

EASTMAN

Eastman™ products
for the composites industry



Introduction

Eastman Chemical Company has a long history of commitment to the composites industry starting back in the 1940s with the introduction of hydroquinone inhibitors. This commitment accelerated through the 1960s with the introduction of Eastman NPG™ glycol, Eastman copromoters, and other Eastman glycols. The industry embraced these products based on their value and Eastman's long-standing tradition of being a reliable supplier of industrial chemicals to many markets across the globe.

Today, Eastman's product offering consists of these same workhorse molecules, along with others, such as Eastman™ isophthalic acid and Eastman™ 1,4-CHDM.

This brochure will highlight the many products Eastman offers to the composites industry with focus on select products that provide unique properties.



Glycols

	Eastman NPG™ glycol	Eastman TMPD™ glycol	Eastman™ 1,4-CHDM	Eastman™ HPHP
Excellent weatherability	●			●
Low color	●		●	●
Thermal stability	●		●	●
Stain resistance	●	●		●
Corrosion/chemical resistance	●	●	●	●
Low resin density/solution viscosity		●		
Processability	●		●	●
Flexibility/toughness	●		●	●
Osmotic blister resistance	●	●		●

Focus product

Eastman TMPD™ glycol is used in applications requiring a high level of corrosion resistance. The sterically shielded secondary hydroxyl of TMPD imparts exceptional stain and chemical resistance to the cured polymer matrix. This allows use in aggressive chemical environments. Additionally, the bulky, asymmetrical structure of TMPD provides for excellent resin solubility in styrene and overall lower solution density.

The end result is resin systems capable of achieving application viscosity using less styrene, an important consideration in today's regulatory environment. The table on the right compares various properties of a resin based on TMPD with those of a typical PG-based resin, with targeted use in corrosion resistant applications.

Property	PG\PIA\FA	TMPD\PG\PIA\FA ¹
Number average MW	2554	2835
Weight average MW	10,125	8,039
Resin T _g , °C	50	44
Solution clarity ²	Hazy	Clear
Brookfield viscosity, cP	540	228
Density, lbs/gal	9.02	8.57
Color, APHA	402	255
Flexural strength, psi ³	11,000	10,000
Barcol, 2 hrs	90	87

¹Eastman TMPD™ glycol/PG molar ratio 75:25. FA = fumaric acid

²Solutions consisted of 55 wt % resin:45 wt % styrene

³Determined via ASTM C581 on 1/8" unreinforced castings

Diacids and diesters

	Eastman™ isophthalic acid	Eastman™ terephthalic acid	Eastman™ 1,4-CHDA	Eastman™ DMCD
Excellent weatherability	●		●	●
Low color	●		●	●
Thermal stability	●	●	●	●
Stain resistance	●	●	●	●
Corrosion/chemical resistance	●	●		
Low resin density/solution viscosity			●	●
Enhanced gloss retention	●		●	●
Processability			●	
Flexibility/toughness/elongation	●		●	●
Osmotic blister resistance	●	●		
Hardness	●	●		

Focus product

Eastman™ 1,4-CHDA is used in premium gel coat systems that utilize a vinyl ester barrier coat between the gel coat and laminating resin to give superior osmotic blister resistance. CHDA provides gel coats with exceptional performance such as high initial gloss, retained gloss upon weathering, and superior anti-yellowing resistance. The aliphatic cyclohexane ring structure is UV transparent. Mechanical properties also improve versus traditional gel coat technologies. Specifically, the cyclohexane ring imparts a good balance of hardness and flexibility, providing better percent elongation without sacrificing flexural strength and heat deflection temperature. Resin solution viscosity in styrene is another important factor CHDA enhances. Gel coats prepared from CHDA exhibit lower solution viscosity, thus less styrene, an important factor in today's regulatory environment.



Inhibitors

	Eastman™ HQ	Eastman™ THQ	Eastman™ MTBHQ	Eastman™ DTBHQ
Overall effectiveness/primary inhibitor	●	●		
Low color	●	●	●	●
Solubility		●	●	
Storage stability			●	●
Cook stabilization/thermal stability		●	●	
Minimal effect on cure				●

Focus product

Eastman™ MTBHQ has been used in the composites industry for decades. The bulky tert-butyl group on the aromatic ring plays a significant role in the performance of MTBHQ as an industrial inhibitor. MTBHQ has the greatest solubility of the hydroquinone derivatives offered by Eastman. The table on the right highlights the solubility of MTBHQ in various solvents compared with other hydroquinone derivatives. Along with solubility, color is also good, making it suitable for use in applications that are sensitive to color effects. MTBHQ is also very useful for those resin systems requiring stabilization during synthesis. Resins designed for high crosslink density that contain high levels of maleic anhydride during synthesis benefit from the good thermal stability. MTBHQ can be used as an effective storage stability inhibitor. Being a secondary inhibitor, MTBHQ has less effect on cure and can be used at higher levels than a primary inhibitor.

