



Solventborne DTM for ACE(T) applications : work in progress...

Gerbrand Daamen

R&D Director

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FOR SOLVENT-BORNE COATINGS

WWW.SYNRES.COM

Slachthuisweg 30
3151 XN Hoek van Holland
The Netherlands

About Synres | History

1947

Synres (SYNthetic RESins) is Established in Hoek van Holland
Initial focus: Production of alkyds

1962

Synres launched styrene-modified alkyd resins

1963

Start production of amino resins

1970

Synres became part of DSM

1973

Solvent-borne acrylic resins are added to the portfolio

1982

Start production of Thixotropic resins

1983

DSM acquired the Scado resin group from Unilever, further boosting the capabilities and output of Synres.

1985

Acrylic resins for printing inks and alkyd emulsions were introduced, reinforcing Synres' brand recognition in an increasingly crowded market.

1991

Launch of first generation of high solid alkyd resins

2008

Launch second generation of high solid alkyd resins

A tradition of excellence in synthetic resins since 65 years.

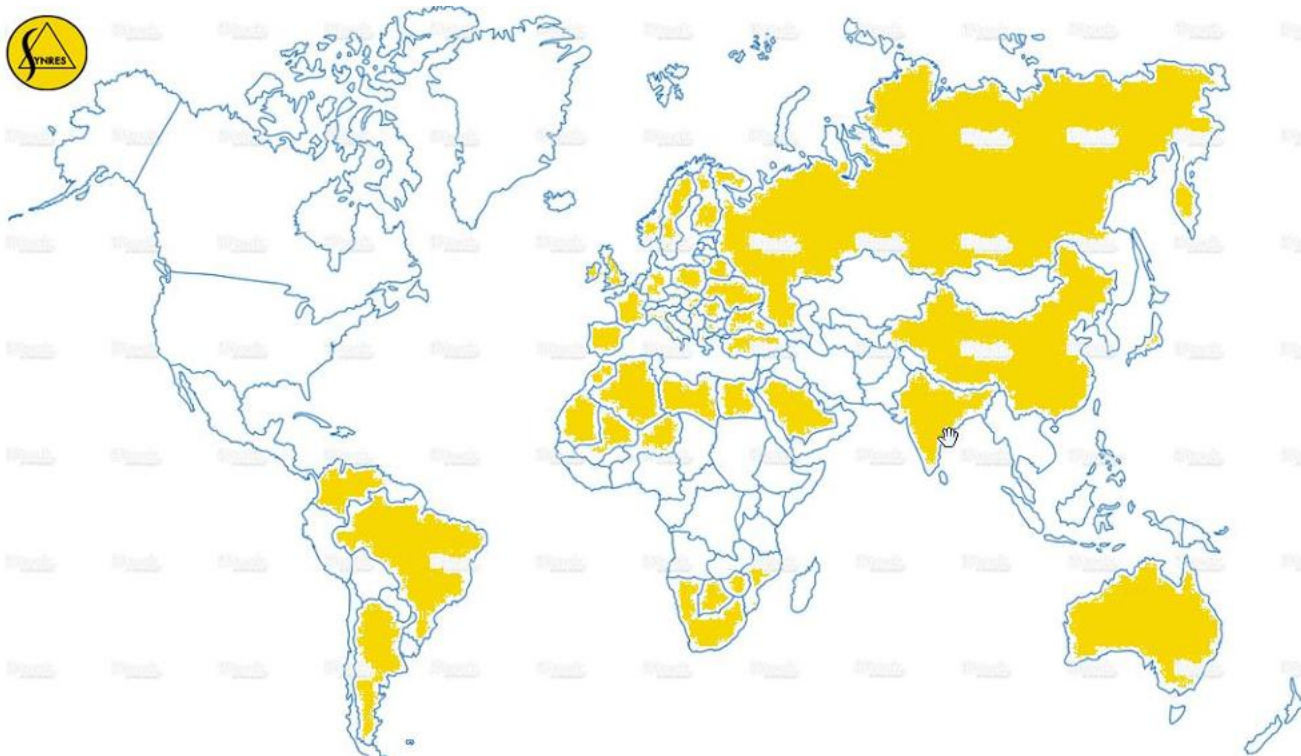


- April 2015 : Standard Investment, together with Synres management, acquired all the shares of Synres B.V. from Koninklijke DSM N.V.
- Interest of Standard Investment :
There is potential and a strong determination to re-establish Synres as one of the leading brands in Paints & Coatings.



