Archer RC™: A Nonvolatile, Reactive Coalescent for the Reduction of VOC in Latex Paints

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Resourceful By Nature™

Presentation Outline

- Introduction
- Coalescent Function
- Chemistry
- Architectural Paint Evaluation
- Summary

ADM Mission

'Unlock the potential of nature to improve the quality of life'

- Agriculture is key to sustainable global growth
- Harness the full potential of agriculture by applying advances in R&D to agriculture
- Deliver more nutritional foods, more economically
- Industrial products from renewable feedstocks

ADM Industrials: Paint & Coatings

- Archer RC™: Reactive Coalescent
  - **www.archer-rc.com**
- Linseed Oils
- Bodied and Modified Oils
- Conjugated Oils
- Waxes
- Lecithins
- Xanthan Gum
- Sorbitol
- Envirostrip®
  - **www.envirostrip.com**
- Solvents
  - Ethyl lactate
  - Ethanol
  - FAMEs
  - Glycerol

Archer RC™ Attributes

- **Nonvolatile – help paint formulators meet VOC regulations**
- Equal to better performance
- Based on sustainable technology
- Can be substituted for conventional coalescents
- Use with existing latex polymers
- Provides service and solids

VOC Regulations

South Coast Air Quality Management District Rule 1113

	Level (g/L)	Effective Date
Flat	100	7/1/2001
	50	7/1/2008
Non-Flat	150	7/1/2002
	50	7/1/2006
High Gloss	150	7/1/2002
	50	7/1/2006
Primers	200	7/1/2002
	100	7/1/2006

Ozone Transport Commission (OTC)
(Northeast and Mid-Atlantic states – Jan. 1st 2005)

	National Rule VOC Limit (g/L)	OTC Model Rule (g/L)
Flat	250	100
Non-flat	380	150

Coalescent Function in Latex Paints

Emulsion Particle
No Coalescent

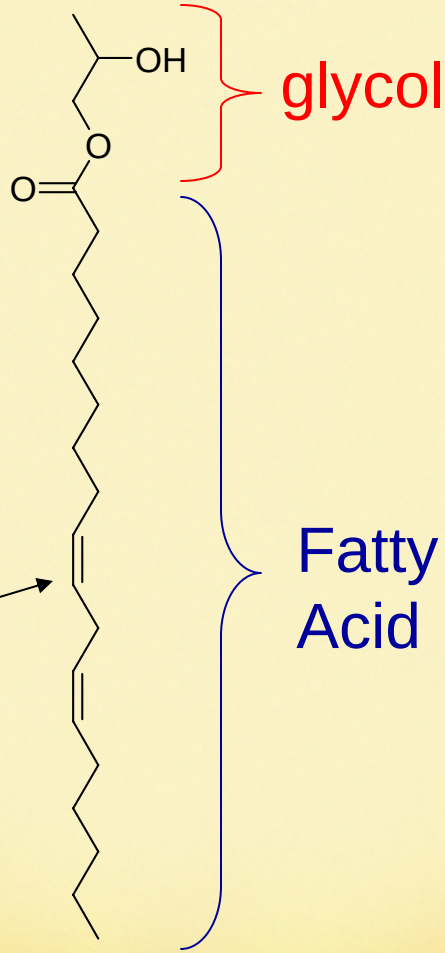
Emulsion Particle
w/coalescent
“plasticized particle”

Conventional coalescents act as temporary plasticizers. They facilitate film formation, then volatilize into the atmosphere allowing for film recovery. Nonvolatile coalescents must have an alternate recovery method.

Comparison of Chemical Composition

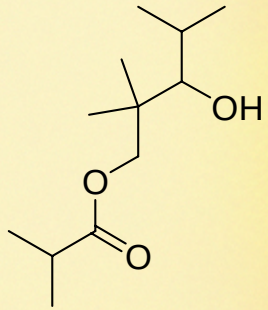
Archer RC™
F.A. Ester-Alcohol Reactive Coalescent

HLB ~ 3.4



TMB **Ester-Alcohol Coalescing Solvent**
(2,2,4-trimethyl-1,3-pentanediol monoisobutyrate)

