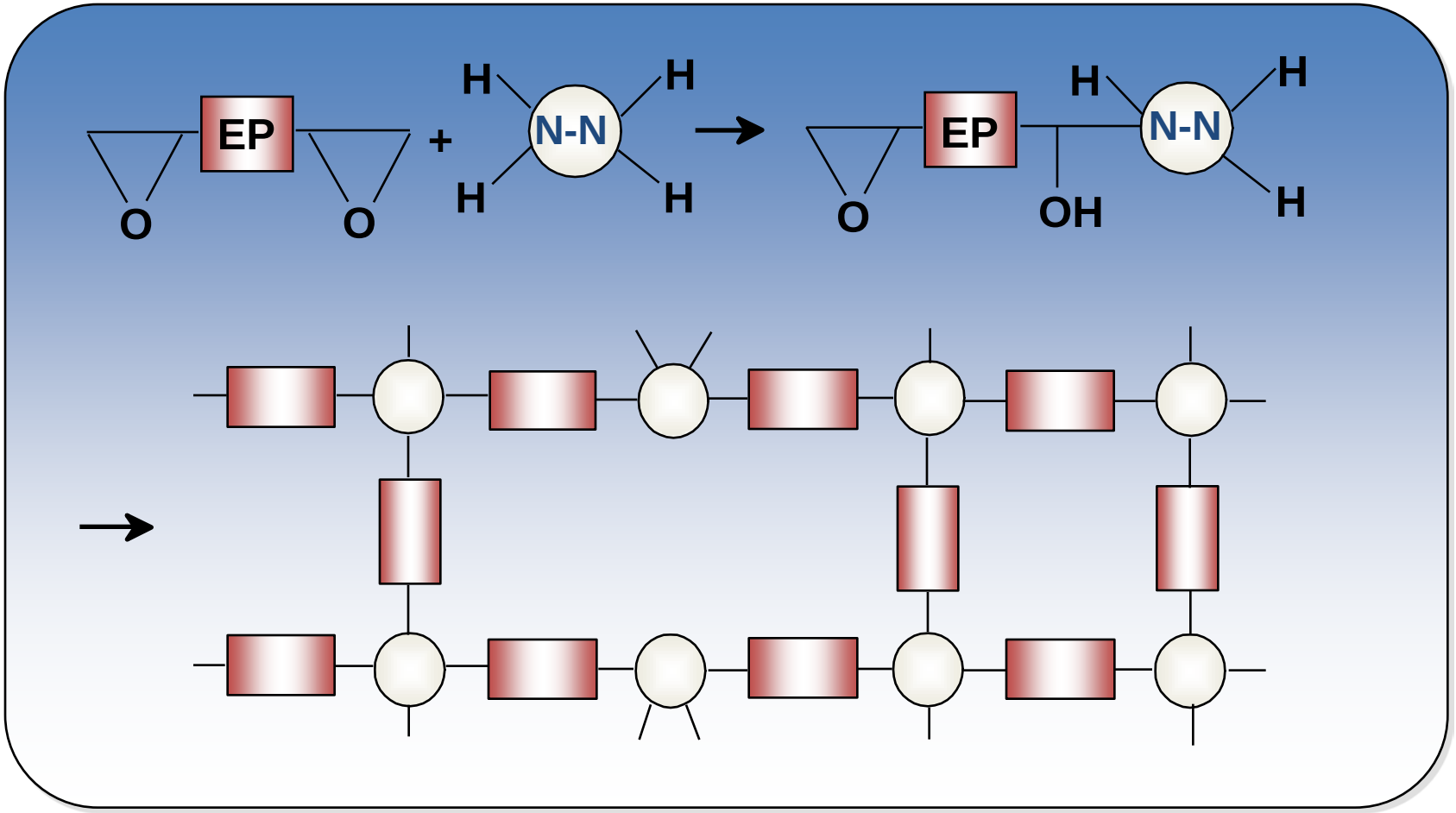
CORROSION CATEGORIES

CORROSION CATEGORY	SALT SPRAY/h	HUMIDITY RESISTANCE/h	TYPICAL ENVIRONMENTS
ISO 12944-2	ISO 7253	ISO 6270	(exampels)
C1 : very low			Heated building with clean atmospheres, e.g. offices, shops, schools, hotels.
C2 : low		Medium 48	Atmospheres with low levels of pollution. Mostly rural areas.
C 3 : medium	Medium 240	Medium 120	Urban and industrial atmospheres, moderate SO2 pollution. Coastal areas with low salinity.
