HALLSTAR- Polymer Modifier Business

EXXATE™ Specialty Acetate Esters for Coatings

HALLSTAR

Who is HALLSTAR?

- Global specialty chemical company, with an emphasis on esterification
- Providing customized solutions through collaboration, innovation and technical expertise
- Expanding global presence, with strong manufacturing base, R&D facilities in North & South America, Europe, and Asia.

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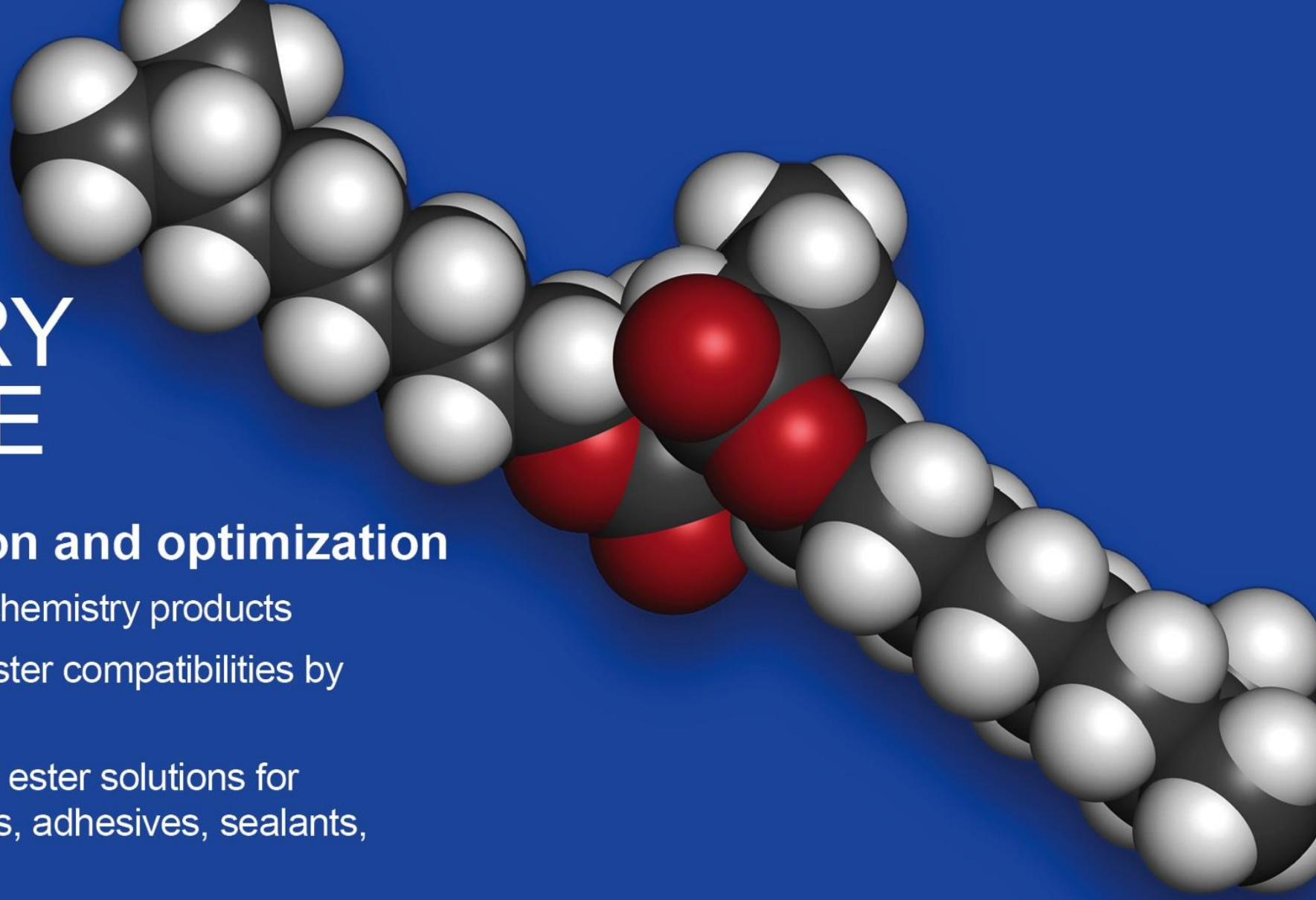
CHEMISTRY EXPERTISE



Polymer modification and optimization

- Over 100 specialty ester chemistry products
- Thorough knowledge of ester compatibilities by polymer/resin type
- Monomeric and polymeric ester solutions for elastomers, thermoplastics, adhesives, sealants, coatings, lubricants, etc.
- Dry blending of esters onto resins, talc, silica, calcium, $Ti0_2$, etc.