HLB ~ 3



100% VOC

Designing the Coalescent

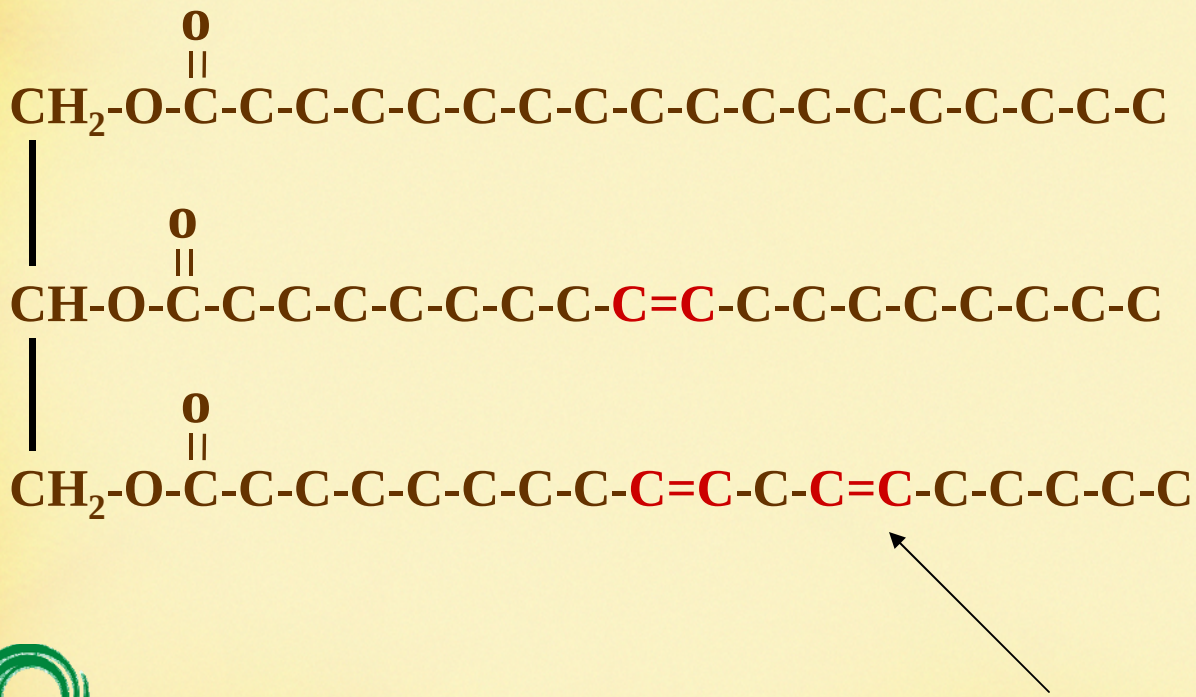
- Feedstock
- Synthesis
- Fatty Acid Composition
- Ester Selection
- Compatibility with Latex Resins
- Performance in Coating