Synres Worldwide

- Reaching customers direct, via distributors, or combined with DSM office partners
- Presence in 4 continents





Your markets, our support



**DECORATIVE
COATINGS**



**INDUSTRIAL
WOOD**



**PROTECTIVE
MARINE**



**VEHICLE
REFINISHES**



**AGRICULTURE
CONSTRUCTION
EARTHMOVING**



Solventborne

DTM = Direct To Metal

- Primer and topcoat = same
- Application “wet in wet”

ACE(T)

- Coatings for **A**gricultural, **C**onstruction and **E**arthmoving equipment

Synres | Solventborne DTM for ACE(T) applications : work in progress...



Solventborne

DTM = Direct To Metal

- Primer and topcoat = same
- Application “wet in wet”

ACE(T)

- Coatings for **A**gricultural, **C**onstruction and **E**arthmoving equipment
- Transport (trains, trucks, buses,...)





Market study

1. Factors driving the market
2. Systems :
 - Current situation
 - Desire



Market study :

1. Factors driving the market :

- Performance
 - Corrosion resistance
 - Multiple application methods : Airless, Airmix
 - Different drying methods : air drying, stoving (20 minutes@ 60°C)
 - Long pot life/open time and really short drying time
 - Different object parts = different gloss and corrosion resistance
 - Multi-surface : cold/hot rolled steel, galvanised steel, Alu, plastic
- Regulatory compliance
 - VOC
 - DBTL free



Market study :

1. Factors driving the market :

- Performance
- Regulatory compliance
- **Productivity**
 - Reduction of drying time
 - Reduction of stoving temperature
 - High layer thickness system
- **Cost**