Exxate™ History

- Introduced to the market by ExxonMobil, producer of Exxal™ alcohols
- Widespread use in multiple coatings and agriculture technologies and market segments for decades
- Production/Promotion by ExxonMobil ceased in 2004, when they moved focus back to core business, the Exxal™ alcohols
- ***Since 2004 the EXXATE™ family of high-purity acetate esters has been produced exclusively by HALLSTAR***, but had only been available through distribution
- That has now changed—EXXATE™ acetate esters are now available in any quantity from HALLSTAR

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Hallstar Acetate Esters

Hallstar produces a range of high purity linear and branched Acetate esters used as Non-HAP cosolvents and tail-solvents that function as desirable alternatives to standard solvents

Key Applications

- High Solids
- Auto Top Coat
- Maintenance
- Wood Lacquer
- Marine
- Polymerization Solvent

Attributes

- Highly defined evaporation rates, controlled release from film
- Non-HAP
- Low and Non-VOC
- Low Odor
- Low Water Miscibility, Low Moisture pick-up

Products

- Acetate 600
- Exxate™ 800
- Exxate™ 1000
- Acetate 700
- Exxate™ 900
- Exxate™ 1300

Product Chemistry

Acetate 600
- C6 Acetate with fastest evaporation rate

Acetate 700
- C7 Linear and Branched Acetate Ester

Exxate™ 800
- C8 Highly Branched Acetate Ester

Exxate™ 900
- C9 Highly Branched Acetate Ester

Exxate™ 1000
- C10 Highly Branched Acetate Ester

Exxate™ 1300
- C13 Highly Branched Acetate Ester

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Evaporation Rate/Solvent Release

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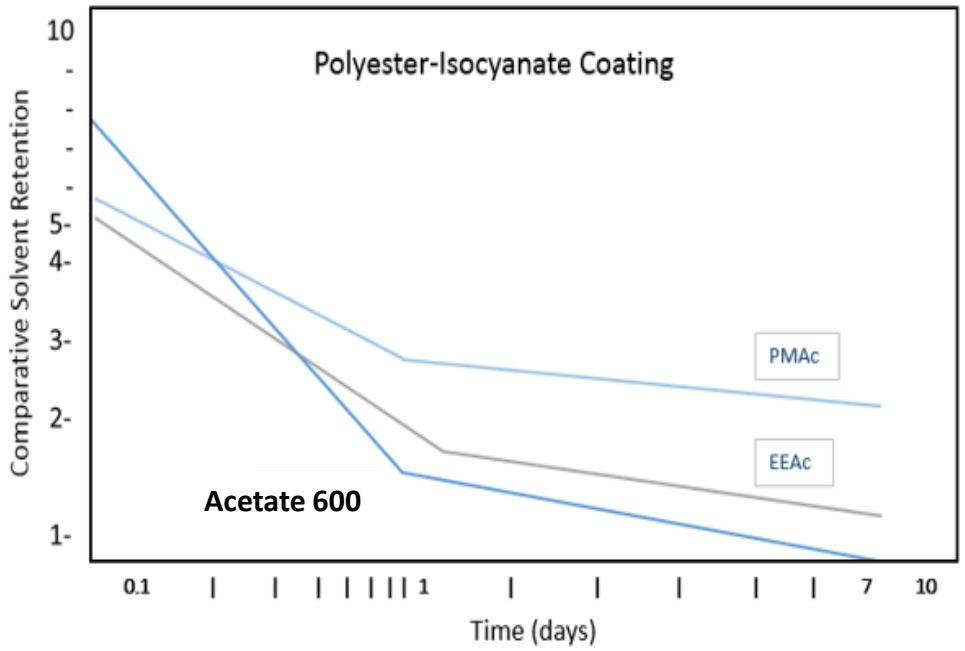
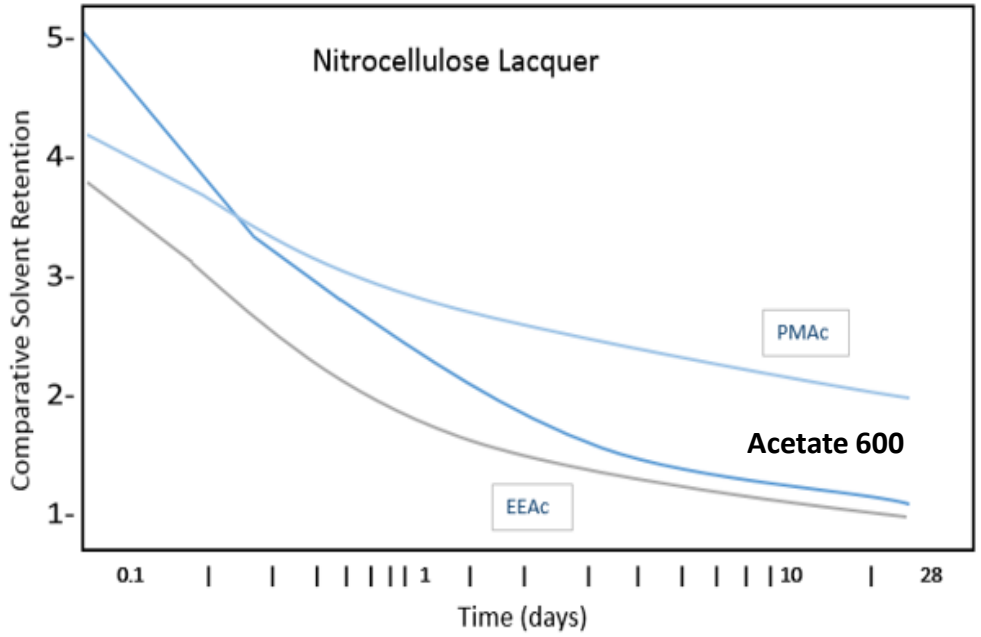
Highly Defined Evaporation Rates