Wt % at 24°C (75°F)	Eastman™ HQ	Eastman™ THQ	Eastman™ MTBHQ	Eastman™ DTBHQ
Eastman™ AAEM	6	15	32	6
Eastman™ EP solvent	27	34	47	30
Ethyl acetate	18	50	50	31
Acetone	17	55	66	25
Ethyl alcohol, 95%	34	44	>60	21
Propylene glycol	23	26	41	10
Diethylene glycol	32	34	41	14
Styrene	<5	<5	<5	<5
p-Methyl styrene	<1	<1	<1	<1
Divinyl benzene	<1	<1	<1	<1
2-Hydroxyethylacrylate	20	28	42	15
Methyl methacrylate	5	16	41	19
Tert-butyl styrene	<1	<1	<1	<1
Alpha-methyl styrene	<1	<1	<1	<1
Vinyl toluene	<1	<1	<1	<1
Triethyl phosphate	32	41	41	10

Copromoters

	Eastman™ AAEM	Eastman™ DMAA	Eastman™ MAA	Eastman™ EAA	Eastman™ AAA
Reacts into polymer backbone	•				
Reduces viscosity	•				
Dual purpose	•				
Reduces in-box yellowing	•				
Most widely used		•			
Low color	•	•	•	•	•
Low toxicity		•	•	•	•
Handling ease (liquid)	•	•	•	•	

Focus product

Eastman™ AAEM offers the composites industry a unique combination of attributes that give the product dual functionality. First, Eastman AAEM is an active copromoter by virtue of the acetoacetyl functionality it shares in common with the other diketene derivatives listed above. Secondly, the AAEM molecule contains an active double bond in the form of a methacrylate group. This reactive bond allows Eastman AAEM to participate in free radical polymerizations. This combination of reactivity and copromotion makes AAEM a “reactive copromoter.” The material polymerizes readily into the polymer backbone. Additionally, the material is a low viscosity liquid, so it can be used to replace a portion of the styrene while still providing copromotion activity. Other benefits include less in-box yellowing in color sensitive applications and lower viscosity versus Eastman™ DMAA in composite formulations using thixotropic agents such as fumed silica. Better mechanical properties and greater storage stability have also been observed in some resin systems. Figures 1 and 2 illustrate some of the advantages described above.

Figure 1. QUVA-340 weathering
Delta b* color

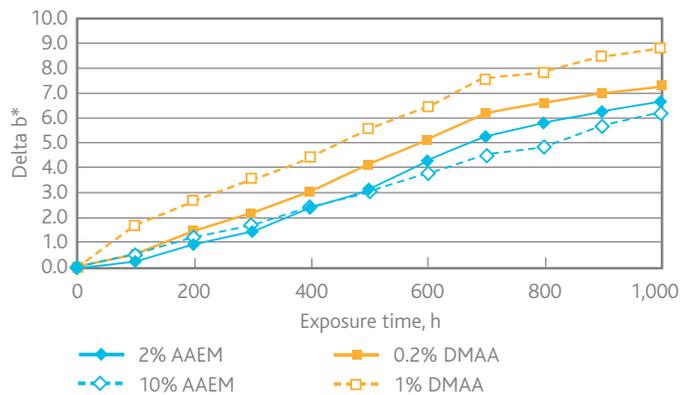
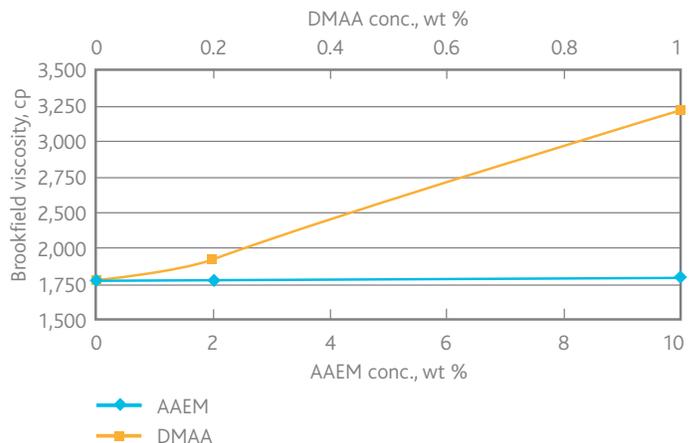


Figure 2. Effect of AAEM and DMAA on gel coat viscosity



Additives

	Eastman™ TEP	Eastman Eastobrite™ OB-1 optical brightener	Eastman Solus™ 2100 performance additive	Eastman™ adhesion promoters
Viscosity reduction for filled systems	•			
Enhanced flame resistance	•			
Low-profile additive			•	
Enhanced whiteness and brightness		•		
Adhesion to acrylic thermoplastics				•
Rheological additive			•	
Safe handling	•	•	•	•

Focus product

Eastman™ TEP is an effective viscosity reduction material for systems filled with aluminum trihydrate (ATH). Additionally, TEP also has been shown to enhance flame resistance of these systems. With the ever increasing scrutiny of other classes of flame retardants, TEP has been used successfully for years in many unsaturated polyester resin applications.

Summary

Eastman offers a broad variety of products to the composites industry. This brochure was developed to provide a quick snapshot of these products and focus on those that offer unique advantages in today's demanding applications for the final composite part. Eastman's product line ranges from basic building blocks used to synthesize resins for a multitude of composite applications to additives that play crucial roles in the cure and ultimate performance of many resin systems. Additional technical data for these products can be found at Eastman's Web site www.eastman.com or contact your Eastman sales or technical service representative for this information.

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