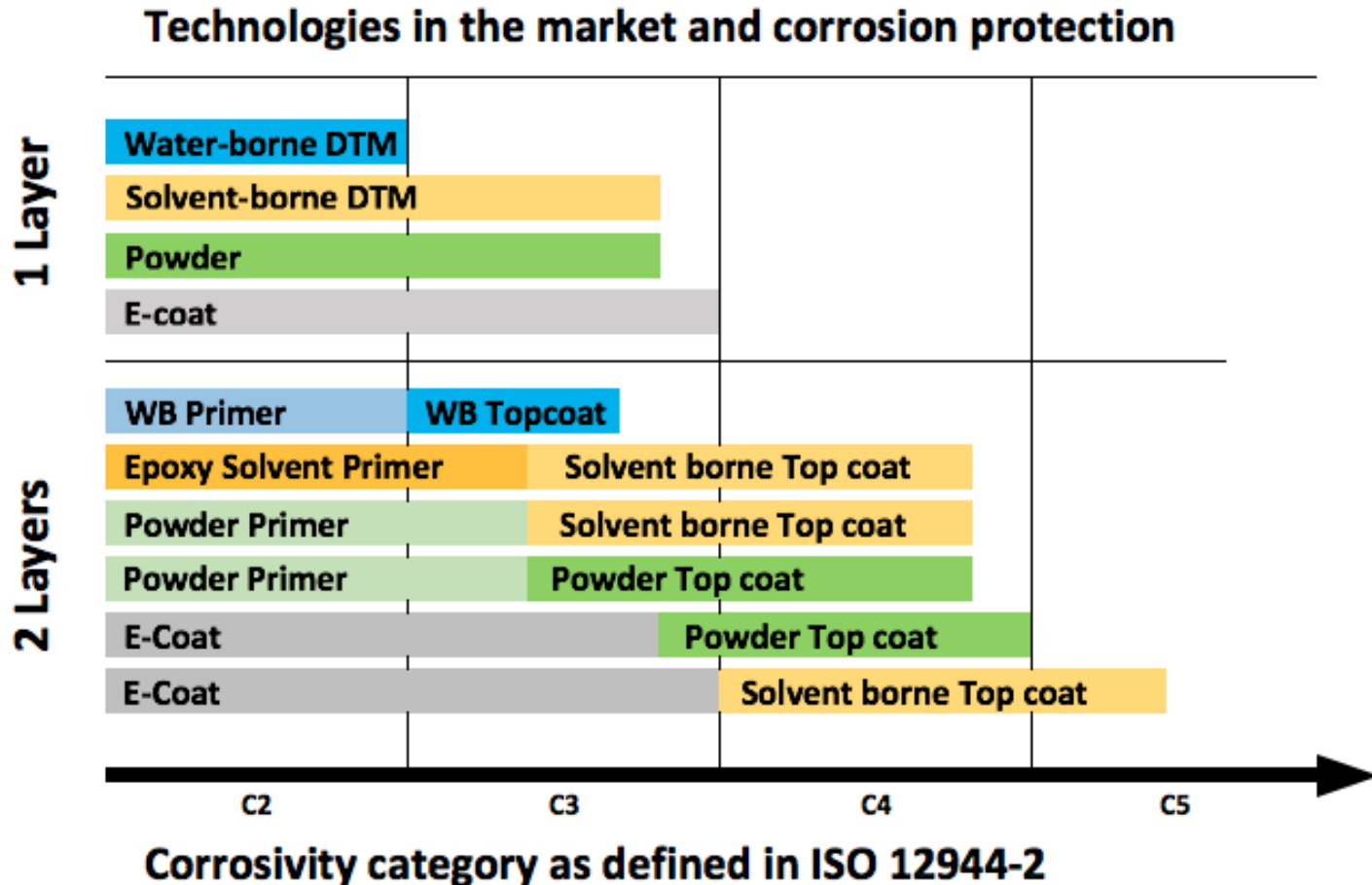


Market study

1. Factors driving the market
2. **Systems**
 - Current :



ACE Technical market analysis | Technologies in the market





Market study

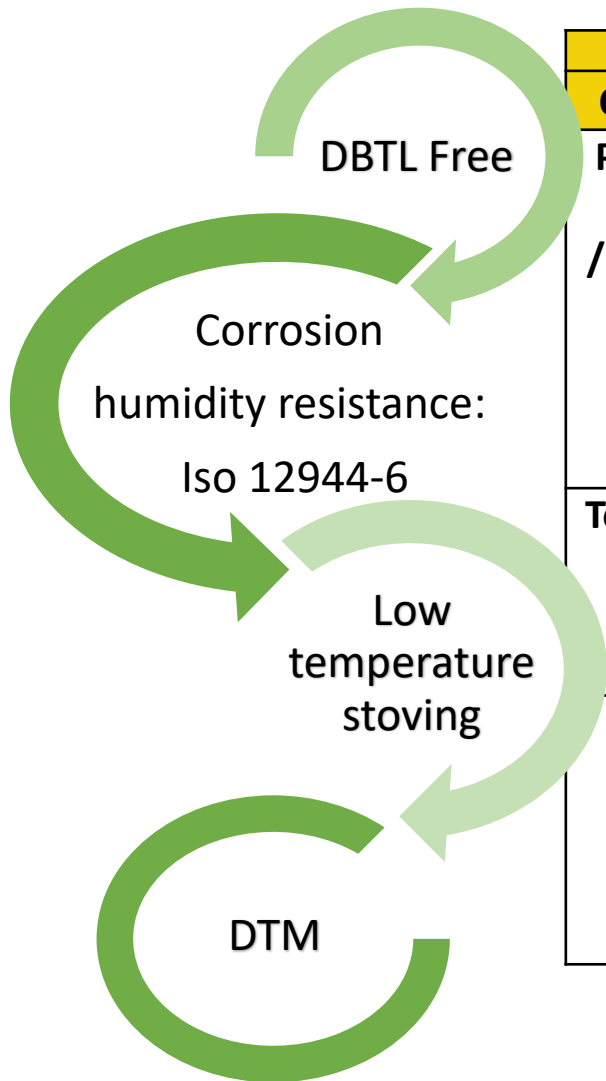
1. Factors driving the market

2. Systems

- Current
- **Desire for DTM system**
 - Challenging
 - Performance is an issue
 - corrosion and humidity resistance

