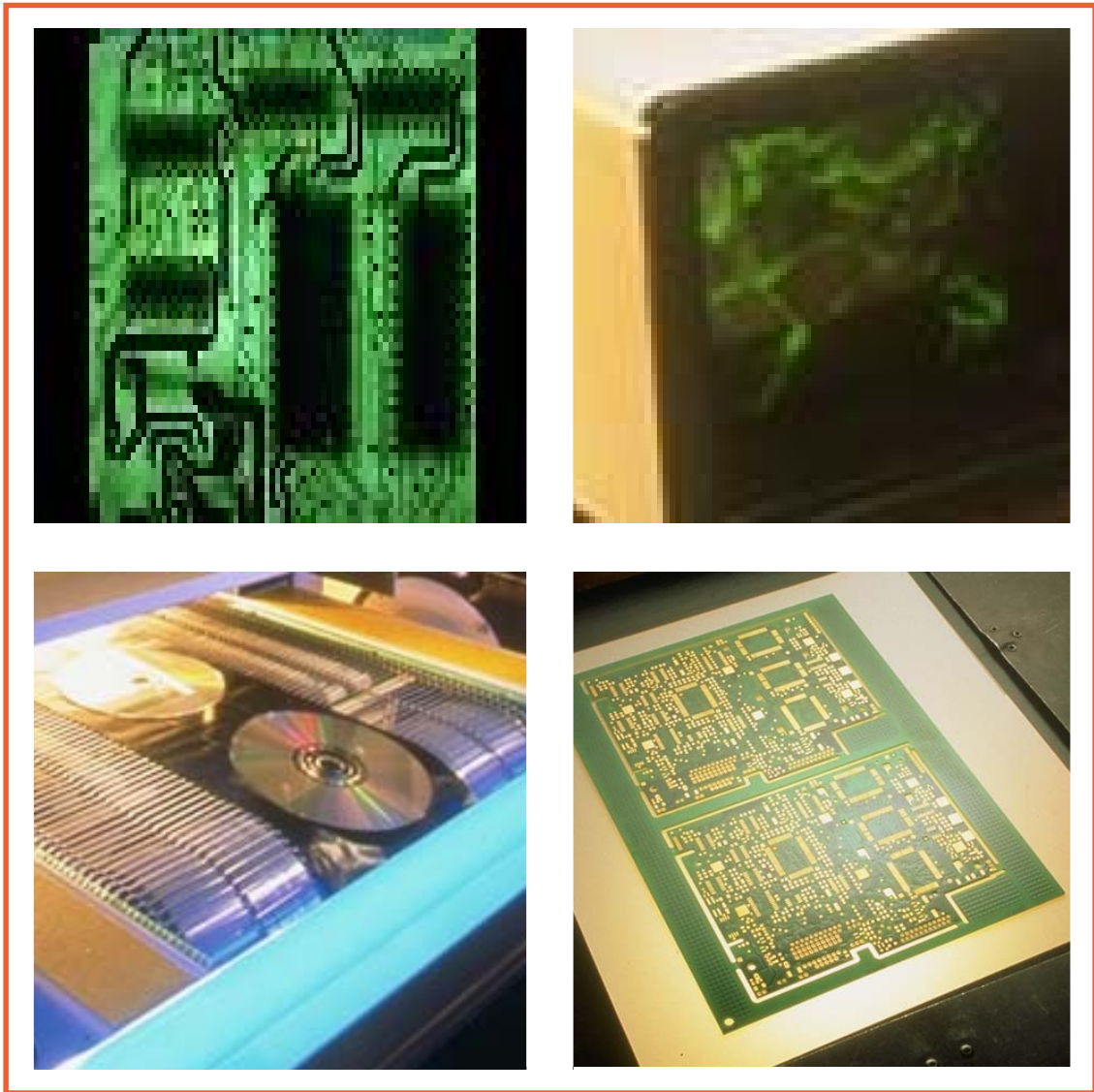
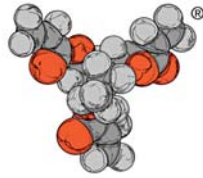


SARTOMER

Our name means tailor-made.™



Sartomer Products for Electronic Applications



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INTRODUCTION

Sartomer Company offers several product lines that are beneficial for electronic markets and offer improved performance properties in diverse electronic applications which include:

