

HYBRIDUR® Polymer Dispersions

Urethane-Acrylic Hybrids For 1K Coatings Applications

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Evonik Hybridur® Products Address Coating Market Trends & Needs



Productivity

- Fast return-to-service time
- Worry-free application
- Reduced downtime and simplified maintenance
- Ease of handling



Performance

- UV durable
- Scratch and mar resistance
- Excellent adhesion to various substrates
- Good chemical and corrosion resistance



Environment

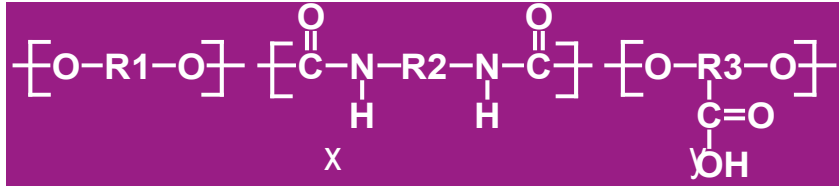
- VOC and Emission reduction
- Less hazardous components
- Sustainable environmental protection

Hybridur® = Evonik proprietary, advanced hybrid acrylics-polyurethane technology

1K, waterborne, isocyanate free, low VOC

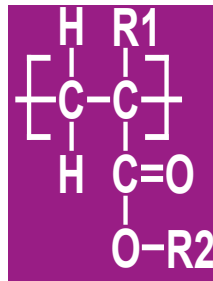
Hybridur[®] is Anionically Stabilized Urethane-Acrylic Hybrid Polymers

Polyurethane



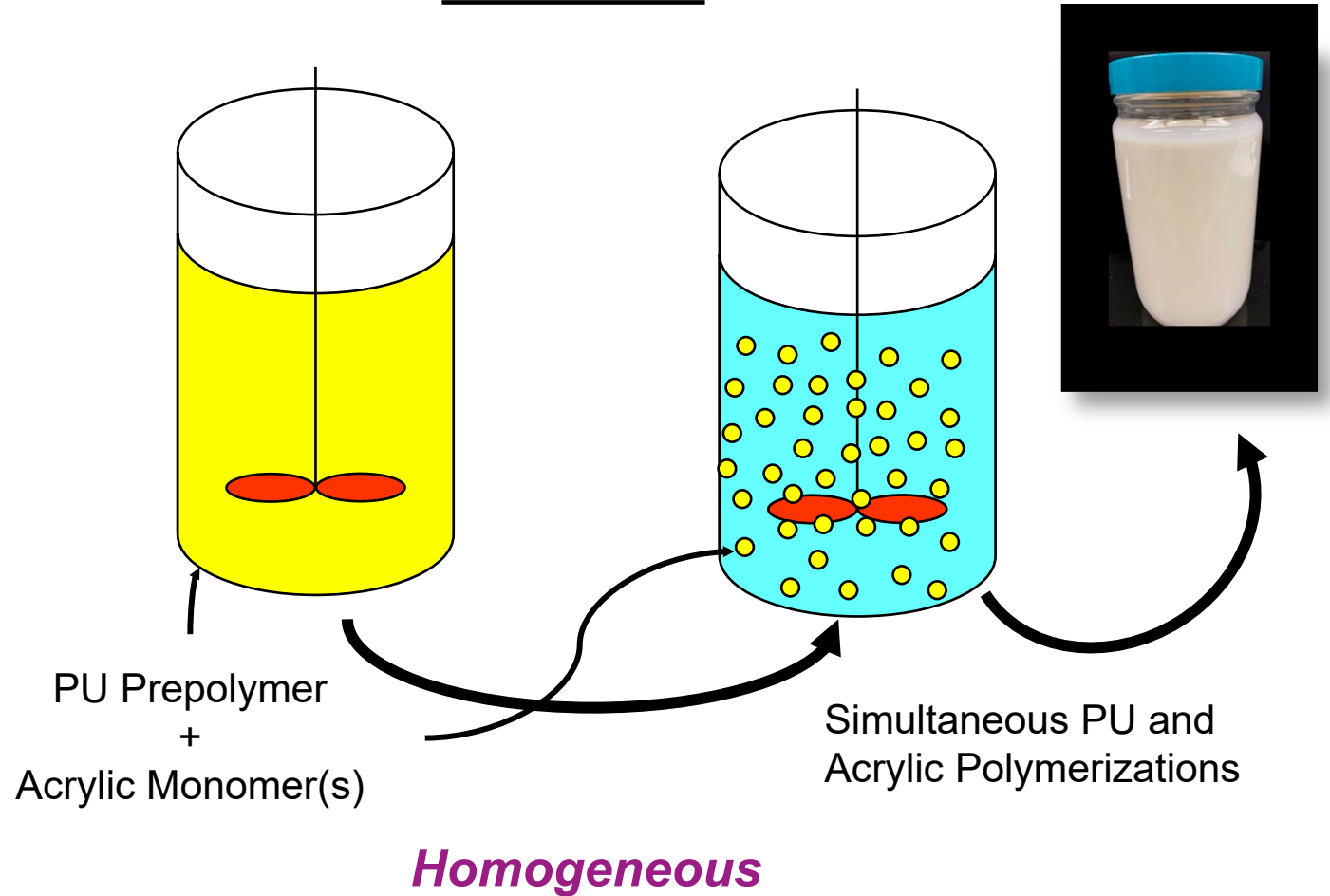
R1 = Polyester, Polyether; R2 = Aliphatic Group; R3 = Aliphatic Group

