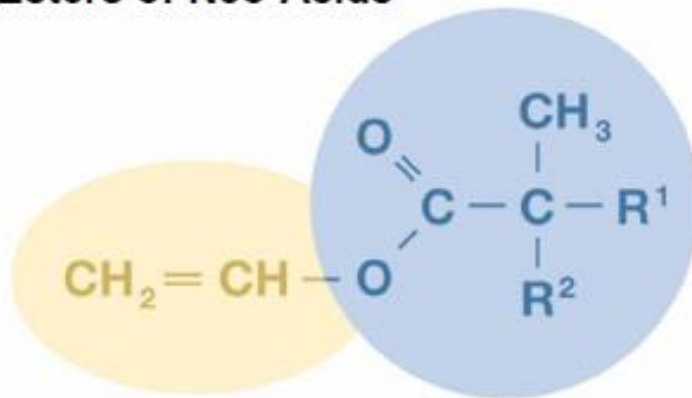


Vinyl Versatate – Acrylic copolymer emulsion developed for architectural paint applications

Vinyl Versatate Technology Overview

Vinyl Esters of Neo-Acids



- Vinyl Neodecanoate Monomer

$\text{R}^1 + \text{R}^2 = 7$ carbon atoms

- Vinyl Neononanoate Monomer

$\text{R}^1 + \text{R}^2 = 6$ carbon atoms

Vinyl Versatate Technology Overview

Properties:

- Saturated, branched alkyl group
- Low water solubility
- Vinyl neodecanoate Tg -3C
- Vinyl neononanoate Tg 70C

Benefits:

- Hydrophobicity
- UV Stability
- Low surface tension

Vinyl Versatate Copolymer Emulsion – VVCE

TYPICAL VALUES

Solids content	52 %
Brookfield viscosity	600 cps
pH	6.0
Minimum film-forming temperature (MFFT)	+13 °C
Glass Transition Temperature (Tg)	+24 °C
Prevailing particle size	0.15 µm

FILM CHARACTERISTICS: Coalesced film is transparent and glossy

Vinyl Versatate Copolymer Emulsion

BENCHMARK TESTING

VVCE was formulated to produce the following paints:

1. Flat finish at 65% PVC
2. Satin finish at 40% PVC

These 2 paints were benchmarked against paints manufactured by a national brand and a regional brand:

1. Flat finish: Paint A1 (regional brand) and Paint B1 (national brand)
2. Satin finish: Paint A2 (regional brand) and Paint B2 (national brand)

Vinyl Versatate Copolymer Emulsion

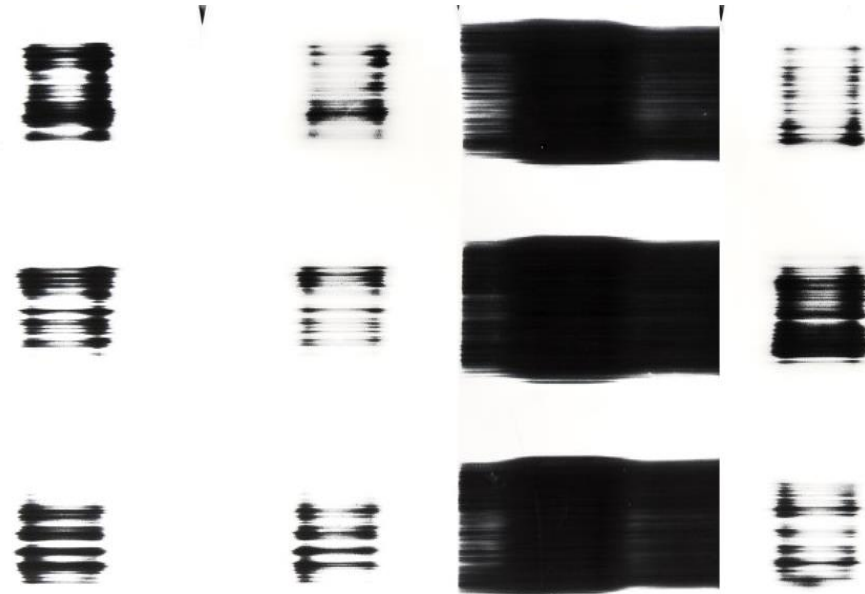
65% PVC Flat Formula

Commercial Name	% weight
Water	16.82%
Natrosol Plus 330PA	0.26%
Propylene Glycol (PG)	0.40%
AMP-95	0.08%
Tamol 165A	1.60%
Triton CF-10	0.24%
Drew T-4507	0.08%
TSP	0.08%
Attagel 50	0.40%
Kronos 2310	16.03%
Minex 4	18.03%
Mattex PRO	11.61%
Water	1.60%
Celite 499	2.00%
Water	4.53%
VVCE	20.02%
Ropaque Ultra E	3.84%
Drew T-4507	0.12%
Texanol	0.72%
Optifilm 400	0.14%
Tergitol NP 13	0.16%
Proxel AQ	0.12%
Polyphase 678	0.28%
Aquaflow NHS-310	0.82%
RM-895	0.02%
Total	100.00%