C4 : high	Medium 480	Medium 240	Industry and coastal areas with moderate salinity.
C5-I : very high, industry (+168h chem. Resistance)	Medium 720	Medium 480	Industrial areas with high humidity and aggressive atmosphere.
C5-M : very high, marine	Medium 720	Medium 480	Coastal and offshore areas with high salinity.

1-pack
Alkyd
PU
Acryl

2-pack
Epoxy

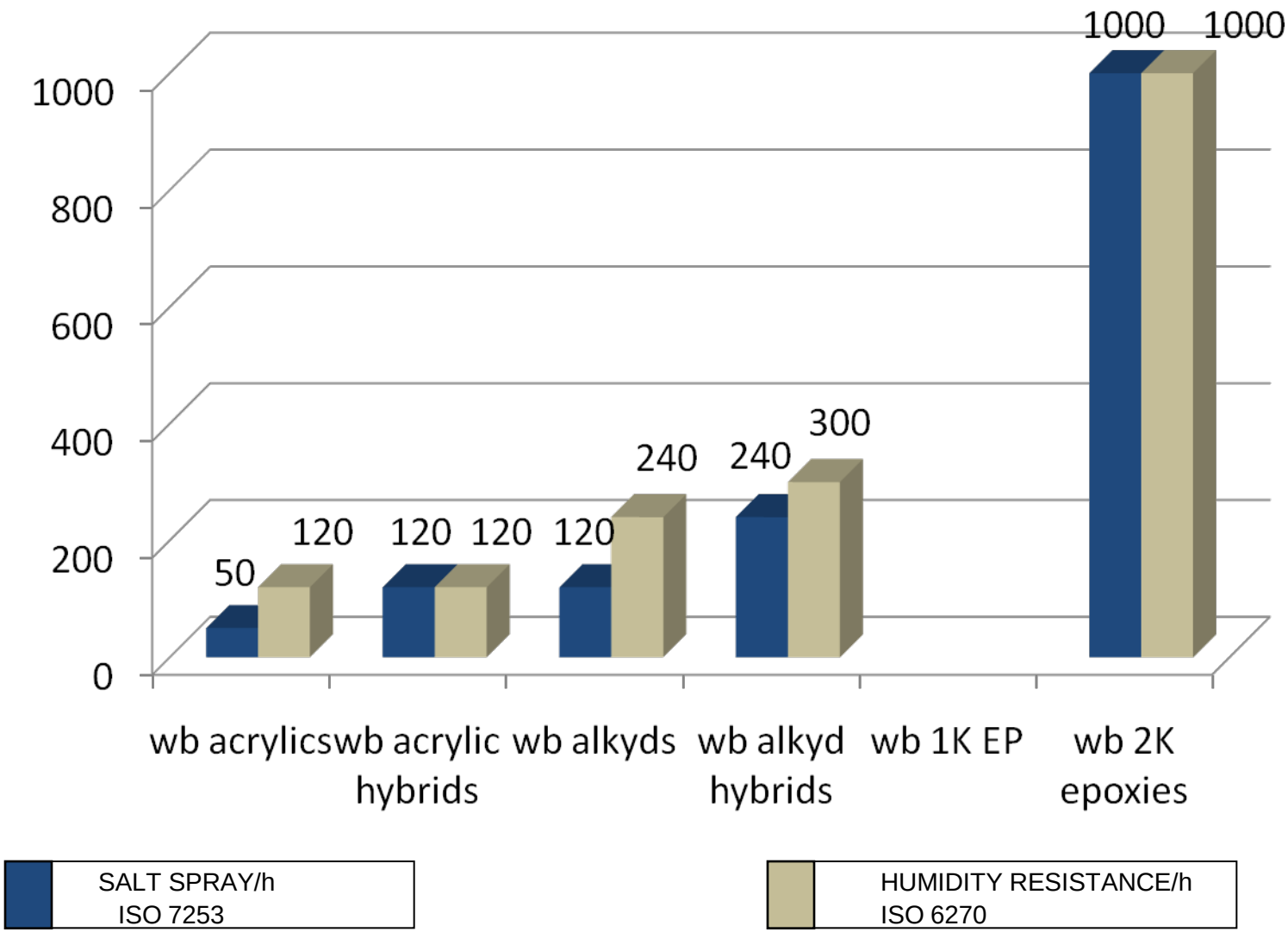
Cross linking reaction of epoxy resins with amine hardeners