- Photoresists
- Solder masks
- Printing Plates
- PWB's
- Resists and Coatings
- Stereo Lithography
- Circuit Boards
- Potting Compounds and Encapsulation
- Liquid Crystal Displays (LCD)
- Plasma Display Panels (PDP)
- Light Emitting Diodes (LED)
- Organic Light Emitting Diodes (OLED)

This brochure explores the practical benefits of Sartomer's varied product lines and assists in product selection. Sartomer's product lines include acrylate and methacrylate monomers and oligomers, photoinitiators and resins, which include our Norsolene hydrocarbon resins, SMA Resins, and polybutadiene based materials.

This brochure will assist in choosing materials that will enhance the performance properties of electrical applications.

Overview of Sartomer's Product Lines for Electronics

Sartomer has a broad product line of monomers, oligomers, photoinitiators, metallic coagents, resins, and other specialty chemicals.

Sartomer offers **monomers** with functionalities from one to six for radiation and peroxide cure systems. Sartomer's monofunctional (meth)acrylic esters are non-crosslinkable, low-viscosity monomers which function as reactive diluents. Difunctional (meth)acrylics offer a good balance of low viscosity, fast reactivity and crosslink density properties. Trifunctional monomers are highly reactive monomers that offer high crosslink density properties. Tetra- and penta-functional monomers are highly reactive monomers that offer high crosslink density properties to radiation and peroxide cure systems. Most monomers are available to meet specific customer requirements. Water dispersible monomers are soluble or partially soluble in water. Adhesion promoting monomers improve adhesion to substrates such as metals and plastics.

Oligomers from Sartomer include several different chemistries. Urethane (meth)acrylate oligomers are high performance oligomers for radiation and peroxide curing. Sarcryl[®] Functional Acrylic Oligomers improve adhesion and assist in pigment dispersion. Amine Modified Polyetheracrylate Oligomers are highly reactive and can be used as sole binders or with other monomer diluents or oligomers. Sarbox[®] Specialty Oligomers are aromatic acid methacrylate half ester and aromatic acid acrylate half ester blends in solvent or monomer. Low Viscosity Oligomers are low viscosity materials which offer excellent overall property enhancement. Polyester Acrylate Oligomers are designed for fast cure, flexibility, and pigment

wetting. Sartomer's Metallic Acrylate Oligomers provide adhesion and ionic crosslinking. Epoxy (Meth)Acrylate Oligomers offer fast cure, high gloss, and hardness. Adhesion Promoting Oligomers allow good adhesion performance, provide ease of handling and offer high peel strength.

Sartomer's **Styrene Maleic Anhydride, SMA[®]** Resins, are multi-functional resins used in many applications for improving heat resistance, gloss, dispersing pigments, stabilizing emulsions, and sizing properties of paper.

Various **polybutadiene resin** sold under the tradenames Poly bd[®], Ricon[®] Resins and Krasol[®] products are available from Sartomer and include polybutadiene homo-polymers, copolymer and derivatives. Included in this product line are low vinyl homopolymers of butadiene, medium vinyl homopolymers of butadiene, high vinyl homopolymers of butadiene, hydroxyl terminated polybutadiene resins, hydrogenated hydroxyl-terminated polyolefins, random copolymers of butadiene and styrene, low vinyl maleinized polybutadiene, isocyanate-terminated butadiene prepolymers, and adhesion promoting butadiene polymers.

Sartomer can tailor make new types of monomers, oligomers, and resins to meet your specific requirements. We have the capability to produce laboratory, pilot plant and commercial size batches of these new materials.

Please contact your Sartomer representative to obtain additional information.

Sartomer Product Lines and Electronic Applications

Applications										
Sartomer Product Line	Photoresists (dry film and liquid)	Solder masks	Printing plates	Stereo-lithography	Circuit boards	Etch Resists	Potting compounds and encapsulation	Liquid Crystal Displays (LCD)	Plasma Display Panels (PDP)	Organic Light Emitting Diodes (OLED)
Discussion page	7	8	11	12	9	10	13	14	14	14
Monomers	√	√	√	√		√		√	√	√
Oligomers	√	√	√	√		√		√	√	√
Ricon Resins			√		√		√			
SMA Resins	√				√					
Poly bd Resins		√					√			
Krasol Resins							√			

Photoresists

Photoresists need components that offer fast film formation but also ingredients that give fast, clean developing. In addition the cured film must have high Tg and chemical resistance. Sartomer offers many

types of (meth)acrylates to give the necessary curing speed and chemical resistance as well as SMA[®] and Sarbox[®] copolymers that yield fast clean developing.