Renewable Feedstock: Triglycerides

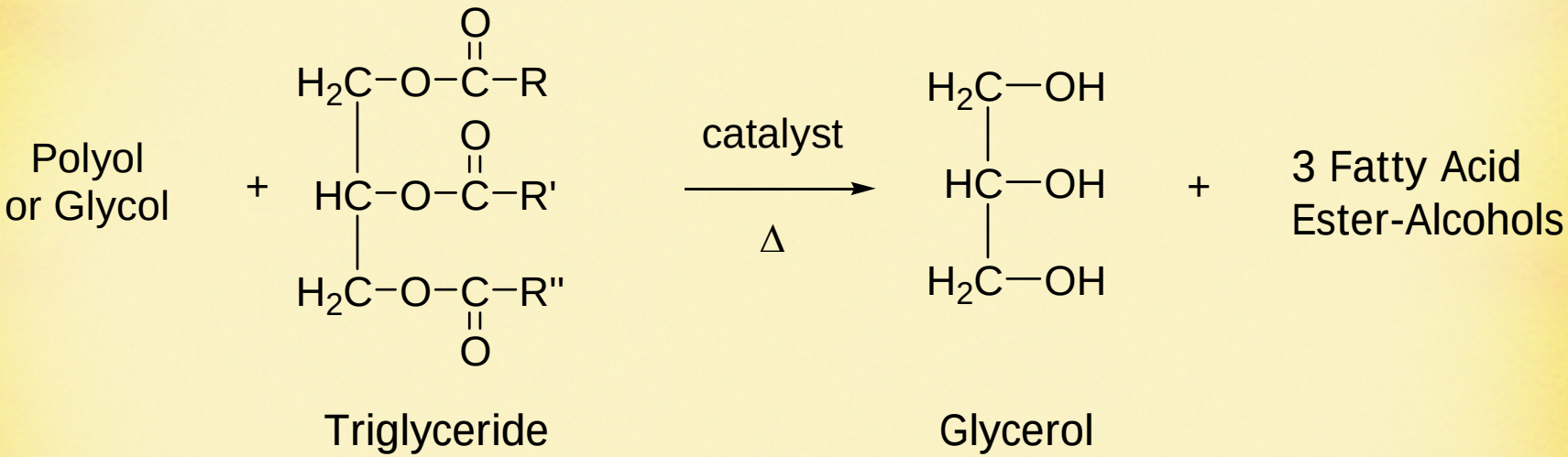
Oils: *Liquid*

High degree of unsaturation

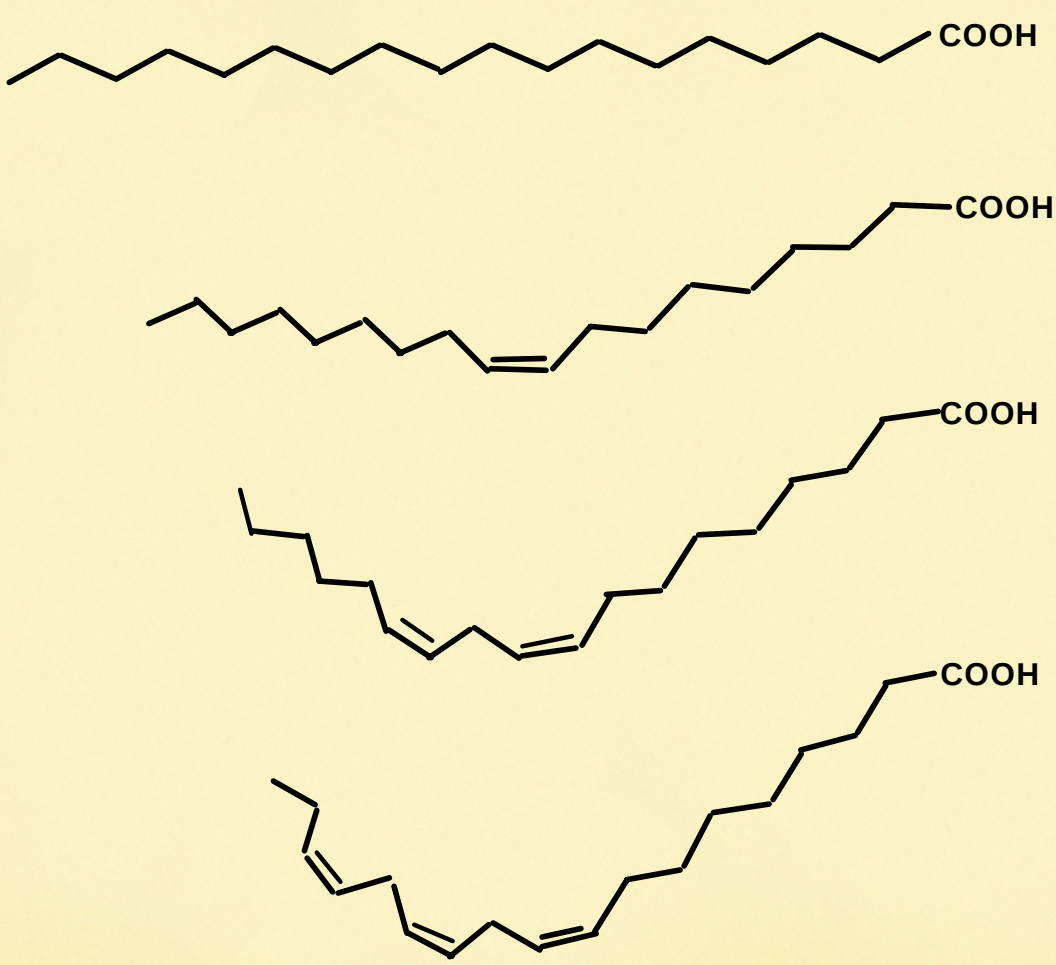
Sunflower, Corn, Soy, Linseed



Synthesis of Archer RC™ Fatty Acid Ester



Fatty Acids Available for Archer RC™ Synthesis



Saturated

M.P. 158^{0}F
70^{0}C