2K Epoxy Systems

+ Excellent corrosion protection
- Limited pot life
- Exact mixture of 2 components needed
- Labeling issues for amine hardeners
- Drying speed

Comparision of different technologies



Wanted:

1K resin system with good corrosion resistance

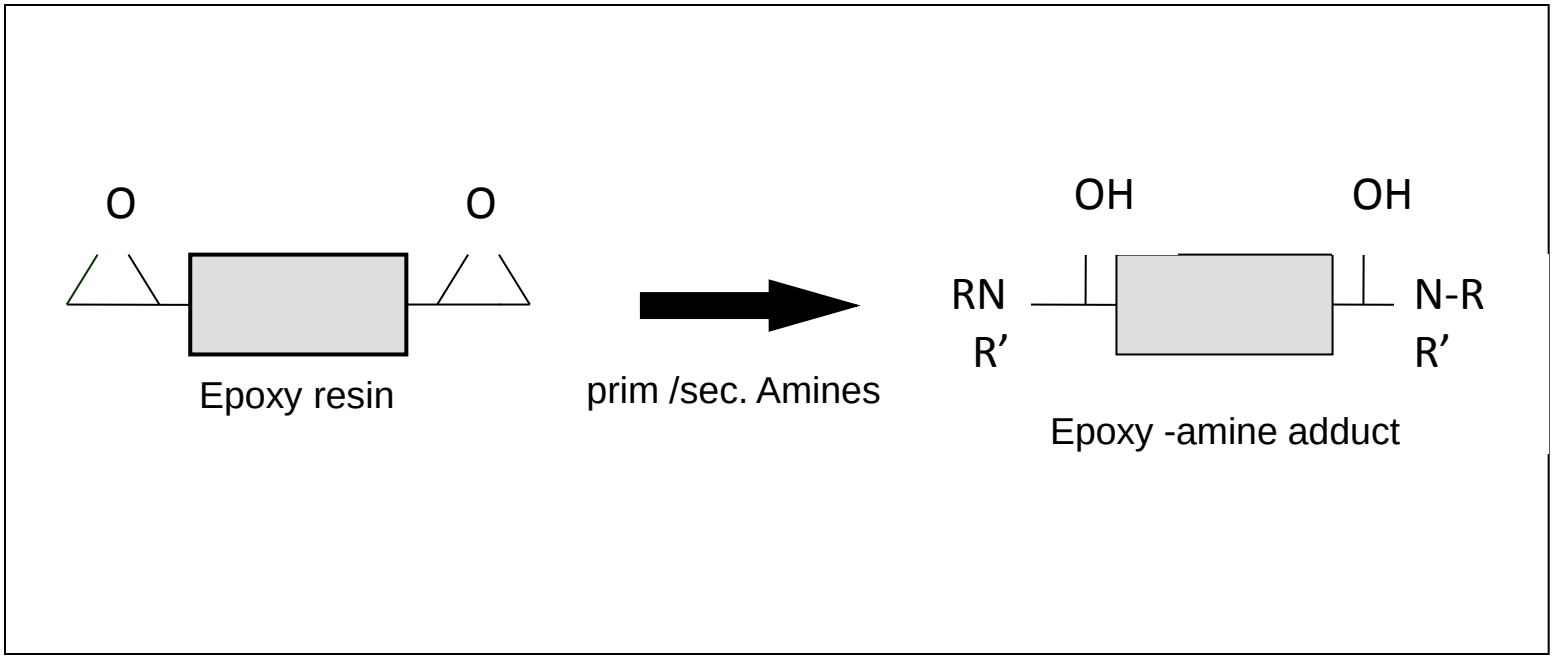
- no pot life problems
- less risk of formulation errors
- Easier handling
- No reactive components
- Recycling of paint surplus
- Fast physical drying