Polyacrylate/methacrylate

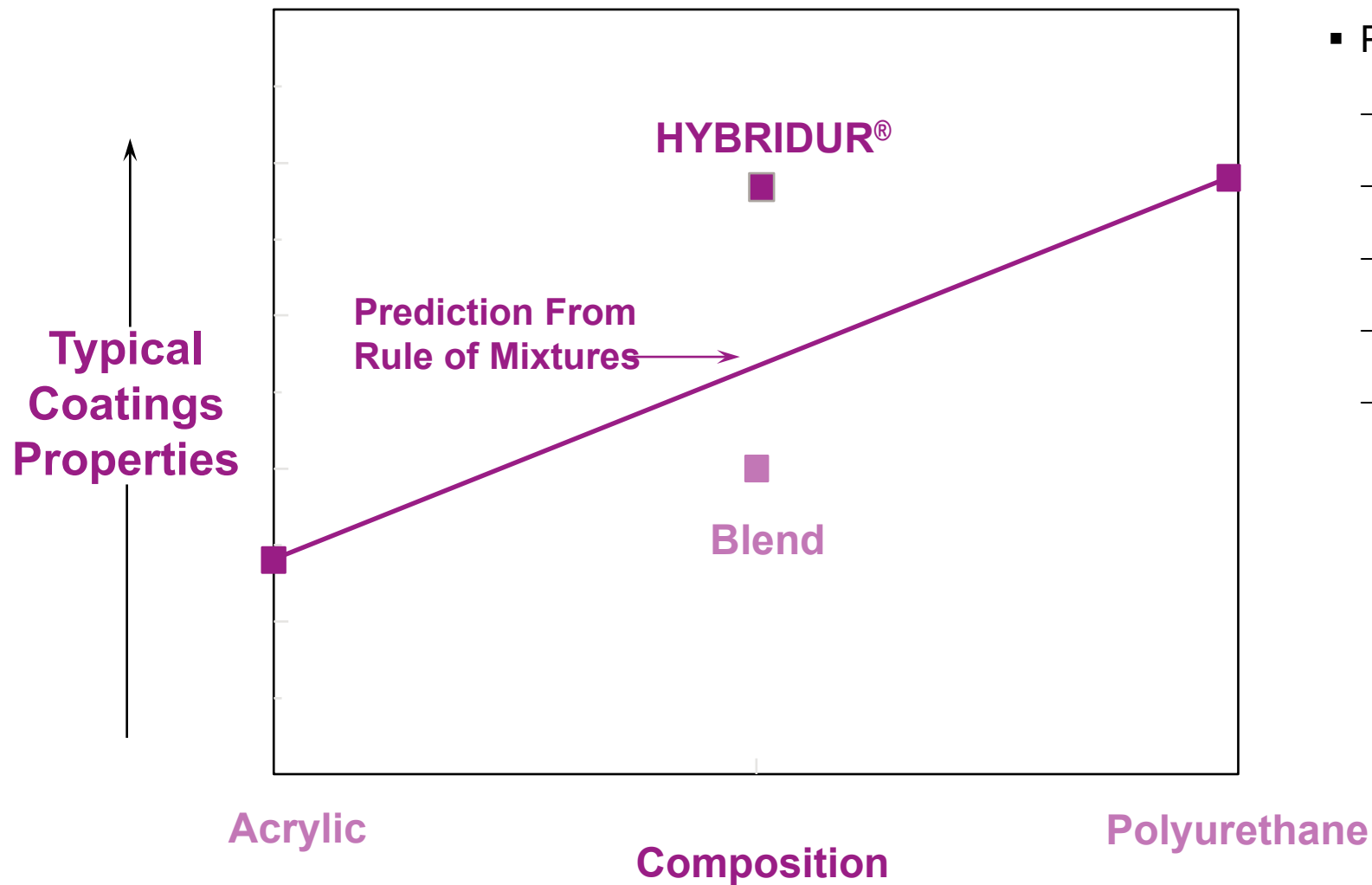


R1 = H, CH₃; R2 = Alkyl Group, H

HYBRIDUR[®]



HYBRIDUR® Provides Advanced Performance vs. Physical Blends of Acrylic and Polyurethane



- Performance benefits include:
 - Wear/abrasion resistance
 - Chemical resistance
 - Adhesion
 - Long term outdoor exposure
 - Cost in use benefit vs. typical polyurethane dispersions (PUDs)