Cis-mono-unsaturated
Oleic

M.P. 61^{0}F
16^{0}C

Cis-di-unsaturated
Linoleic

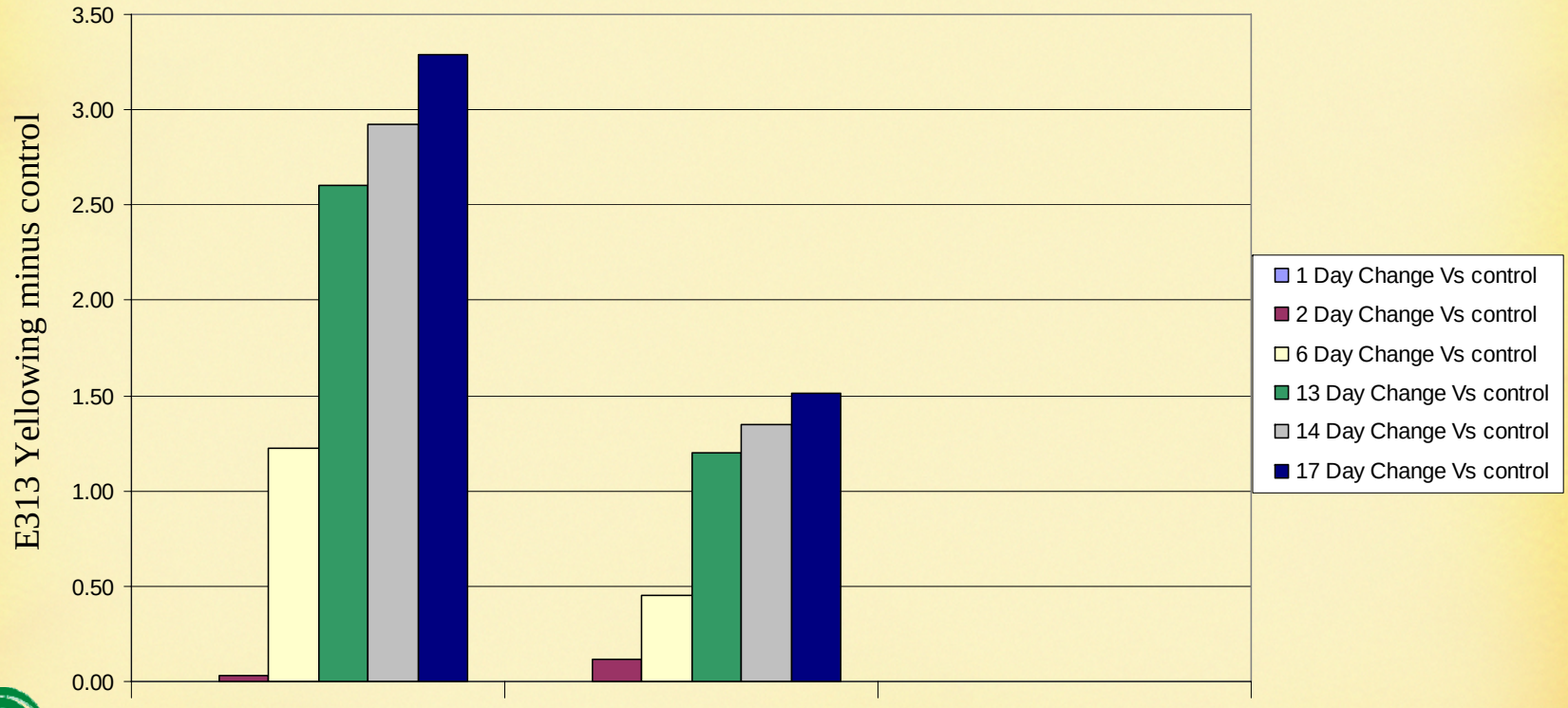
M.P. 19^{0}F
-7.2^{0}C

Cis-Tri-unsaturated
Linolenic

M.P. 9^{0}F
-12.8^{0}C

Fatty Acid-Ester Yellowing

Styrene-Acrylic Semigloss Paint - 10 mil E313 Yellowing Exp minus TMB control, Difference