Idea

Anticipation of the crosslinking reaction
in the resin synthesis

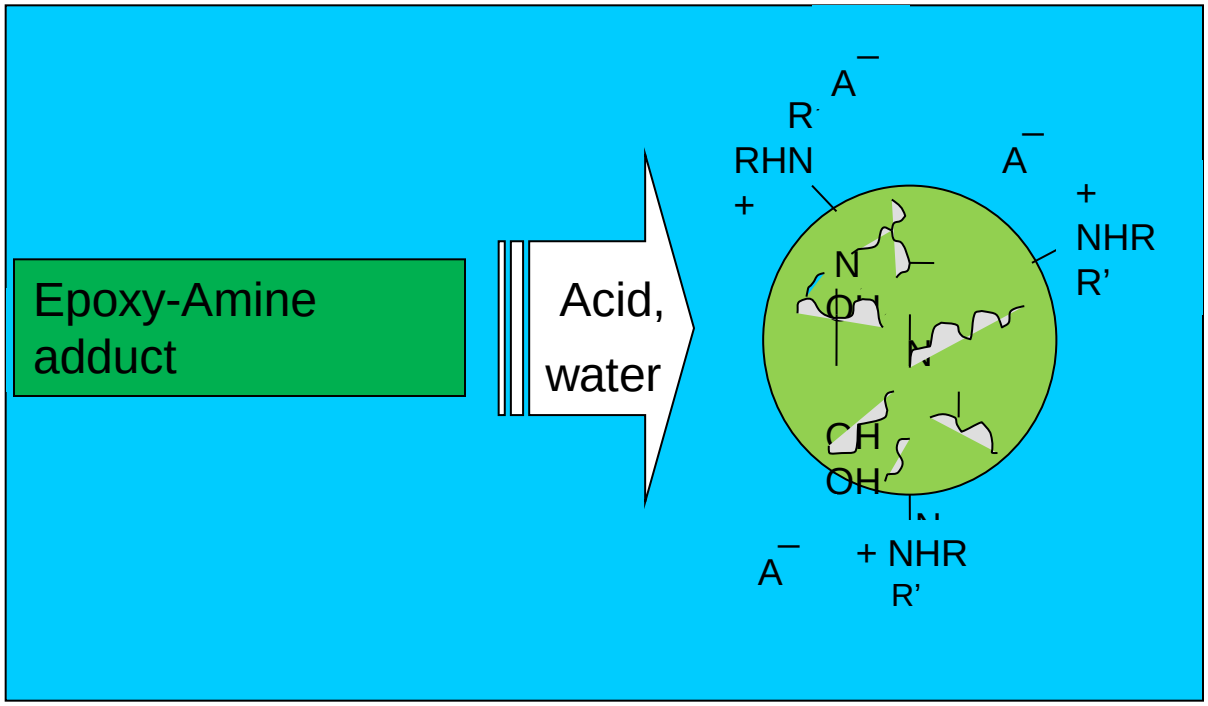
An ultra high molecular
epoxy-amine adduct dispersion

Synthesis



Build up of a high molecular weight with branched structure by reaction with polyamines