Product	Type	Functionality	Tg (°C)	Property
(meth)acrylates for photoresists				
SR454	EO ₃ TMPTA	3	-40*	Fast cure, highest chemical resistance
SR9036	EO ₃₀ BADMA	2	-43*	Chemical resistance/Developing balance
SR480	EO ₁₀ BADMA	2	-1*	Chemical resistance/Developing balance
SR644	PPGDMA	2	-5*	Chemical resistance
SR306	TPGDA	2	62*	Tack free, chemical resistance, high hardness
SR541	EO ₆ BADMA	2	54*	Chemical resistance/Developing balance
SR351	TMPTA	3	62*	Fast cure, high Tg, chemical resistance
SR9045	Acrylate ester	2	-52*	Chemical resistance, flexibility
Sarbox[®] Specialty oligomers for photoresists				
Sarbox [®] SB404	Aromatic Acid Acrylate half ester/PMA	Neat AV = 145	152 ⁺	Developing speed, UV curable
Sarbox [®] SB405	Aromatic Acid Acrylate half ester/PMA	Neat AV = 94	26 ⁺	Developing speed, UV curable, flexibility
Sarbox [®] 510E35	Aromatic Acid Acrylate half ester/SR454	Neat AV = 185	148 ⁺	Developing speed, UV curable
Sarbox [®] 520A20	Aromatic Acid Acrylate half ester/SR306	Neat AV= 179	62 ⁺	Developing speed, UV curable
SMA[®] Resins for photoresists				
SMA [®] 17352	SMA Ester	AV = 270	125 ⁺	Developing speed, high Tg, hardness
SMA [®] 2625	SMA Ester	AV =220	110 ⁺	Developing speed, high Tg

* = Tg of UV cured film

+ = Tg on product “as is”, uncured

Solder Masks

Solder mask formulations need many high performance properties including high Tg, high refractive index, fast surface/through cure, and high resolution.

Sartomer offers many types of (meth)acrylate monomers and oligomers to meet this demanding combination of properties.

Product	Type	Functionality	Tg (°C)	Property
(meth)acrylates monomers for solder masks				
SR295	PETA	4	103*	High Tg, cure speed
SR348	EO ₂ BADMA	2	6*	High refractive index
SR368	THEICTA	3	272*	Hardness, high Tg
SR833S	TCDDMDA	2	185*	Hardness, high Tg, high modulus
SR349	EO ₃ BPADA	2	67*	Hardness, high Tg
SR399	PEPA	5	90*	Hardness, high Tg
SR9041	Pentaacrylate ester	5	102*	Hardness, high Tg
Oligomers for solder masks				
CN929	Urethane acrylate	3	17*	High mechanical properties
Sarbox [®] SB404	Aromatic acid acrylate half ester/PMA	8-12	152 ⁺	Strippable, excellent adhesion
CN112C60	Epoxy novolac acrylate	3.6	60*	Fast cure, chemical resistance, hardness
CN9008	Urethane acrylate	3	84*	High mechanical properties
Poly bd[®] resins for solder masks				
Poly bd [®] R45 HTLO	Hydroxy functional Poly bd [®]	2.5	-80 ⁺	Flexibilizer

* = Tg of UV cured film

+ = Tg on product "as is", uncured

Circuit Boards

Circuit boards require high Tg and chemical resistance combined with low dielectric loss properties.

Sartomer offers SMA[®] resins and Ricon[®] resins for this application.