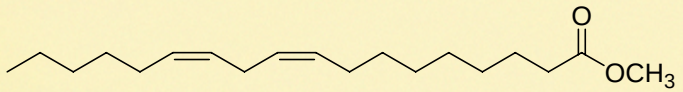
Fatty Acid Composition of Common Vegetable Oils

		Mono-unsaturates	Di-unsaturates	Tri-unsaturates	Conjugated	
	Saturates	Oleic	Linoleic Acid	Linolenic Acid	Eleostearic	Ricinoleic
	C-C	1 C=C	2 C=C	3 C=C		1 C=C (-OH)
Location		9	9,12	9,12,15		
Vegetable Oils						
Non-Dring Oils						
Canola	6%	62%	21%	9%		
→ Corn	13%	25%	61%	<1%		
Cottonseed	27%	19%	54%			
Palm	51%	39%	10%			
Peanut	18%	48%	34%			
Safflower	9%	13%	78%			
→ Sunflower	11%	20%	69%			
Drying & Semi-Drying Oils						
Soybean	15%	24%	54%	7%		
Linseed	9%	19%	15%	57%	2C=C/3C=C	
Linseed (75% conj.)*	9%	19%	4%	14%	54%	
Other Oils						
Tung	6%	7%	4%	3%	80%	
Castor Oil	2.5%	3.30%	3.60%	0.20%		89.20%

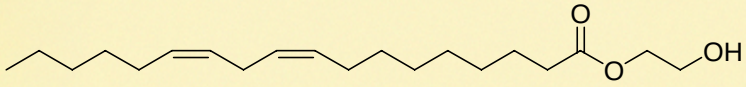
Target: High linoleic (2 C=C) with low linolenic 3(C=C)

Which ester should we choose?

HLB Value



1.0



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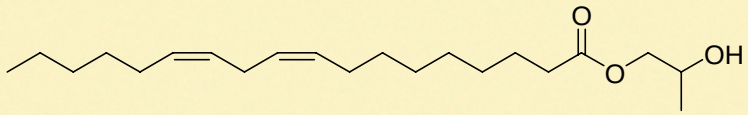

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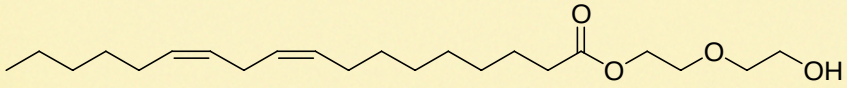

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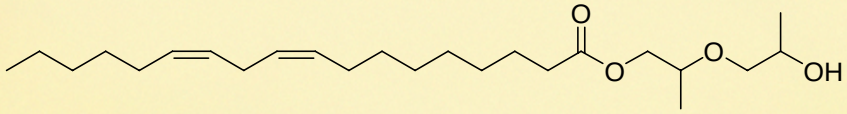


