ARKEMA COATING RESINS

AMERICAS

Binder Systems for Cool Roof Coatings

- Performance
- Value
- Formulating Flexibility

ENCOR® FLEX BY ARKEMA

KYNARAQUATEC® BY ARKEMA

ARKEMA
INNOVATIVE CHEMISTRY

ENCOR® Flex Polymers and Kynar Aquatec® PVDF

Formulate Cool Roof Coatings with Arkema Binder Systems

Now it is simple to specify a binder system for cool roof coatings. From high value to high performance there is an Arkema binder system that offers performance and formulating flexibility.

- **AC III Binder System** – Kynar Aquatec® FMA-12 Latex with either ENCOR® Flex 187 acrylic latex or ENCOR® Flex 192 modified acrylic latex – this topcoat/basecoat combination includes a PVDF topcoat for outstanding performance and durability in top-of-the-line cool roof coatings.

- **AC II Binder System** – ENCOR® Flex 187 acrylic latex or ENCOR® Flex 192 modified acrylic latex – this comprehensive base and topcoat system delivers excellent performance and meets ASTM D-6083 standards.

- **AC I Binder System** – ENCOR® Flex 3186 Styrene Acrylic System – your choice for Arkema's combination of value and performance.

System Components

ENCOR® Flex 3186 Latex

ENCOR® Flex 3186 latex is a styrene-acrylic binder offering a good balance of properties such as weatherability, elongation, water resistance and caustic resistance and excellent dirt pickup resistance. It is intended to be used in roof systems that meet the "Cool Roof Rating Council's (CRRC)" product rating program requirements for reflectance and emittance at VOC levels less than 50 grams per liter.

ENCOR® Flex 187 Latex

ENCOR® Flex 187 latex is a high solids, all-acrylic binder with inherent dirt pickup resistance. This polymer meets the requirements of the "Leadership in Energy and Environmental Design (LEED®) Green Building Rating System" and the U.S. Environmental Protection Agency/Department of Energy's "Energy Star®" program. Properly formulated, ENCOR® Flex 187 latex also meets the requirements of ASTM D-6083 ("Standard Specification for Liquid Applied Acrylic Coating used in Roofing") and the "Cool Roof Rating Council's (CRRC)" product rating program for reflectance and emittance at VOC levels less than 50 grams per liter.

ENCOR® Flex 192 Latex

ENCOR® Flex 192 is a high solids, ambient crosslinking, modified acrylic latex for use in self-priming coatings which extend the service life of weathered TPO membranes eliminating the need for solvent based primer for reduced overall system VOC and cost. It offers ambient crosslinking functionality for increased toughness and superior dirt pick up resistance, and meets ASTM D-6083 performance standards for elastomeric coatings.

Kynar Aquatec® FMA-12 Latex

Kynar Aquatec® FMA-12 latex is a waterborne polymer dispersion which enables the production of highly weatherable waterborne, air-dry paints and coatings. Formulated coatings meet South Coast Air Quality Management District (SCAQMD) 50 gm/liter standards for volatile organic compounds. Kynar Aquatec® FMA-12 latex contains, on polymer solids, 50% by weight Kynar® PVDF resin, and 50% proprietary acrylic resin.

System Components Offer Formulating Flexibility

System/Property	AC I	AC II		AC III	
Chemistry/Application	ENCOR® Flex 3186 Styrene Acrylic Basecoat & Topcoat	ENCOR® Flex 187 Acrylic Basecoat & Topcoat	ENCOR® Flex 192 Modified Acrylic Basecoat & Topcoat	ENCOR® Flex 187 Acrylic Basecoat Kynar Aquatec® FMA-12 Fluoropolymer Topcoat	ENCOR® Flex 192 Modified Acrylic Basecoat Kynar Aquatec® FMA-12 Fluoropolymer Topcoat
Solvent primer (Recommended for TPO Restoration)	√	√	Not Required	√	Not Required
Elastomeric Properties	+	++	++	++	++
Dirt Pick-up Resistance (long term)	+	++	++	++++	++++
Low Temperature Flexibility	x	√	√	√	√
ASTM D-6083 Compliance	x	√	√	√	√
Long Term Reflectance and Durability	+	++	++	++++	++++
Low VOC Capable (<50 g/L)	√	√	√	√	√

Typical Properties†

Property	ENCOR® Flex 3186	ENCOR® Flex 187	ENCOR® Flex 192	Kynar Aquatec® FMA-12
Polymer Type	Styrene Acrylic	Acrylic	Modified Acrylic	PVDF/Acrylic
Total Solids, % by weight	50	60	60	46
Weight per Gallon, lb	8.8	8.9	8.7	9.6
pH Value	8.0	8.0	8.0	8.2
Particle Size, microns	0.20	0.45	0.35	0.20
Viscosity, 25°C, cP	300	150	500	100
Glass Transition Temperature, midpoint, °C	-7	-18	-21	12

†Typical properties not to be construed as specifications, *Brookfield, RVT, #6, 60 RPM, **Brookfield 30 s-1

Elastomeric Properties

The high performance of coatings based on Arkema binders is due, in part, to the excellent overall elastomeric properties of ENCOR® Flex latexes. Figure 1 reports data from the formulations detailed in this publication.