Agricultural, Construction and Earthmoving | Market trends

Synres follow closely the market trends



VOC concentration limits for automotive refinishing products		
Category	Coatings	VOC g/L
Primers / Sealers / Surfacers / Fillers	Category 1: General (Metal) primer, Adhesion promoter, Sealer	150
	Category 2: Primer - surfacers, Undercoats, Plastic primer, Wet on wet, Non- sand filler, Spray fillers	500
	Category 3: Wash / etch primer, Weldable primers, Mordant solution - galvanised and zinc	650
Topcoats / Finishes	Single layer - Solid colour	420
	Multiple layer base - Solid colour and metallic / pearl effect	150
	Clear Coat (inc. tinted)	420
Special Finishes	Single layer metallic / pearl effect, high performance solid colour and clear coats (e.g. anti-scratch and fluorinated clear coat), Reflective base coat, textured finishes (e.g. hammer), anti-slip, under-body sealers, anti-chip coatings, interior finishes etc.	650



2 K Acrylics - medium & high solids

Resin	Feature	OH%
Uracron CY430 E-70	Topcoats. Good drying, very high gloss & good appearance, high solids	3.0
Uracron FH 28 70BAC	Best product for DTM. Flexible, good corrosion resistance. Good adhesion to various metals. High solids.	2.7
Uracron CY474 E-70	Topcoats. Quick drying & good hardness, weathering and chemicals resistance, high solids	4.2
Uracron CY433 XE-60	Topcoats. Quick drying & hardness. High UV and weathering resistance. Medium solids.	4.5





1K & 2 K Alkyds - mainly used for maintenance ACE-segment

Resin	Feature	OH%
Urakyd AK418 X-60	Chain stopped short oil alkyd, Economic product	1.7
Urakyd AK429 X-60	Chain stopped medium oil alkyd. High quality, quick air drying, very good through drying	2.7
Urakyd AK410 Q-52	Chain stopped medium oil alkyd. Solved in Exxsol D40, low aromatic product	2.0
Urakyd B32 75 BAC	Chain stopped short oil alkyd. Higher solids product. Good compatibility with acrylics.	2.4





Synres project :

1. DBTL replacement
2. Dispersants
3. Adhesion promoters
4. Anti-corrosion pigments



Synres project :

1. DBTL replacement

- Dibutyltin dilaurate (DBTL) is suspect CMR
- Replacement : pot life, hardness, drying time and flexibility
- Pre-study :
 - 18 different catalysts :
 - Non-CMR catalysts
 - Di-octyltin catalyst
 - Recommended quantities, or twice the amount of DBTL



Synres project :

1. DBTL replacement

Uracron FH28 70BAC	100,5
Xylene	14
Butyl acetate	14
MPA	8,26
Solvesso 100	8,26
Tolonate HDT LV	17,7

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Synres project :

1. DBTL replacement

FH28 70BAC		Dosage level (as supplied, on solid binder)	Pot life (visco in seconds)							Drying			hardness (100µ wet)		
			0 h	0,5h	1h	1,5h	2h	2,5h	4,5 h	Dust free	Tack free	Through dried	5 h	overnight	3 days
ref.	No cat		20	20	21	21	21	21	liquid	1:00	5:00	4:00	2	5	99
1	Tin	0,05	20	24	30	38	60	90	gel	0:30	2:00	1:30	9	9	124
5	Diocetyltn	0,07	20	22	30	42	60	80	gel	0:30	2:00	1:30	6	10	102
7	Zn/Bismuth carboxylate	0,07	20	26	50	>90	gel	gel	gel	1:00	2:00	1:30	9	19	111
8	Metal carboxylate	0,1	20	23	22	22	22	23	liquid	1:00	2:00-4:00	1:30	6	34	130
8	Metal carboxylate	0,2	20	22	22	22	22	23	liquid	1:00	2:30	1:30	10	52	136
13	Zirconium	0,025	20	24	28		38	45	liquid	1:00	2:00-4:00	1:30	3	10	105
13	Zirconium	0,05	20	24	50		>90	gel	gel	1:00	2:00	1:30	6	17	111



Synres project :