5.9

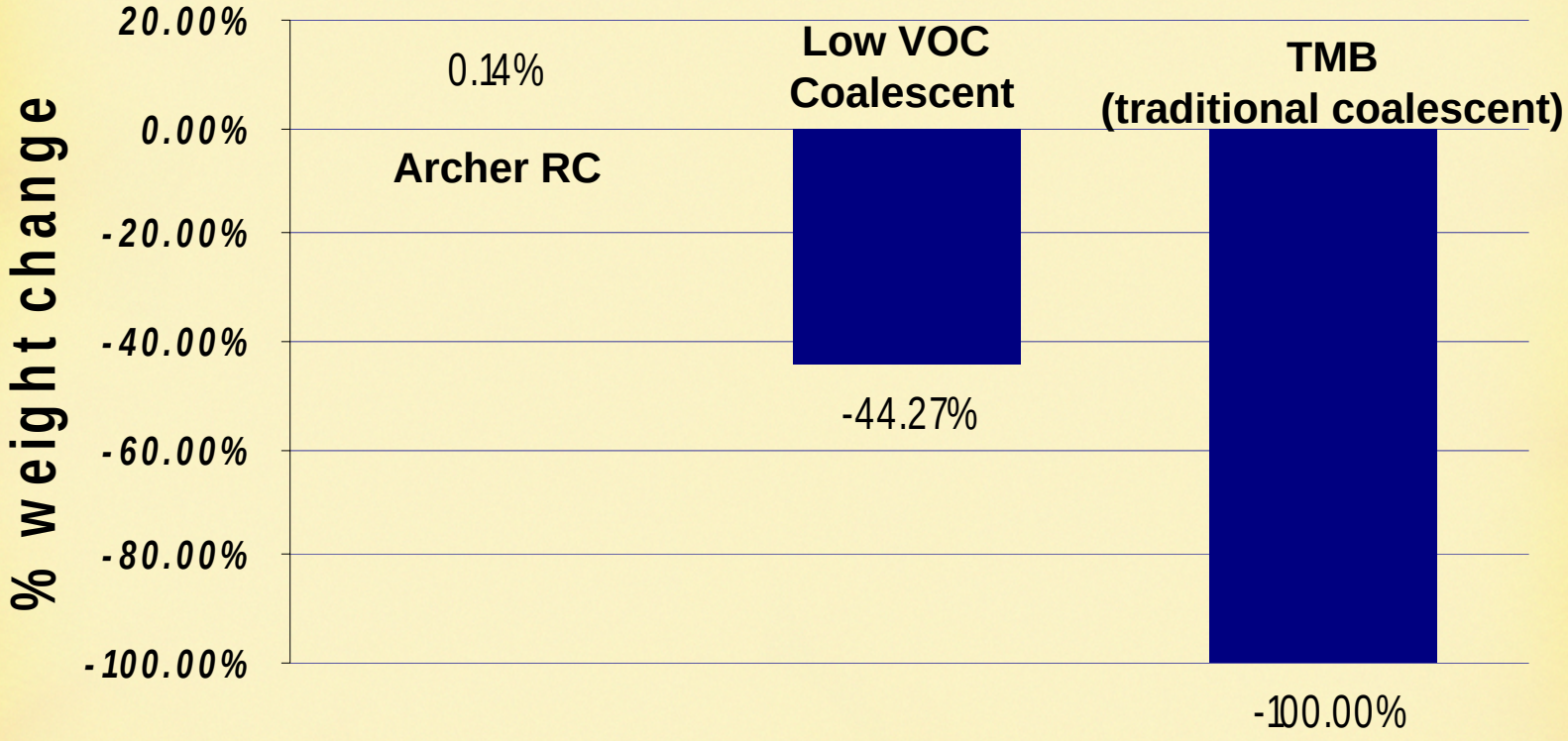
HLB of **TMB** is ~3

HLB = 20 (1- S/A)

S = Saponification Number
A = Acid Value

Total Volatile Content

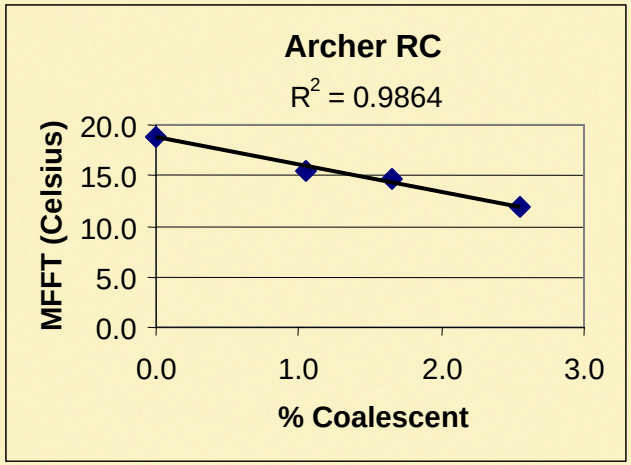
(1 Hour @ 110^{0}C, forced air oven)