Property	ENCOR® Flex 3186	ENCOR® Flex 187	ENCOR® Flex 192
Ultimate Tensile, psi	254	272	230
Ultimate Elongation, %	410	253	250

Figure 1

Total Solar Reflectance Properties

Conventional elastomeric acrylic based roof coatings drop to 0.55 Total Solar Reflectance in less than two years. With dirt pick-up resistant ENCOR® Flex latexes, two-year Total Solar Reflectance retention can be improved to over 0.70. Kynar Aquatec® based coatings have been reported by CRRC (Cool Roof Rating Council) to have initial Total Solar Reflectance and Emissivity values greater than 0.85 each. Furthermore, additional south Florida exposure studies have demonstrated that these coatings are able to retain values over 0.80 for more than seven years. These new fluoropolymer coatings will revolutionize the roof coating market by providing long-term energy savings that no conventional coating can achieve.

Dirt Pick Up Resistance

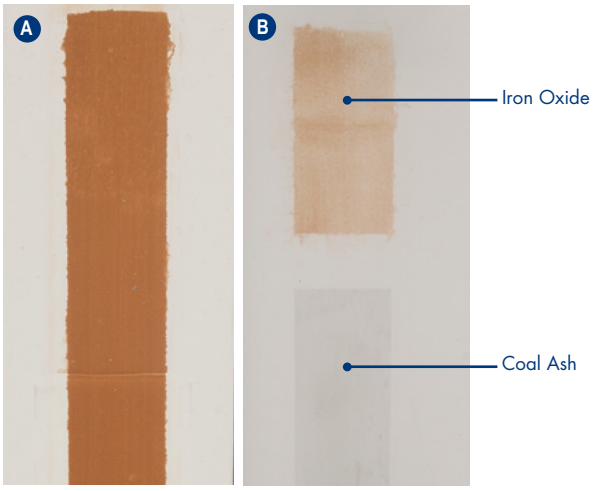

Figure 2 shows a comparison of dirt pick up resistance, comparing the performance of a commercially-available roof coating with a coating based on the Arkema AC III binder system. Coated panels were subjected to iron oxide and coal ash dirt in the form of a slurry. The slurry was allowed to dry for one day, washed off with running water, and put in a 30 cycle wet sponge scrub. Panel B, using the ENCOR® Flex 187 basecoat with Kynar Aquatec® FMA-12 Latex topcoat, demonstrates exceptional resistance compared to the commercial coating used on Panel A.

Asphalt Bleed-Through Resistance

Figure 3 demonstrates resistance to asphalt bleed-through. The panel is coated with a styrene acrylic basecoat and a topcoat based on Kynar Aquatec® FMA-12 Latex,which provides significant improvement in bleed-through resistance.

Elastomeric System Formulations
AC I — ENCOR® Flex 3186 Latex

Grind Paste		Mass (lbs)	Volume (US Gallons)
Water	Solvent	99.0	11.9
Coadis™ 123K	Dispersant	25.5	2.9
Surfynol® 104E	Surfactant	2.5	0.3
Propylene Glycol	Solvent	10.0	1.1
Foamaster® NXZ	Defoamer	1.5	0.2
Ti-Pure® R-960	TiO_2	98.0	2.9
Drikalite®	Extenders	360.0	16.0
Eagle Zinc	Zinc Oxide	25.0	0.5
Acticide™ BW20	Preservative	1.1	0.1
Polyphase® 663	Mildewcide	7.0	0.3
Letdown		**Mass (lbs)**	**Volume (US Gallons)**
ENCOR® Flex 3186	Binder - Latex	550.0	61.8
Texanol®	Solvent	4.1	0.5
Foamaster® NXZ	Defoamer	4.1	0.5
Ammonium Hydroxide [28%aq]	Base	1.6	0.2
Viscoatex® 730	HASE Thickener	6.0	0.7
		1196.5	100.0