1. DBTL replacement

- Most interesting catalysts : Spray test

Dosage level catalyst (%)

catalyst nr.	1	5	7	8	13
ref.	DBTL (Tin)	Diocetyl tin	Zn/Bismuth carboxylate	Metal carboxylate	Zirconium
0	0,05	0,07	0,06	0,2	0,04



Synres project :

1. DBTL replacement

- Air spray gun, 1.4 mm nozzle
- DIN4 cup viscosity : 21 s @21°C

Uracron FH28 70BAC	100,8
Xylene	16
Butyl acetate	16
MPA	8
Solvesso 100	8

Tolonate HDT LV	21,2
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- DTM : 2 layers - Flash off time of 2 minutes
- Drying conditions :
 - RT
 - Forced drying (10' @RT°, followed by 30' @60°C)

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Synres project :

1. DBTL replacement

Dried 21 C	catalyst nr.	1	5	7	8	13
	ref.	DBTL (Tin)	Diocetyltn	Zn/Bismuth carboxylate	Metal carboxylate	Zirconium
Dry layer thickness	55	75	80	80	80	80
Hand-feel 1 day	Sticky	Sl.sticky	Sl.sticky	Sl.sticky	Sl.sticky	Sl.sticky
Hardness 1 day	0	9	9	7	13	7
Hardness 4 days	35	27	26	27	24	27
Hardness 7 days	76	35	35	38 (1)	27	38
Dried 30 minutes, 60 C	catalyst nr.	1	5	7	8	13
	ref.	DBTL (Tin)	Diocetyltn	Zn/Bismuth carboxylate	Metal carboxylate	Zirconium
Dry layer thickness	70	80	70	80	75	80
Hand-feel 30 min 60 C	Wet	ok	ok	ok	Sl. sticky	Sl.sticky
Hand-feel 1 day	Sl.sticky	ok	ok	ok	ok	very sl. Sticky
Hardness 1 day	1	16	20	16	52	7
Hardness 4 days	44	45	58	42	87	38
Hardness 7 days	86	59	69	53 (1)	98	58

(1) panels showed wrinkling after 5 days



Synres project :

1. DBTL replacement : conclusions

- Dioctyl tin is good alternative for DBTL
 - Probably only temporary solution
- A lot of other “theoretical” technologies
 - Only a few come close in performance
 - Optimization needed
 - Higher concentrations needed



Synres project :

1. DBTL replacement
2. **Dispersants**
3. Adhesion promoters
4. Anti-corrosion pigments



Synres project :

2. Dispersants

Preliminary screening : white topcoat

- TiO₂ as sole pigment
- Uracron FH28 : best resin
- Epoxy modification improves adhesion
 - BUT causes too much yellowing
- Combination FH28 with polyester (80/20 on solids) :
 - further adhesion improvement (GT0)
- Pigment stability issues
 - → Dispersant needed



Synres project :

2. Dispersants

➔ Testing : white topcoat

- Performance in humidity cabinet and salt spray
- Different technologies
- Quantities as recommended by supplier
- Results :



Synres project :

2. Dispersants



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Synres project :

2. Dispersants





Synres project :

2. Dispersants

→ Further screening :

- Different types
- Different concentrations
- Results :

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Synres project :

2. Dispersants





Synres project :

2. Dispersants : conclusions

- Necessary for pigment stabilization
- Negative influence on adhesion
 - Adhesion promoters
- Optimization needed
 - Type and amount are important
 - Lowest concentration possible


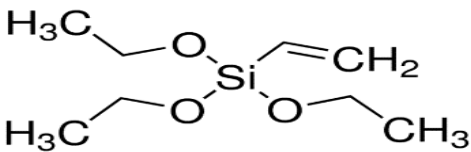
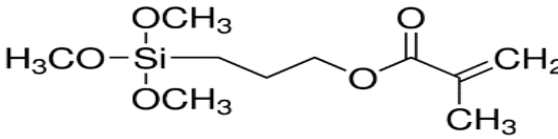
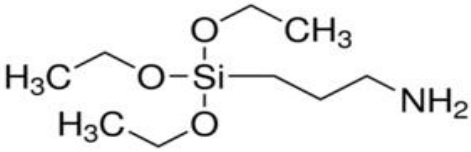
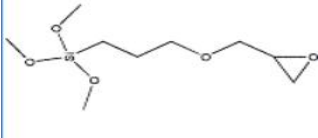