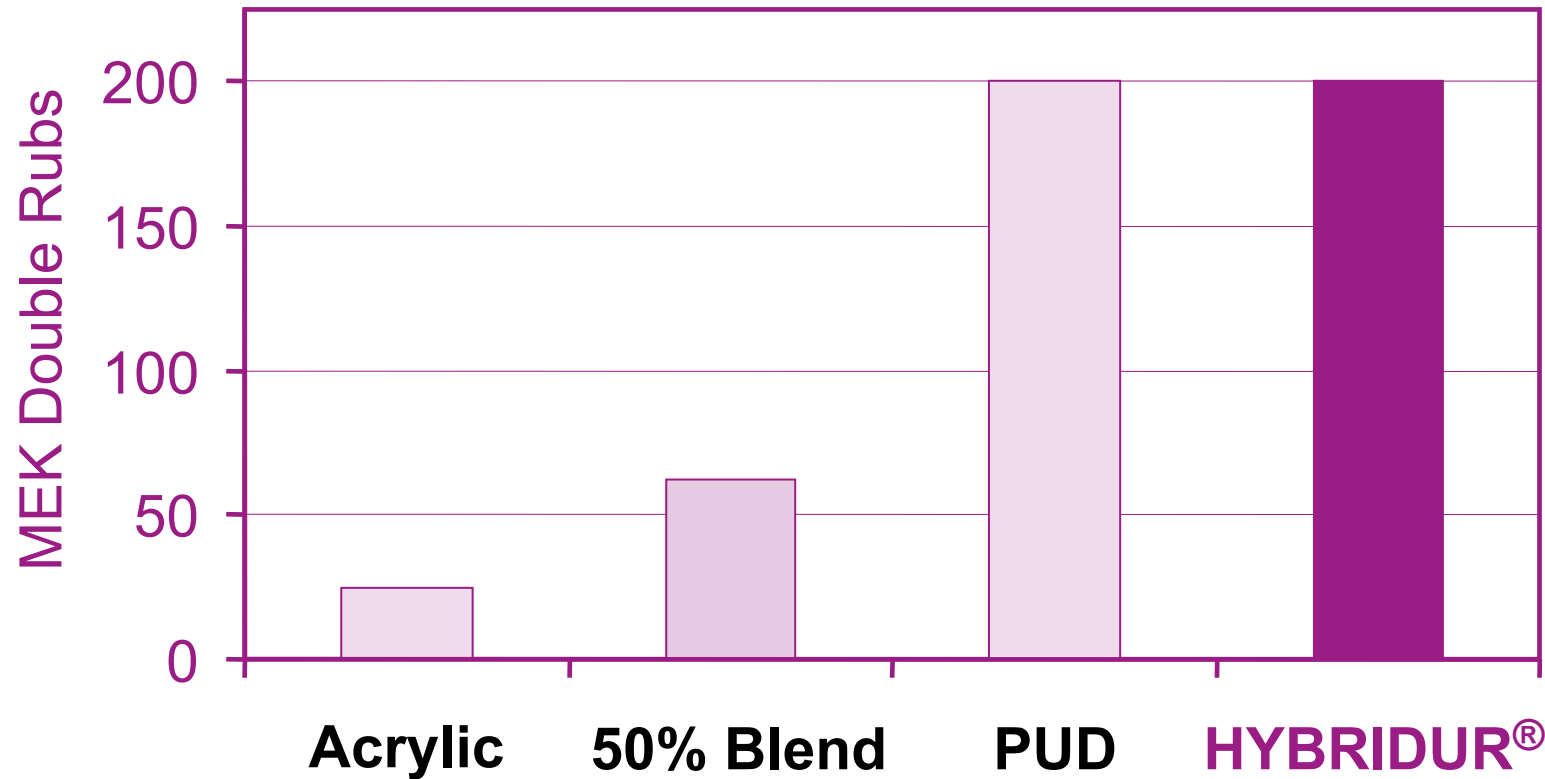
General Comparison of HYBRIDUR® Properties vs. PUD and Acrylic Polymers for 1K Coatings



Property	Acrylic	HYBRIDUR®	PUD
Flexibility	Fair	Excellent	Excellent
Adhesion	Fair	Good	Good
Hardness	Fair	Good	Good
Chemical resistance	Poor	Good	Good
Durability	Fair	Excellent	Excellent

- Hybridur® dispersions provide a cost - effective alternative solution to PUDs without sacrificing performance