ASTM D-2370 Tensile & Elongation	
Elongation (%, 23°C)	410
Tensile Strength (psi, 23°C)	254
After 1000 hrs WOM	
Elongation (%, 23°C)	147
Tensile Strength (psi, 23°C)	599
ASTM D-1653 Water Resistance	
Permeance (Perms, grain/ft2*H*in.Hg)	15
ASTM D-471 Water Swelling (%)	
Water Uptake (%)	6
ASTM D-624 Tear Resistance	
Tear Strength (lbf/in.)	128
ASTM D-522 Low Temp Flex	
(1/2 in mandrel @ -26°C) Low Temp Flex	Fail
Stability	
ΔKU 2 week heat age @ 120°F	6

Paint Properties	
Weight Solids:	64.8%
Volume Solids:	49.7%
PVC:	40.3%
Viscosity (KU):	110-130
pH:	9.2
VOC (#/Gal):	0.37
VOC (g/L):	44.8
Pounds per Gallon:	11.92
Total Pigment:	40.48%
Non-volatile Binder:	23.05%
Coalescent Level:	1.49%
Dispersant Level:	1.16%

Elastomeric System Formulations
AC II — ENCOR® Flex 187 Latex

Grind Paste		Mass (lbs)	Volume (US Gallons)
Water	Solvent	142.0	17.1
Rhodoline® 230	Dispersant	8.2	0.8
KTPP	Dispersant	2.0	0.1
Surfynol® 104E	Surfactant	2.5	0.3
Propylene Glycol	Solvent	19.2	2.1
Nopco™ NXZ	Defoamer	1.5	0.2
Ti-Pure® R-960	TiO_2	105.2	3.2
Drikalite®	Extenders	350.0	15.5
Eagle Zinc	Zinc Oxide	25.0	0.5
Acticide™ BW20	Preservative	1.1	0.1
Polyphase® 663	Mildewcide	7.0	0.3
Letdown		**Mass (lbs)**	**Volume (US Gallons)**
ENCOR® Flex 187	Binder - Latex	502.7	57.8
Texanol®	Solvent	4.1	0.5
Nopco™ NXZ	Defoamer	4.1	0.5
Ammonium Hydroxide [28%aq]	Base	1.6	0.2
Polyphobe® 106HE	HASE Thickener	7.0	0.8
		1183.2	100.0

ASTM D-2370 Tensile & Elongation	
Elongation (%, 23°C)	253
Tensile Strength (psi, 23°C)	272
After 1000 hrs WOM	
Elongation (%, 23°C)	162
Tensile Strength (psi, 23°C)	472
ASTM D-1653 Water Resistance	
Permeance (Perms, grain/ft2*H*in.Hg)	24.1
ASTM D-471 Water Swelling (%)	
Water Uptake (%)	12
ASTM D-624 Tear Resistance	
Tear Strength (lbf/in.)	104
ASTM D-522 Low Temp Flex	
(1/2 in mandrel @ -26°C)	
Low Temp Flex	Pass
After 1000 hrs WOM	Pass
Stability	
ΔKU 2 week heat age @ 120°F	11

Paint Properties	
Weight Solids:	65.4%
Volume Solids:	50.6%
PVC:	39.0%
Viscosity (KU):	120-140
pH:	8.7
VOC (#/Gal):	0.49
VOC (g/L):	58.9
Pounds per Gallon:	11.79
Total Pigment:	40.73%
Non-volatile Binder:	23.45%
Coalescent Level:	1.48%
Dispersant Level:	1.14%

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Surfynol® is a registered trademark of Air Products & Chemicals Inc.
Nopco™ is a trademark of Nopco Paper Technology
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Drikilite® is a registered trademark of ECC America Inc.
Polyphase® is a registered trademark of Troy Technology Corporation, Inc.
Texanol® is a registered trademark of Eastman Chemical Company
Polyphobe® is a registered trademark of Coatex SAS

Elastomeric System Formulations
AC II — ENCOR® Flex 192 Latex

Grind Paste		Mass (lbs)	Volume (US Gallons)
Water	Solvent	134.4	16.2
Propylene Glycol	Solvent	10.0	1.2
Ecodis™ P 30	Dispersant	4.3	0.4
Natrosol® 250MBR	HEC Thickener	1.5	0.2
Ammonium Hydroxide [28%aq]	Base	1.5	0.2
Foamstar® A10	Defoamer	2.0	0.3
Ti-Pure® R-960	TiO_2	75.0	2.3
Omyacarb® 10	CaCO3	380.0	16.8
Acticide™ BW20	Preservative	1.1	0.1
Polyphase® 663	Biocide	15.0	1.5
Letdown		**Mass (lbs)**	**Volume (US Gallons)**
ENCOR® Flex 192	Latex	490.1	54.5
Foamstar® A10	Defoamer	2.0	0.3
Texanol®	Solvent	6.0	0.8
Ammonium Hydroxide [28%aq]	Base	1.5	0.2
Water	Solvent	40.0	4.8
Natrosol® 250MBR	HEC Thickener	2.5	0.3
		1166.9	100.1