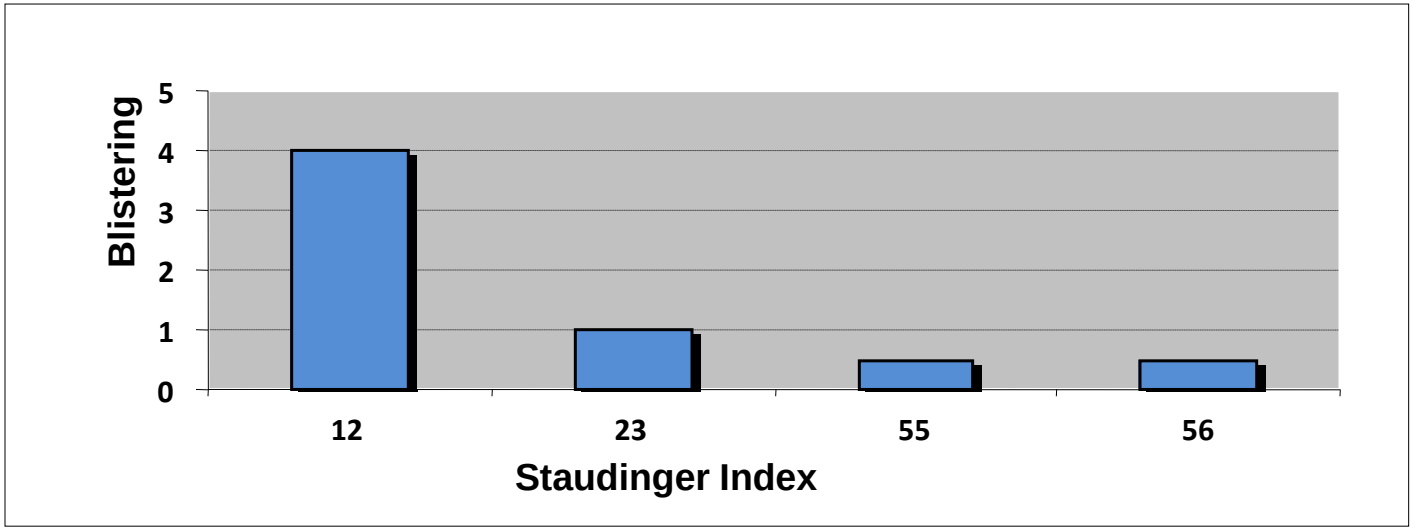
Synthesis



Dispersing of the resin after acid neutralization

Influence of molekular weight

(24 h H2O Immersion)



wb 1K Epoxy resin

Staudinger Index	55 - 56 ml / g
Molecular weight (Mw)	approx. 45 000 dalton

Technical data wb 1K Epoxy resin

pH	4-6
Dynamic viscosity	25 – 1000 mPa.s
Solids content	45%
Minimum film forming temp. (MFFT)	5°C
Glass transition temperature (Tg)	30°C
Molecular weight (Mw)	45 000 Dalton
Solvent content	~ 1 %

Formulation

- Cationic system requires proper additive selection
- Fast physical drying – coalescent needed
- Right choice of fillers and active pigments
- no anionic systems as a combination partner

Guiding formulation

I	3,0	Additol XW 6545	(wetting and dispersing agent)
	6,83	deionisiertes Wasser	
	0,3	Additol VXW 6211	(defoamer)
	0,07	Printex U	(carbon black)
	4,60	Microtalc AT 1	(Talc)
	4,60	ASP 600	(Kaolin)
	4,9	Active Pigment *	(Zinc phosphate)
	4,50	Kronos 2190	(Titan dioxide)
	4,60	Minex 10	(feldspar)
	0,60	Halox 550	(corrosion inhibitor)
II	1,0	Butylglycol	(coalescent)
	0,10	Additol VXW 6211	(defoamer)
	64,40	wb 1K Epoxy resin	(resin)
	0,50	Acrysol RM 8/6WA	(thickener)