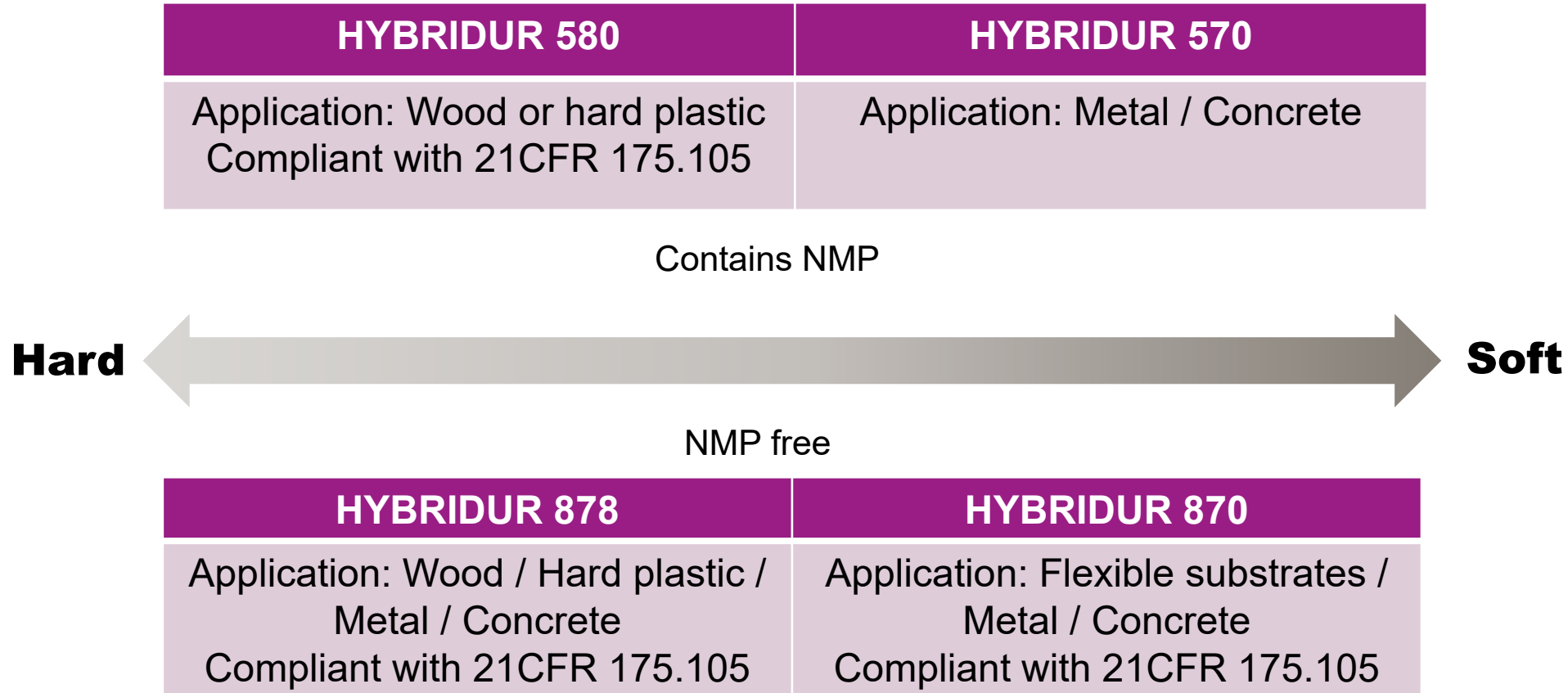
HYBRIDUR® Clear Topcoats Demonstrate High Solvent Resistance



- High degree of coalescence with the interpenetrating network leads to the good film integrity
- Good film integrity leads to longer term durability

Coating properties were tested over cold rolled steel with a zinc phosphate treatment (Bondrite 952). Coatings were applied using #60 wire –wound drawdown rod and allowed to dry for 7 days at 25° C and 50% relative humidity

Evonik HYBRIDUR® Product Offerings



HYBRIDUR® Polymer Dispersions – Typical Properties

Typical Properties	HYBRIDUR 570	HYBRIDUR 580	HYBRIDUR 870	HYBRIDUR 878
Solids %	40 - 42		35 - 41	39 - 41
Viscosity (cP)	50 -150			
Particle size	Colloidal			
Particle charge	Anionic			
pH	7.5 - 8.5		7.5 - 9.0	
Density g/cm ³	1.03	1.04	1.03	1.04
VOC, g/L	150		11	
%Solvent (NMP)	6		<0.1	

HYBRIDUR® Polymer Dispersions – Typical Properties

Typical Properties	HYBRIDUR 570	HYBRIDUR 580	HYBRIDUR 870	HYBRIDUR 878
MFFT [°C]	NA	NA	25	62
Tg (°C)	(-) 35 - 35	(-) 35 - 100	(-) 40 - 23	(-) 40 - 100
Persoz hardness 25°C [s]	NA	NA	95	230
Tensile strength [MPa]	26	27	18	30.4
Tensile Modulus[GPa]	2.2	-	0.3	1.1
Tensile Elongation[%]	200	120	250	8
Direct Impact Resistance[kg.cm]	>185			
Reverse impact resistance[kg.cm]	>185			
Double rubs(MEK)	>200			
Double rubs (IPA)	100	105	50	105

HYBRIDUR® Polymer Dispersions Applications

HYBRIDUR® Polymer Dispersions for Metal Applications

- Storage tanks
- Water towers
- Bridges
- Railcars
- Metal buildings
- Structural steelwork
- Pipes
- Commercial Architectural