- Tight chain length distribution for controlled evaporation
- Eliminate pinholing or popping

Excellent solvent release, limiting tack and surface imperfections





Water Miscibility & Pick-Up

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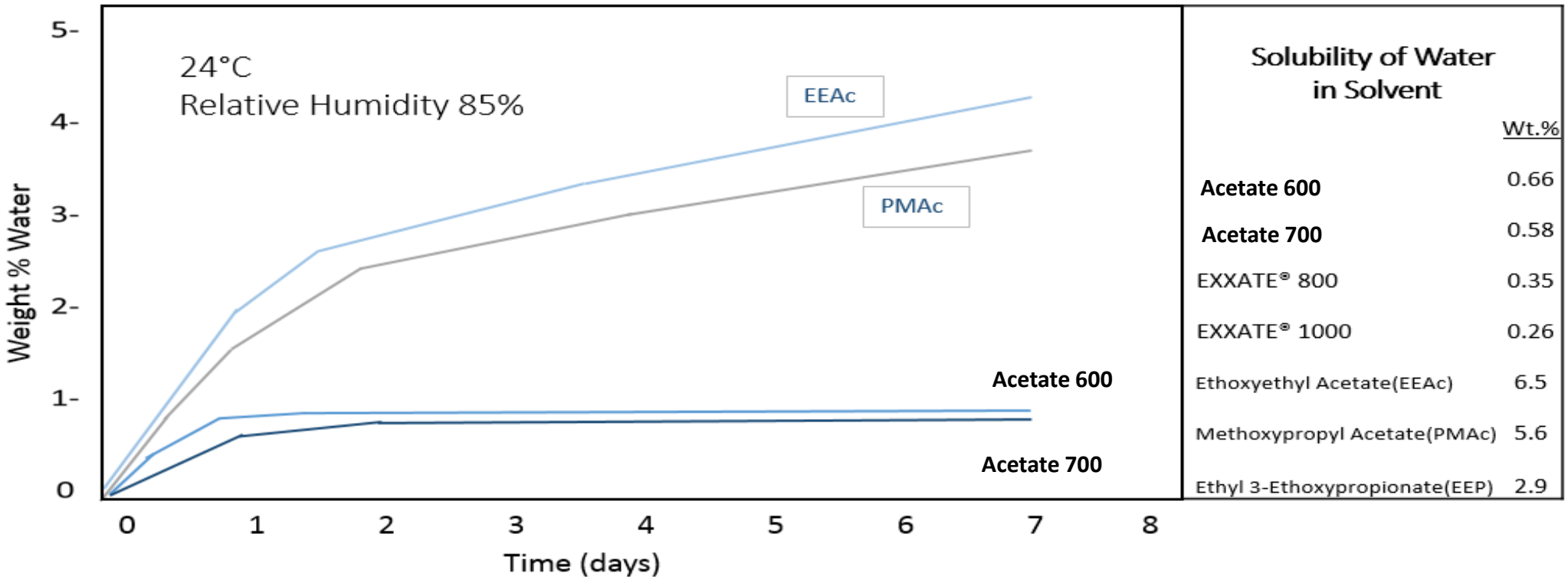
Low Water miscibility