ASTM D-2370 Tensile and Elongation)	
Elongation (%, 23°C)	250
Tensile Strength (psi, 23°C)	229
After 1000 hrs WOM	
Elongation (%, 23°C)	180
Tensile Strength (psi, 23°C)	425
ASTM D-1653 Water Resistance	
Permeance (Perms, grain/ft2*H*in.Hg)	15.8
ASTM D-471 Water Swelling (%)	
Water Uptake (%)	7
ASTM C-794 Adhesion and Peel	
Wet Peel Strength (PLI) galv.	12.5
steel	6.3
Aluminum	3.5
aged TPO	5.4
ASTM D-624 Tear Resistance	
Tear Strength (lbf/in.)	84
ASTM D-522 Low Temp Flex	
(1/2 in mandrel @ -26°C)	
Low Temp Flex	Pass
After 1000 hrs WOM	Pass
Stability	
ΔKU 2 week heat age @ 120°F	8

Paint Properties	
Weight Solids:	65.5%
Volume Solids:	50.1%
PVC:	38.2%
Viscosity (KU):	120-140
pH:	8.8
VOC (#/Gal):	0.31
VOC (g/L):	36.9
Pounds per Gallon:	11.70
Total Pigment:	38.96%
Non-volatile Binder:	25.18%
Coalescent Level:	2.04%
Dispersant Level:	0.38%

Elastomeric System Formulations
AC III — Kynar Aquatec® FMA-12 Latex

Grind Paste		Mass (lbs)	Volume (US Gallons)
Water	Solvent	233.4	28.0
Natrosol® 250MBR	HEC Thickener	3.6	0.4
Ammonium Hydroxide [28%aq]	Base	1.0	0.1
Disperbyk® 190	Dispersant	15.3	1.7
Byk® 022	Defoamer	1.2	0.1
Strodex® PK0VOC	Surfactant	10.2	1.3
TKPP	Dispersant	0.8	0.1
Ti-Pure® R-960	TiO_2	150.4	4.5
Minex® 7	Extenders	150.4	6.9
Letdown		**Mass (lbs)**	**Volume (US Gallons)**
Kynar Aquatec® FMA-12	Latex	447.1	46.8
Byk® 022	Defoamer	0.8	0.1
Glycol Ether DPnB	Solvent	15.0	2.0
Optifilm® 400	Solvent	31.8	3.9
Coapur® XS-71	Rheology Modifier	3.3	0.4
Coapur® XS-52	Rheology Modifier	1.7	0.2
Polyphase 663	Solvent	28.8	3.5
		1094.6	100.0

ASTM D-2370 Tensile & Elongation	
Elongation (%, 23°C)	256
Tensile Strength (psi, 23°C)	226
ASTM D-1653 Water Resistance	
Permeance (Perms, grain/ft2*H*in.Hg)	24.1
ASTM D-471 Water Swelling (%)	
Water Uptake (%)	12
ASTM D-624 Tear Resistance	
Tear Strength (lbf/in.)	90.5
ASTM D-522 Low Temp Flex	
(1/2 in mandrel @ -26°C)	
Low Temp Flex	Pass
After 1000 hrs WOM	Pass
Stability	
ΔKU 2 week heat age @ 120°F	11

System Performance ENCOR® Flex 187 basecoat and FMA12 topcoat

Paint Properties	
Weight Solids:	48.5%
Volume Solids:	29.3%
PVC:	39.1%
VOC (#/Gal):	0.40
VOC (g/L):	48.2
Pounds per Gallon:	10.94
Total Pigment:	27.48%
Non-volatile Binder:	18.79%
Coalescent Level:	22.74%
Dispersant Level:	2.30%

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ARKEMA
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For Kynar Aquatec®

Arkema Inc.
900 First Avenue
King of Prussia, PA 19406
1-800-596-2750
www.kynaraquatec.com

For ENCOR® Flex Polymers

Arkema Inc.
410 Gregson Drive
Cary, NC 27511
919-469-6700
1-800-777-8227
www.arkemacoatingresins.com

Form No. 309000681

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