HYBRIDUR® Polymer Dispersions for Wood Applications

- **High Gloss & Matt Clear / Pigmented Coatings**
 - Parquet Flooring
 - Furniture
 - Window Frames
 - Trim and Siding



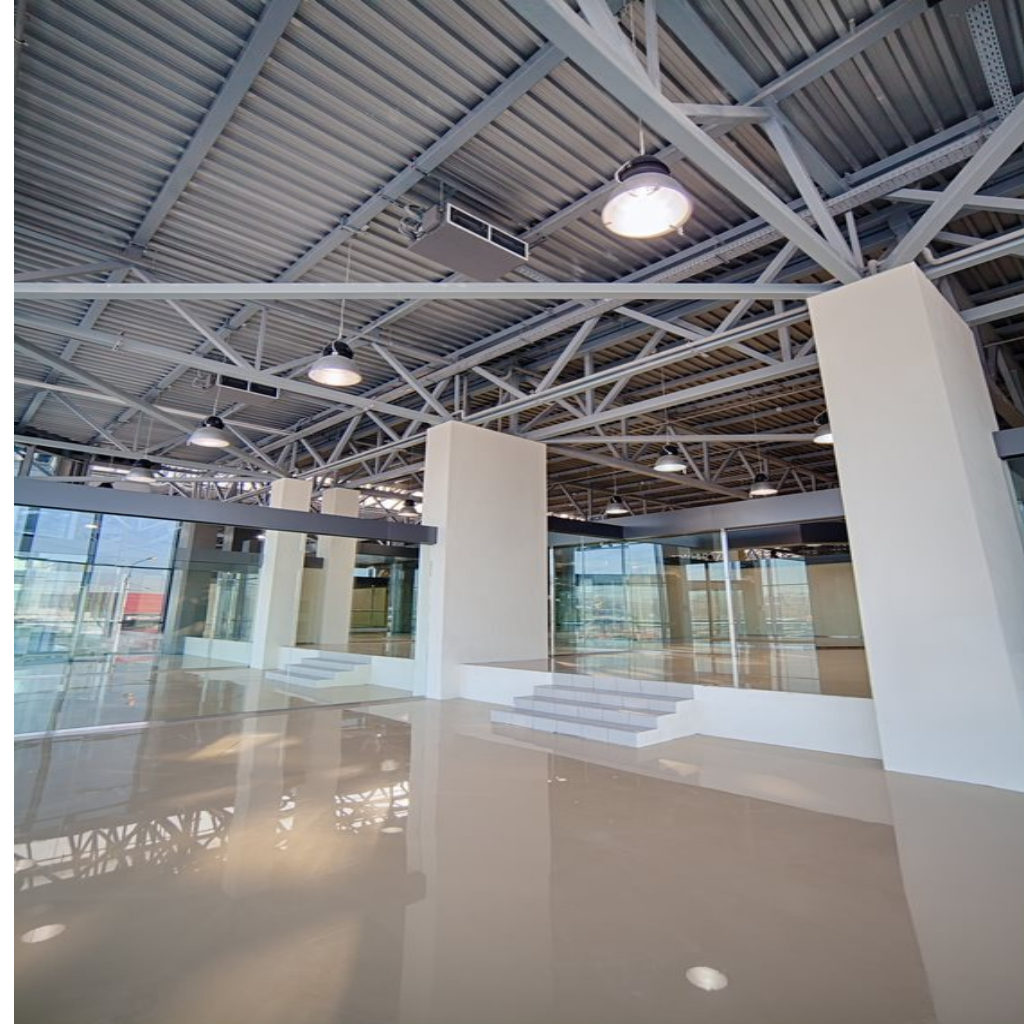
HYBRIDUR® Polymer Dispersions for Plastic Applications

- **Transportation Coatings**
- **Interior Automotive Soft-Feel Coatings, Plastic Components**
- **Computer Housing**