Synres project :

1. DBTL replacement
2. Dispersants
3. Adhesion promoters
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Adhesion promoter	Solids	Reactive groups		Level recommended	Level added
1	100%	Gamma-glycidoxypropyl trimethoxy silane		0.5-1.5 % on solid binder	1.5 %
2	100%	vinyltriethoxysilane			3%
3	100%	3-Methacryloxypropyl trimethoxy silane		1-5% on solid binder	3%
4	100%	3-Aminopropyl triethoxy silane			3%
5	100%	3-Glycidyloxypropyl trimethoxy silane			3%
6	60% X	adhesion resin		3-15% on solid binder	5%
7	75% BAC	adhesion resin		3-15% on solid binder	5%

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Synres project :

3. Adhesion promoters

- Results

Salt spray 240 h								
promoter type	ref.	1	2	3	4	5	6	7
Adhesion 1 h CRS p1	GT0	GT2	GT1	GT5	GT0	GT2	GT2	GT5
Adhesion 24 h CRS p1	GT2	GT2	GT2	GT1	GT0	GT5	GT0	GT5
Blistering Field p1 (middle/side)	ok/2S2	ok/2S2	ok/2S2	ok/2S3	ok	ok/3S3	ok/2S2	ok/3S3
Blistering Scratch p2	2S4/ok	3S2-S3	2S5/ok	2S5	2S2-S3	2S4	ok	2S2-S3
Blistering Field p2	ok	half	ok	ok	2S2	2S3	ok	2S4
delamination 240 h (mm) p2	0-15	0-10	30	15	5	30	30	30
Overall result								



Synres project :

3. Adhesion promoters : Conclusions

- Improvements are possible
- Some promoters have a negative influence
- Promoter 4 seems most interesting, but
 - Optimization needed
 - Process (Reactivity NH₂-group)
 - Quantity



Synres project :

1. DBTL replacement
2. Dispersants
3. Adhesion promoters
4. **Anti-corrosion pigments**



Synres project :

4. Anti-corrosion pigments

- Preliminary screening :
 - Zinc containing AC pigments - no TiO₂
 - PVC = 19%
 - 240 h salt spray

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Synres project :





Synres project :

4. Anti-corrosion pigments

- Preliminary screening :
 - Zinc containing AC pigments - no TiO₂
 - Good salt spray and humidity test performance
 - - : No hiding power
 - 2 types selected
- Testing in combination with TiO₂ :
 - PVC constant (20%)
 - 2 Zinc-containing (different ratio's)
 - 3 Zinc-free

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Synres project :

4. Anti-corrosion pigments





Synres project :

4. Anti-corrosion pigments : conclusions

- Some zinc and also non-zinc containing AC pigments
 - Good salt spray and humidity test performance
- TiO₂ : negative influence on adhesion and delamination
- Further testing needed



Synres project :

General conclusions :

1. DBTL replacement
 - Alternatives defined
2. Dispersants
 - Necessity but negative impact
3. Adhesion promoters
 - Improve performance
 - Stability is an issue ?
4. Anti-corrosion pigments
 - Improve performance