Product	Type	Functionality	Tg (°C)	Property
SMA[®] Resins for circuit boards				
SMA [®] 3024	S:MA = 3:1 Resin	8 - 12	141 ⁺	Higher Tg, higher mw version of SMA [®] EF30
SMA [®] EF-30	S:MA = 3:1 Resin	8 - 12	125 ⁺	High Tg, low dielectric loss, epoxy crosslinker
SMA [®] EF-40	S:MA = 4:1 Resin	8 - 12	115 ⁺	High Tg, low dielectric loss, epoxy crosslinker
SMA [®] EF-60	S:MA = 6:1 Resin	8 - 12	107 ⁺	High Tg, low dielectric loss, epoxy crosslinker
SMA [®] EF-80	S:MA = 8:1 Resin	8 - 12	104 ⁺	High Tg, low dielectric loss, epoxy crosslinker
Ricon[®] Resins for circuit boards				
Ricon [®] 250	Styrene grafted Polybutadiene	N/A	---	Very low dielectric loss, peroxide curable resin
Ricon [®] 153	High vinyl Polybutadiene	N/A	-22 ⁺	Very low dielectric loss peroxide curable resin
Ricon [®] 154	High vinyl Polybutadiene	N/A	-14 ⁺	Very low dielectric loss peroxide curable resin

⁺ = Tg on product “as is”, uncured

Etch Resists

Etch resists require fast cure and good, clean developing.

Product	Type	Functionality	Tg (°C)	Property
Monomers for etch resists				
SR9036	EO ₃₀ BADMA	2	-43*	Developing Speed
SR454	EO ₃ TMPTA	3	-40*	Hardness
SR480	EO ₁₀ BPADA	2	-1*	Developing Speed
CD560	Alkoxyated HDDA	2	2*	Toughness
SR9051	Trifunctional acid ester	3	41*	Adhesion
SR9003	PO ₂ NPGDA	2	32*	Toughness, Flexibility
Oligomers for etch resists				
Sarbox [®] SB520A20	Aromatic acid acrylate half ester in SR306	AV= 179	62 ⁺	Developing Speed, UV curable
Sarbox [®] SB404	Aromatic acid acrylate half ester in PM acetate solvent	8-12	152 ⁺	Developing Speed, Cure Speed

* = Tg of UV cured film

+ = Tg on product "as is", uncured

Printing Plates

Printing plates need to be flexible and yet still have good chemical resistance. In addition they must be easily wet out by inks and fountain solutions. Sartomer

offers acrylates that have a combination of flexibility and chemical resistance. Also, the Ricon® resins are also used as flexibilizers.

Product	Type	Functionality	Tg (°C)	Property
Monomers for printing plates				
SR238	HDDA	2	43*	Fast cure, diluent, hard
SR239	HDDMA	2	30*	Diluent, hard
SR350	TMPTMA	3	27*	Crosslinker, diluent, high Tg
SR313A	Lauryl methacrylate	1	-28*	Flexible
SR604	PGMA	1	72*	Diluent
SR504	EO ₄ -NPA	1	-27*	Flexible, diluent
SR256	2-EHEA	1	-54*	Flexible, diluent
SR344	PEG400-DA	2	-25*	Flexible, diluent
SR499	PO ₆ TMPTA	3	-8*	Flexible, diluent
SR335	Lauryl Acrylates	1	-30*	Hydrophobic, flexible
SR399	DiPEPA	5	90*	Hard, fast cure
SR9003	PONPGDA	2	32*	Flexible, tough
SR231	DEGDMA	2	66*	High Tg, diluent
SR209	EGDMA	2	-8*	High Tg, diluent
SR242	IDMA	1	-	Hydrophobic
SR9035	EO ₁₅ TMPTA	3	-32*	Flexible, hydrophilic
SR502	EO ₉ TMPTA	3	-19*	Flexible, hydrophilic
SR203	TMFMA	1	23*	Diluent, adhesion
SR252	PEG (600) DMA	2	-39*	Flexible, hydrophilic
SR205	TEGDMA	2	-8*	Toughness, diluent
SR9036	EO ₃₀ BPADMA	2	-43*	Flexible, hydrophilic
SR350	TMPTMA	3	27*	Hard, diluent
SR480	EO ₁₀ TMPTMA	2	-1*	Flexible, hydrophilic
SR348	EO ₂ BPADMA	2	6*	High Tg
SR349	EO ₃ BPADA	2	67*	Toughness
CD277	Acrylate ester	1	31*	Diluent
CD278	DEGBEA	1	58*	Flexible, diluent
CD501	PO ₆ TMPTA	3	21*	Flexible, diluent
Polybutadiene based products for printing plates				
Ricon® 134	Low vinyl polybutadiene		-67 ⁺	
Ricon® 142	Medium vinyl polybutadiene		-74 ⁺	
Ricon® 150	High vinyl polybutadiene		-38 ⁺	
CN301	Acrylated polybutadiene	2.5	-17*	Hydrophobic
CN303	Polybutadiene Dimethacrylate	2.5	-70	Hydrophobic
CN307	Polybutadiene Dimethacrylate	2.0	-17**	Hydrophobic
Ricacryl® 3500	Acrylated Ricon resin	6.0		Hard, fast
Oligomers for printing plates				
CN964E75	Aliphatic urethane acrylate blended with 25% SR454	2	66*	Toughness