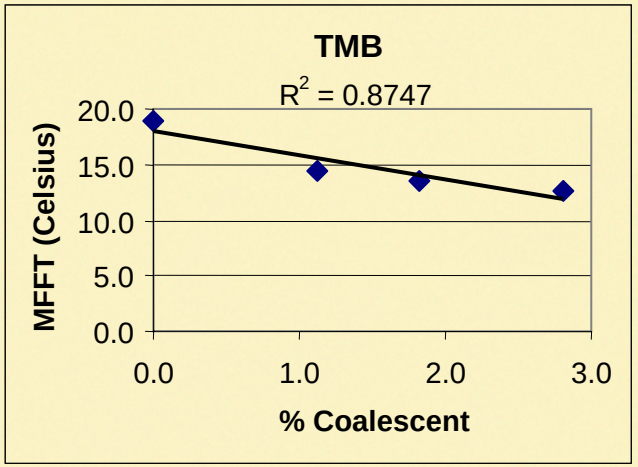


Example Latex Paint Evaluation

- Determine coalescent demand for a given acrylic latex polymer (Rhoplex® AC-264, Rohm & Haas)
- Determine VOC contribution by EPA Method 24
- Baseline comparison to conventional coalescents in standard paint formulation
- Rate overall performance

MFFT: Coalescent Demand
(AC-264 Acrylic Latex)





The optimal amount of Archer RC with this latex is 5.4% on resin solids. The optimal amount to form the same film with TMB is 6.2% on resin solids.

Formulas:	Archer RC		TMB	
Ingredient				
Dispersion	Pounds	Gallons	Pounds	Gallons
Water	83.00	10.00	83.00	10.00
Colloid 643	2.00	0.26	2.00	0.26
Tamol 731	16.10	1.77	16.10	1.77
Triton CF-10	2.00	0.23	2.00	0.23
Kathon LX 1.5%	2.00	0.20	2.00	0.20
28% Ammonia	2.00	0.18	2.00	0.18
TiPure R-706	225.00	6.75	225.00	6.75
Minex 4	43.40	2.00	43.40	2.00
Disperse 20 Minutes				
Pre-mix then add				
Natrasol Plus 330	1.50	0.15	1.50	0.15
Water	41.65	5.00	41.65	5.00
Disperse 20 Minutes				
Letdown				
Water	181.26	21.76	179.59	21.56
Rhoplex AC-264	398.72	45.05	398.72	45.05
Colloid 643	5.00	0.65	5.00	0.65
Rozone 2000	3.00	0.30	3.00	0.30
Coalescent	12.92	1.67	15.03	1.90
Acrysol RM-8W	5.98	0.63	6.51	0.71
Acrysol RM-2020 NPR	7.11	0.79	8.18	0.90
Water (hold)	21.96	2.61	19.90	2.39
Total	1054.6	100.00	1054.58	100.00

VOC Content: EPA Method 24

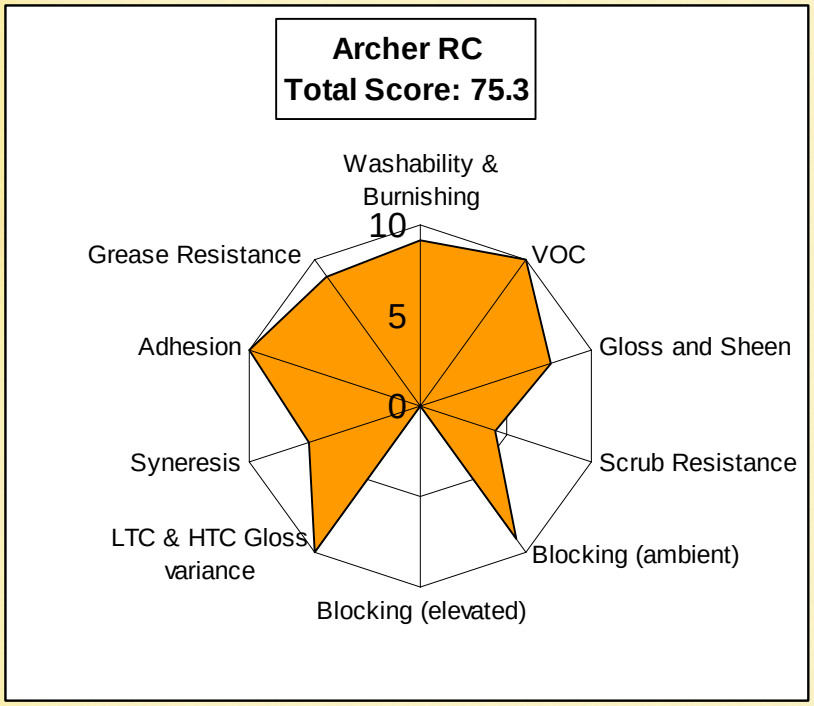
In tests conducted at an independent lab, Archer RC did not contribute to VOC emissions when tested as part of a representative paint formulation according to EPA Method 24*.