- Superior blister and corrosion resistance for coatings formulated in moist environments

Low Moisture Pick-up

- Minimizing moisture blush



Solubility of Water in Solvent	Wt.%
Acetate 600	0.66
Acetate 700	0.58
EXXATE® 800	0.35
EXXATE® 1000	0.26
Ethoxyethyl Acetate(EEAc)	6.5
Methoxypropyl Acetate(PMAc)	5.6
Ethyl 3-Ethoxypropionate(EEP)	2.9

Surface Tension

Low surface tension

- Better atomization of paint for improved gloss
- Good pigment and substrate wetting
- Good flow out and reflow of overspray also improving gloss

	HALLSTAR **Products**											
	Acetate 600	Acetate 700	Exxate® 800	Exxate® 900	Exxate® 1000	Exxate® 1300						
	C6 Ac	C7 Ac	C8 Ac	C9 Ac	C10 Ac	C13 Ac	n-BuAc	MIBK	Arom 150	PM Ac	MAK	BuCell
Surface Tension	25	26	26	27	27.5	28	25.3	23.6	30.5	28.9	26.1	27.4

Polymerization Solvent

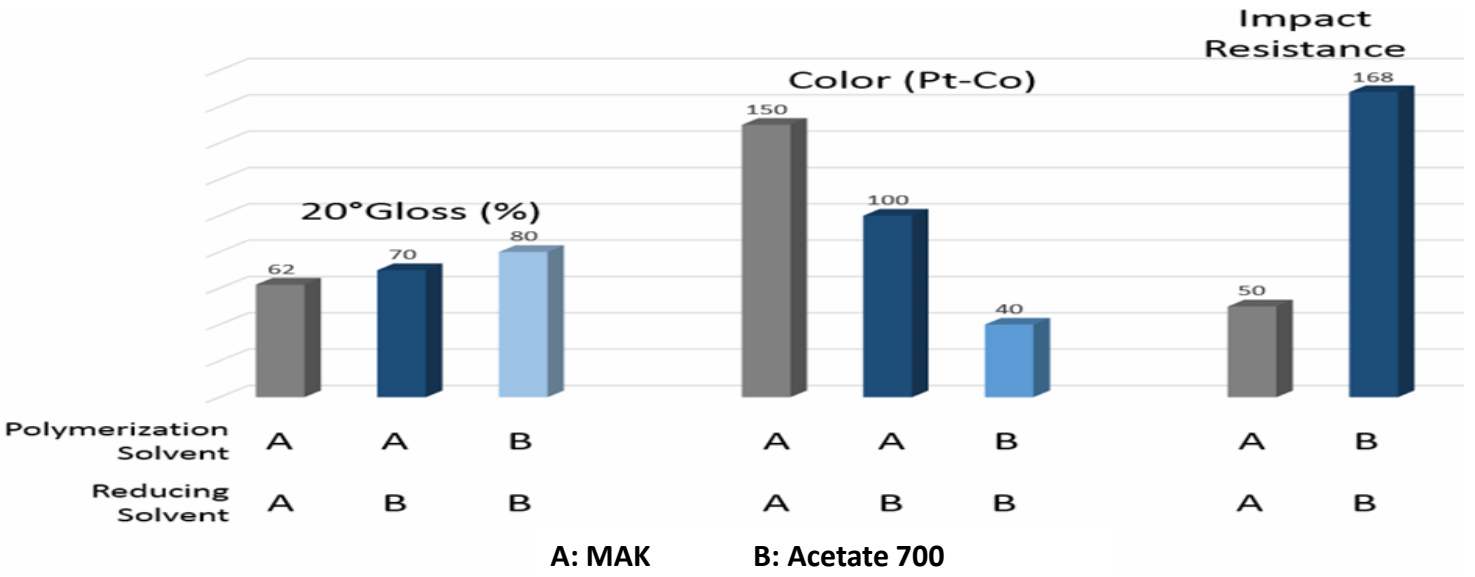
- Efficient polymerization solvent

POLYMERIZATION SOLVENT				
Polymerization Solvent	**Acetate 700**	**EEP**	**MAK**	**Xylene**
Molecular Wt. of Polymer	6500	6500	6600	7900
% Initiator Required	1.5	2.0	7.2	10.0
Coating Properties				
Electrical Resistivity, (Ransburg Megohms)	0.49	0.22	0.05	1.40
Viscosity, Sec. Zahn #2	30	31	24	30
Film Properties:				
20° Gloss	81	79	72	72
Impact Resistance				
Direct (Inch Lbs.)	133	100	82	90
Reverse (Inch Lbs.)	21	8	4	2
Coating Solvent Composition (Wt. %):				
Reference Solvent (1)	12.1	24.0	25.8	19.8
Acetate 600	12.8	-	-	-
Aromatic 100	5.6	5.4	5.8	12.9
n-BuOH	4.0	3.8	4.1	4.0

(1) Totally or partially from resin

Gloss, Color, Impact

- Exxate solvents provide higher gloss, reduced resin color and greater impact resistance



A: MAK **B: Acetate 700**

Application	Formulation:	
Phosphatized panels sprayed electrostatically at 2800 rpm	Hydroxyacrylic resin, wt.%	25.5
Resin solids "at the gun" - 60 wt.%	Polymerization solvent	10.9