VOC content = 40 g/L

Vinyl Versatate Copolymer Emulsion

Scrub Test Environment	Commercial Paint A1	VVCE 65% PVC paint	Commercial Paint B1	VVCE 65% PVC paint
Panel 1-2 Average Cycle	417.5	466	27.88	419.25
% Ave Cycle	89.59	Control	6.65	Control



Vinyl Versatate Copolymer Emulsion

Property	VVCE	A1	B2
Water Absorption- 7 Days	7.1%	23.8%	24.7
Caustic Resistance - 7 Days	No Change	Dissolved	Dissolved

Vinyl Versatate Copolymer Emulsion

DIRT PICK UP RESISTANCE

VVCE
65% PVC Paint

Commercial
Paint A1

Commercial
Paint B1



VVCE based
paint shows better
dirt pick up resistance

Vinyl Versatate Copolymer Emulsion

Pendulum Hardness

Formula ID		65% PVC VVCE	Commercial Paint A1	Commercial Paint B1
König Pendulum Hardness	3 – OSC	44	19	24

A pendulum resting on a coating surface is set into oscillation (rocking) and the time for the oscillation amplitude to decrease by a specified amount measured. The shorter the damping time, the lower the hardness.

Vinyl Versatate Copolymer Emulsion

Formula ID		A1	B1	VVCE
LTC		Pass	Pass	Pass
LTC GLOSS		1.4/2.5/2.2	1.3/2.6/0.8	1.4/2.3/2.1
WPG		11.60	11.25	12.656
pH		8.64	8.61	8.76
Rheology (KU)	Initial	N/A	N/A	89.7
	ON	N/A	N/A	92.3
	7 Days	108.3	104.0	94.2
	DE KU	N/A	N/A	4.5
ICI	Initial	N/A	N/A	1.48
	ON	N/A	N/A	1.55
	7 Days	1.41	0.54	1.45
Gloss	AD, O/N	1.3/2.3/1.7	1.3/1.9/0.7	1.3/2.1/1.5
Contrast Ratio	3 mils - AD	96.64	97.75	97.75
Reflectance		90.91	85.93	90.41
Yellowness		1.72	2.11	1.97
Sag Resistance	4-24 mil	18	16	24
Flow Leveling	Leneta	6	7	5
Wet Edge	RT - 10mil square	4	7	9
Dry to Touch	RT - 7mil	28	35	20

Vinyl Versatate Copolymer Emulsion

40% PVC Satin Formula

Formula ID	40% PVC VVCE
Commercial Name	Weight %
Kronos 4311	28.69
Water	4.48
Propylene Glycol (PG)	0.90
AMP-95	0.09
Foamstar 2420	0.22
Tamol 1124	0.54
Triton CF-10	0.29
Attagel 50	0.25
Minex 10	10.22
Water	15.42
VVCE	33.66
Ropaque Ultra E	1.79
Foamstar 2420	0.22
Texanol	0.40
Optifilm 400	1.26
Proxel AQ	0.13
Polyphase 678	0.27
Aquaflow NHS-310	0.45
SCT-275	0.43
RM-895	0.29
TOTAL	100.00
% Solid WT	50.8
% Solid Vol	35.0
PVC	40.05
VOC	< 50 g/L

Vinyl Versatate Copolymer Emulsion

Scrub Test Environment	Satin Commercial Paint A2	Satin VVCE 40% PVC paint	Satin Commercial Paint B2	Satin VVCE 40% PVC paint
Panel 1-2 Average Cycle	471	1092	1467	1183
% Ave Cycle	43.0	Control	124	Control



Vinyl Versatate Copolymer Emulsion

Property	VVCE	A2	B2
Water Absorption- 7 Days	13.4%	14.7%	16.0%
Caustic Resistance - 15 Days	No Change	Dissolved	No Change

Vinyl Versatate Copolymer Emulsion

Satin Physical Properties

Formula ID		40% PVC VVCE	Commercial Paint A2	Commercial Paint B2
LTC		PASS	PASS	PASS
LTC GLOSS		2.3/12.4/35.8	2.5/14.7/36.8	1.9/10.4/14.1
WPG		10.264	10.46	10.86
pH		8.33		
APPEARANCE PERFORMANCE				
Rheology (KU)	Initial	98.6		
	ON	98.9		
	7 Days	99.1	109.3	109.4
	DE KU	0.5		
ICI	Initial	0.533		
	ON	0.504		
	7 Days	0.523	0.397	0.488
Gloss	AD, O/N	2.4/13.0/34.7	2.5/14.8/35.5	1.8/9.3/12.4
Contrast Ratio	3 mils - AD	98.33	97.49	98.81
Reflectance		93.27	90.7	85.71
Yellowness		0.72	1.47	3.66
Sag Resistance	4-24 mil	20	24	24
Flow Leveling	Leneta	8	7	6
Pendulum Hardness	3 - OSC - Koenig	15	15	11

Vinyl Versatate Copolymer Emulsion

Summary:

Paints formulated with vinyl versatate copolymer emulsion offer:

- High scrub resistance, especially at high PVC levels
- Excellent alkali resistance
- Superior water resistance
- Better hiding power and pigment binding at higher PVC levels
- Excellent rheology behavior achieving high sag resistance in paint
- Cost-effective in paint formulations

Vinyl Versatate Copolymer Emulsion

Next Steps:

- Formulate exterior flat and masonry coatings
- Evaluate side by side with commercially available competitive samples