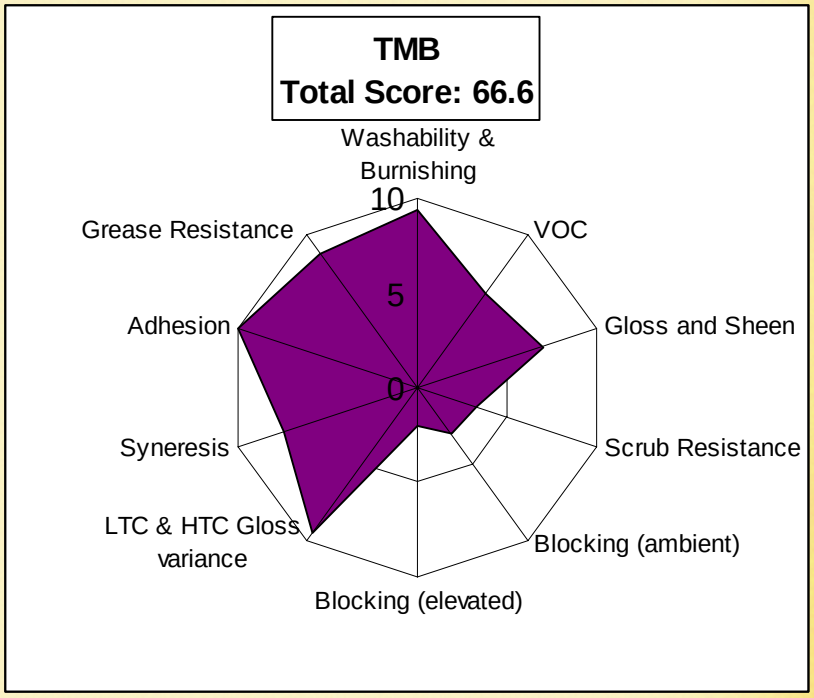
VOC Testing Results

	TMB	Archer RC
% Non-Volatile	50.51 +/- 0.04	51.49 +/- 0.06
% Water	47.72 +/- 0.09	48.70 +/- 0.15
Density (lbs./gal.)	10.62 +/- 0.02	10.60 +/- 0.01
VOC (lbs./gal.)	0.48	-0.05
VOC (g/L)	57.5	-6.4

*see the August 2001 issue of the *The Journal of Coatings Technology* for a paper by Mania et. al. regarding the errors associated with EPA Method 24.

Performance Summary





Archer RC™: Service and Solids

- TMB coalescent facilitates film formation and then volatilizes into the atmosphere
  - Provides coalescing function only
  - No additional benefits
  - Added costs of meeting VOC regulations
- Archer RC™ facilitates film formation and remains as part of coating
  - Adds to overall solids in latex particle
  - Potential for minor resin reduction (cost savings) to keep solids level equal to TMB containing formulations
  - Meet VOC regulations with possibility of cost savings

Archer RC™ Summary

- Lower paint's overall VOC content without compromising quality
- Archer RC™ can be substituted for conventional coalescents
- Provides increased scrub resistance
- Shows equal color acceptance
- Maintains a superior gloss
- Provides service and solids
- Semi-gloss and flat formulations at <50 g/L VOC with Archer RC™ reformulation available today!

Other Applications for Archer RC™

- Alkyd Paints – reactive diluent (replaces portion of mineral spirits to lower VOC)
- Pesticides/Herbicides – carrier solvent
- Lubricants/metalworking fluids – nonvolatile/nonhazardous solvent

Acknowledgements

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