Resin spray viscosity - 21.5 ± 0.2 seconds, Zahn cup #2	Melamine formaldehyde resin	10
Baked for 15 minutes at 315°F	Titanium dioxide	24
Baked film thickness - 1.1 ± 0.1 mils	Catalyst	0.5
	Aromatic 100	6.6
	n-Butanol	4.7
	Tail Solvent	17.8

Product Typical Values

	HALLSTAR **Products**									
	Acetate 600	Acetate 700	Exxate™ 800	Exxate™ 900	Exxate™ 1000	Exxate™ 1300				
	C6 Ac	C7 Ac	C8 Ac	C9 Ac	C10 Ac	C13 Ac	n-BuAc	MIBK	Arom 150	PM Ac
Molecular Weight	144	158	172	186	200	242	116	100	n/a	132
Specific Gravity	0.874	0.874	0.875	0.873	0.873	0.879	0.883	0.802	0.895	0.966
Evaporation Rate	0.11	0.05	0.033	0.012	0.006	0.001	1	1.66	0.06	0.33
Vapor Pressure(20C)	1.4	0.8	0.75	0.24	0.09	0.03	1.39	16	0.08	2.8
Surface Tension	25	26	26	27	27.5	28	25.3	23.6	30.5	28.9
Water Sol. (% wt)										
Ester In Water	0.02	0.01	0.02	0.02	0	0	0.7	1.8	0	16
Water in Ester	0.66	0.58	0.35	0.29	0.26	0.2	1.9	1.9	0	3
Electrical Resist.(MΩ)	high	>20	>20	>20	>20	>20	>20	0.4	>20	5
Odor	Sweet Ester	Sweet Ester	Mild Ester	Mild Ester	Mild Ester	Nearly Odorless	Sweet Ester	Acetone	Aromatic	Ether
HAPS Free	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes
Non-VOC (VP <0.1)	No	No	No	No	Yes	Yes	No	No	Yes	No
Solubilty(Hansen)										
Dispersion	7.8	7.8	7.8	7.9	7.9	8.2	7.7	7.5	8.7	7.6
Polar	1.4	1.3	1.2	1.0	0.8	0.4	1.8	3	0.3	2.7
H-Bond	3.0	2.7	2.4	2.4	2.0	1.4	3.1	2	0.7	4.8

EXXATE™ Summary

Hallstar's Acetate esters are desirable alternatives to standard solvents

- Synthesized from linear and branched aliphatic alcohols from C6 to C13 chain length
- Preferred Tail-Solvents with controlled evaporation rates and excellent solvent release
- Non-HAP
- Low Moisture pick-up, Low Water miscibility
- High Electrical Resistivity for Electrostatic Spray application

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for samples or additional information please contact:

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