	100,00		

* Heucophos ZPO or Heucophos ZAM-Plus

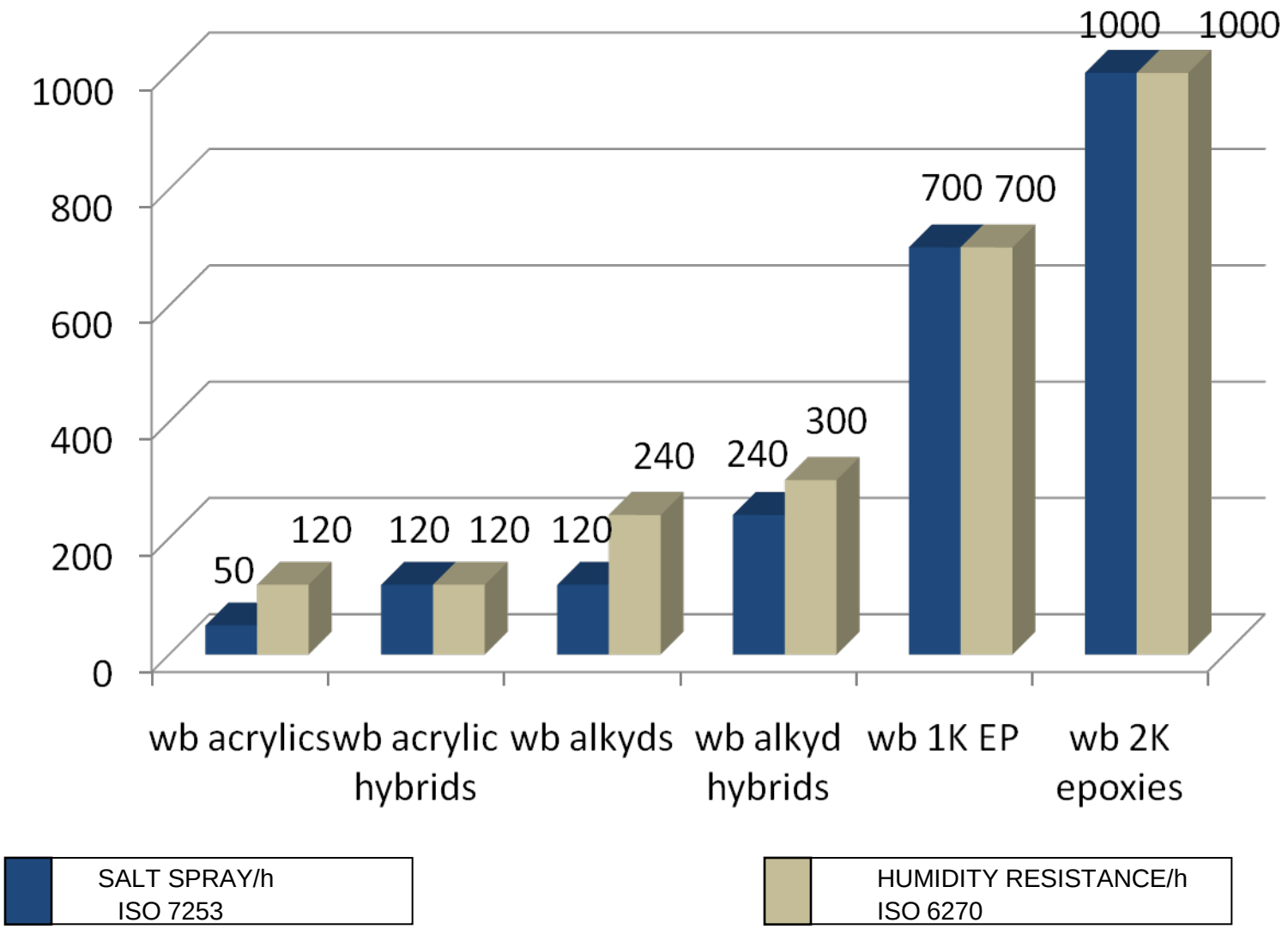
Specifications of the guiding formulation

Solid content		52 %
VOC (ASTM D 3960)		110 g/L
Dust free time		30 min
Tack free time		50 min
Blockability	after 2h	Drying grad 4
	after 24h	Drying grad 6
Pendelum hardness 7d		45 s

Camparison of salt spray resistance of different technologies

wb 2K Epoxy | wb 1K Epoxy | wb Epoxy-mod. Alkyd | sb Alkyd

Comparision of different technologies



Propeties of this new technology as overview

Application :

No pot life limitations
less risk of formulation errors
ease of use
Recycling of paint surplus

Health and labeling:

no labeling (e.g. Xi or C)
very low VOC content
very low flammability

Fast drying

Early water resistance and blockability

Corrosion protection

good adhesion on different Metalls

Thanks to the team:

Willibald Paar

Roland Feola

Florian Lunzer

Ursula Meisner

Manfred Gogg

Katja Sabolek

Sandra Reisinger

Manfred Krassnitzer

Hans Gmoser

Thanks for your attention!