* = Tg of UV cured film

+ = Tg on product "as is", uncured

** = Tg tested using DMA

Stereolithography

Products that give low shrinkage, high hardness and toughness are needed in stereolithography. Sartomer

offers urethane acrylates, fast curing monomers and hyperbranched polyester oligomers for this application.

Product	Type	Functionality	Tg (°C)	Property
Monomers for stereolithography				
SR348	EO ₂ BADMA	2	6*	Low shrinkage
SR349	EO ₃ BADA	2	67*	Fast cure, low shrinkage
SR506A	IBOA	1	88*	High Tg, high hardness
CN2302	Polyester dendrimer		74*	Low shrinkage, high hardness, fast cure
SR399	PEPA	5	90*	Fast cure, hardness
CN133	LV Triacrylate Olig	3	60*	Fast cure, hardness, low shrinkage
CD420	TMCHA	1	30*	Low odor, excellent surface cure
SR531	CTMPFA	1	32*	Fast cure, flexibility, excellent surface cure
SR833S	TCDOMDA	2	-	Fast cure, hardness, high Tg
CD536	Acrylate Ester		-	Fast cure, hardness
Oligomers for stereolithography				
CN991	Urethane acrylate	2	27*	Toughness, flexibility
CN981B88	Urethane acrylate	2	28*	Toughness, flexibility
CN9009	Urethane acrylate	2	40*	Low shrinkage, toughness, flexibility
CN996	Urethane acrylate	2	8*	Flexibility, Cure speed

* = Tg on UV cured film

Potting Compounds and Encapsulants

Poly bd[®] and Ricon[®] Resins are used in electrical encapsulation and potting formulations to provide excellent hydrophobicity, low temperature ductility, retention of properties during thermal cycling and low embedment stress properties. Through a combination

of ease of handling, superior electrical insulating properties, minimal curing exotherm, excellent low temperature ductility and stability in hot, humid environments, Poly bd[®] and Ricon[®] Resins systems outperform other materials.

Product	Type	Functionality	Tg(°C)	Property
Polybutadiene based resins				
Poly bd [®] R45HTLO	Polybutadiene		-75 ⁺	Water resistance, re-enterable
Ricon [®] 130 MA8	Maleinized poly butadiene		-	Water resistance, re-enterable
Ricon [®] 131MA5	Maleinized poly butadiene		-	Water resistance, re-enterable

⁺ = Tg on product “as is”, uncured

Safety, Storage, & Handling Information

TOXICOLOGY INFORMATION

As with any chemical, the potential health and safety hazards associated with Sartomer products should be understood to ensure that they are used safely. Review each product's Material Safety Data Sheet (MSDS), which includes specific hazard and precautionary information, prior to working with these materials.

Should you require assistance in an emergency situation involving a Sartomer Company product, call us at 610-692-8401, twenty-four hours a day.

MONOMERS:

- **Skin & Eye Irritation:** These products range from minimally irritating to corrosive in acute animal skin and eye irritation tests. Methacrylates are generally less irritating than acrylates with a similar chemical structure. Alkoxyated products are also generally less irritating than their non-alkoxyated counterparts. Monomers may cause redness or rash, swelling and, in severe cases, blistering (burns) if skin contact occurs — the skin irritation response will depend on the conditions of exposure and the irritation potential of the product. Symptoms of skin irritation may be delayed.
- **Oral Toxicity:** These products are typically minimal ingestion hazards, as demonstrated in animal tests.
- **Inhalation Toxicity:** Liquid monomers are typically non-volatile and have high boiling points (> 150°C); consequently, they do not pose an inhalation hazard at room temperature. However, aerosols or vapors which can be generated from spraying or heating these materials, respectively, may cause upper respiratory tract irritation if inhaled.
- **Skin Sensitization:** Some of these products have been shown to be skin sensitizers (substances which cause an allergic skin reaction in susceptible individuals after repeated exposure) in animal tests. Cases of sensitization in workers have been

reported in the published literature for a limited number of products. It is important that skin contact with these products be prevented to ensure that skin sensitization does not occur.