HYBRIDUR® Polymer Dispersions for Concrete

- Industrial sealers, primers and topcoats for concrete
- Glaze coat over epoxy primer
- Pigmented topcoat over epoxy primer



Formulating with HYBRIDUR® Polymer Dispersions

Formulating with HYBRIDUR® - Key Points

- Anionically stabilized product has high surface tension so must add surfactant for wetting
- For most properties, need highly coalesced system
 - Must add sufficient cosolvent
 - Appropriate choice of cosolvent is also critical
- Almost all additives detract from performance
 - Recommended additives minimize this negative



HYBRIDUR® 870 Gloss White Coating 50g/l VOC

Material	Pounds	Gallons	Supplier
Resin- Free Grind: Add the following into a clean container under mild agitation and mix until dissolved			
Water (deionized)	56.21	6.74	
ZetaSpense®1200 Dispersant	6.78	0.76	Evonik
ZetaSpense®170 Dispersant	6.78	0.80	Evonik
Surfynol® DF-75 Defoamer	0.60	0.07	Evonik
Continue agitation while adding the pigment below			
Ti-Pure® R-706 TiO2	299.80	8.98	Chemours
Increase speed to high and disperse to Hegman ≥ 7 grind. Temperature must not exceed 60°C			
Blend: Add the following into a separate, clean container under mild agitation and mix until blended			
Hybridur® 870	655.80	78.27	Evonik
Pre-blend the next 4 items before adding to the Hybridur 870 polymer dispersion with strong agitation			
DOWNAOL®TPnB	7.50	0.97	Dow
SURFYNOL ®AD01 Surfactant	7.50	1.00	Evonik
Optifilm®400	18.73	2.31	Eastman
Surfynol® DF 58 Defoamer	0.38	0.05	Evonik
Dynol ®604 wetting agent	0.38	0.05	Evonik
Final Blend: Slowly add the resin-free grind to the blend and mix with mild agitation until homogeneous			
Total	1090.46	100	

HYBRIDUR® 870 Gloss White Coating: Application properties

Formulation properties	Value	Application properties	Value
Weight Solids %	54.3	Adhesion Dry (ASTMD3359)	5A
Volume solids %	39.8	Adhesion wet (24 hr. @70° F	5A
Viscosity cP	500	Gloss, 60°(ASTM D 523)	77
PVC%	22.6	Direct and Reverse impact resistance (ASTM D4366)	160
VOC, (g/l)	46	Double rubs (ASTM D4752)	
Density, g/cm ³	1.30	IPA	60
		MEK	>160

Coating properties were tested over cold rolled steel with a zinc phosphate treatment (Bondrite 952) . Coatings were applied using #60 wire –wound drawdown rod and allowed to dry at 25 °C at 50% relative humidity for 7 days

HYBRIDUR® 870 Direct to metal coating formulation

Material	Pounds	Gallons	Supplier
Water (deionized)			
	130.20	15.15	Evonik
ZETASPESE® 3200	8.65	0.99	Evonik
FOAMMASTER VF	3.47	0.45	BASF
Ti-Pure R960 (TiO ₂)	65.00	1.95	Chemours
HEUCOPHOS ZBZ (Anticorrosive)	113.59	3.58	Heucotech Ltd
Continue agitation while adding the pigment below			
Increase speed to high and disperse to Hegman \geq 7 grind. Temperature must not exceed 60°C			
Let down: Add the following to the grind ; mix with medium agitation for a minimum of 15 minutes			
Hybridur® 870	523.75	6.93	Evonik
TAFIGEL PUR 60 Thickener	0.84	0.09	Munzing Chemie GMBH
Ammonium Benzoate (Flash rush inhibitor) 10% solution	37.57	4.59	
ACROSLV DPNB	39.76	5.24	Eastman
TEXANOL Ester alcohol (Solvent)	52.03	6.57	Eastman
BYK 348	4.33	0.56	Byk-Chemie
Total	979.19	100	