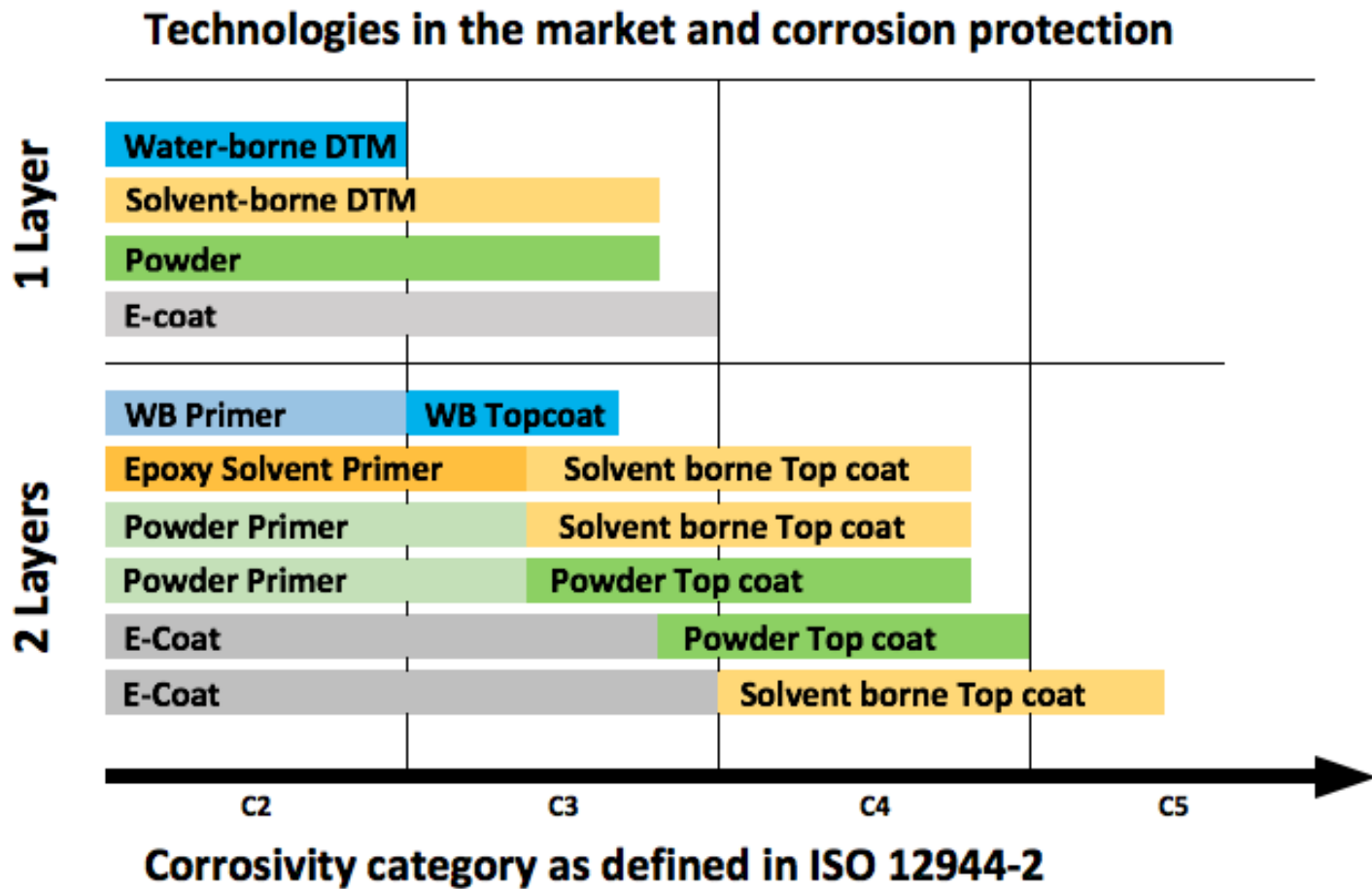
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Category	Durability range	ISO 2812-1 chemical resistance (h)	ISO 6270 water condensation (h)	ISO 7253 neutral salt spray (h)
C2	Low Medium High	NA	48 48 120	NA
C3	Low Medium High	NA	48 120 240	120 240 480
C4	Low Medium High	NA	120 240 480	240 480 720
C5-I	Low Medium High	168 168 168	240 480 720	480 720 1440
C5-M	Low Medium High	NA	240 480 720	480 720 1440



ACE Technical market analysis | Technologies in the market





Synres project : Future work

1. Further optimization
2. Other parameters (isocyanates, defoamers,...)
3. Combine previous findings



Synres project : Future work

1. Further optimization
2. Other parameters (isocyanates, defoamers,...)
3. Combine previous findings

A central graphic featuring a yellow rectangular sign with rounded corners and a black border, containing the text 'WORK IN PROGRESS' in bold, black, sans-serif capital letters. The sign is surrounded by several strips of yellow and black striped caution tape with the words 'UNDER CONSTRUCTION' printed on it in black capital letters. The tape strips are layered and crisscrossed around the sign.

**WORK
IN
PROGRESS**



Thank you for the attention

Questions?