HYBRIDUR® 870 DTM Coating: Application properties

Formulation properties	Value	Application properties	Value
Weight Solids %	46.5	Adhesion Dry (ASTMD3359)	5A
Volume solids %	36.4	Adhesion wet (24 hr. @70° F)	5A
Viscosity cP	500	Gloss, 60°(ASTM D 523)	14
PVC%	16.4%	Direct and Reverse impact resistance (ASTM D4366)	160
VOC, g/l	231	Double rubs (ASTM D4752)	
Density, g/cm ³	1.17	IPA	125
Humidity resistance (ASTM D 22247) 37 °C /100% RH /1000 hrs	No blisters	MEK	>200

Salt spray performance after 500 hrs

Formulation	Degree of rust	Scribe Creep /Field Blistering	Blister size
Hybridur 870 DTM (500 hrs)	None	10/10	10 (No blisters)

Coating properties were tested over cold rolled steel with a zinc phosphate treatment (Bondrite 952) . Coatings were applied using wire –wound drawdown rod and were allowed to dry at 25°C at and 50% relative humidity for 7 days. DFT 1.8 mils



Coalescing Solvents for HYBRDIUR® Dispersions

Hydrophobic solvents	Hydrophilic solvents
Texanol 0.002*	PM 0.71*
DPNB 0.01*	TPM <0.01*
TPNB <<0.01*	DMM 0.13*
	NMP 0.03*
	PG 0.01*

- Proper choice of co-solvent(s) is critical for an adequate film coalescence
- Typically, the mix of hydrophobic and hydrophilic solvents is used
- The optimal ratio of hydrophobic to hydrophilic solvents is about 1:1 by weight

*Evaporation Rates Posted for all solvents

Coalescing and Cosolvent Recommendation for HYBRIDUR® Systems

- The softer HYBRIDURs (570 and 870) require about 5 to 8% cosolvent on resin solids
- The harder HYBRIDURs (580 and 878) require 10 to 15% cosolvent on resin solids
- Multiple combinations of hydrophobic/hydrophilic cosolvents could be used depending on the availability
- Evonik can help formulators to recommend the best combination of cosolvents

Primary coalescing and Cosolvent recommendation

Hybridur®	Hydrophobic	Hydrophilic
570, 580, 870, 878	Texanol	TPM
570, 580, 870, 878	DPNB	TPM
570, 580	Texanol- DPNB	TPM
570, 580	DPNB	None
570, 580, 870, 878	Texanol	TPM/ PG*
870, 878	Texanol- DPNB	DMM
870, 878	Texanol-DPNB	NMP

*Texanol-TPM/Propylene glycol can be used to increase open time of a formulation

Hybridur FAQ:

How do we slow down HYBRIDURS fast dry?

The slow evaporating and high boiling solvents/blends will slow drying time of HYBRIDUR coatings

- TPM/PG
- Methyl Carbitol/Texanol
- TPNB
- DPM

What are the most compatible defoamers?

The best practice is to pre-dissolve the defoamer (and other additives) into the solvent and to add that mixture slowly and with strong agitation to the Hybridur Polymer Dispersion

- SURFYNOL® DF58 - 1-2%
- SURFYNOL® MD20 - 0.1- 1.0%
- Foammaster VF
- DEE FO PI-4

What surfactants can be added to improve surface appearance and wetting?

- SURFYNOL® 465 / Aerosol OT75 - 0.25-1.0%
- SURFYNOL® 440 - 0.25 -1.0%

Hybridur FAQ:

How do I incorporate pigments into Hybridur?

Resin free Pigment dispersions are preferred. The recommended dispersing aids are

- Zetasperse 3800
- SURFYNOL® CT-171

When I prepare the formulation, I see seed or graininess in the mixture and drawdowns. How do I prevent this?

- Prevent rapid addition of solvents
- Solvents and additive-solvent mixtures should always be added slowly and under strong agitation

What rheology modifiers can be used?

- Acrysol RM2020/ Acrysol RM 8W (10:1)
- Acrysol RM-825
- Acrysol SCT -275



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