OLIGOMERS:

Most epoxy, urethane, and aromatic acid methacrylate oligomers tend to have low skin and eye irritation potential. Skin ingestion, absorption and inhalation hazards are minimized because of their higher molecular weights compared to most monomers. However, oligomers may be supplied as blends with monomers or solvents, therefore, the hazards of monomers and solvents must also be considered when working with some oligomers. These hazards will be listed on the product's MSDS.

STYRENE-MALEIC ANHYDRIDE RESINS:

Some Styrene-Maleic Anhydride (SMA[®]) products are supplied in powdered or flake form — inhalation of dust from handling or processing these products may cause irritation of the respiratory tract and other mucous membranes. These materials may also cause eye and skin irritation. The degree of irritation varies with each product and ranges from slightly irritating to severely irritating as demonstrated in animal tests. Some products elicited no irritation response in these tests. Refer to the product's MSDS for specific information. In addition, due to their higher molecular weights, these resins are not expected to be ingestion or skin absorption hazards.

SMA[®] resins supplied as salts in a water solution may also be irritating to the eyes and skin. In addition, respiratory tract irritation may occur upon exposure to vapors that are generated during the processing of these materials.

Some SMA[®] resins are reacted with an alcohol to form an ester. Due to their higher molecular weights, these SMA[®] esters are not expected to be ingestion or skin absorption hazards. However, SMA[®] esters may cause eye, skin and respiratory tract irritation.

Hazards of the alcohol(s) used to manufacture these esters must also be considered –the alcohols may be present in small amounts in the final product(s) and vapors from the alcohol(s) may be released during processing. Refer to the product’s MSDS for specific information.

POLYbd®/RICON®/KRASOL® PRODUCTS

These products are polybutadiene and polybutadiene-based polymers. Due to their higher molecular weights, these resins are not expected to be ingestion, inhalation or skin absorption hazards. They may cause slight eye and skin irritation. In addition, respiratory tract irritation may occur upon exposure to vapors that may be generated during processing.

Some Krasol® products are diisocyanate-based polybutadiene polymers. These products often contain free residual diisocyanate at very low concentrations. Diisocyanates are known eye, skin and respiratory tract irritants and, more notably, they are skin and respiratory sensitizers. Refer to the product’s MSDS to review the hazards of a particular product and protective measures that can be implemented to handle the product safely.

GENERAL HANDLING PROCEDURES & PRECAUTIONS

As with all industrial chemicals, it is important to prevent exposure through the use of protective equipment, proper work practices and engineering controls.

The following precautions should be observed for general handling practices:

- ensure a clean, well ventilated work environment;
 - avoid skin contact by wearing impervious gloves;
 - wear eye protection such as goggles;
 - wear other protective equipment as appropriate;
 - review the MSDS prior to working with a material.
- If skin contact does occur, wash affected areas immediately with soap and water. Rinse thoroughly. If eye contact occurs, immediately flush the eye(s) with clean water for at least 15-20 minutes. Seek medical attention.

- Minimize the potential for dust explosion, which can be associated with handling organic powders, such as the styrene-maleic anhydride resins, metallic coagents and solid photoinitiators. Eliminate and control ignition sources and use good housekeeping practices during storage, transfer and handling of these products. These same practices should also be applied to the pelletized Norsolene® resins.

For Monomers and Oligomers:

- Transfer liquid monomers and oligomers in stainless steel lined hoses. Tygon and other similar plastics can also be utilized in transferring these materials.
- Avoid localized high temperatures in mixing and transferal procedures to avoid premature polymerization of monomers and oligomers.

GENERAL STORAGE INFORMATION

All products should be stored indoors, out of direct sunlight, under room temperature conditions unless noted on the MSDS. Products should be stored away from incompatible materials such as oxidizers and acids and away from heat, sparks, open flame and other ignition sources. Contamination with foreign materials, such as iron or copper must be avoided particularly when working with monomers and oligomers. Contact with moisture should also be prevented.

All products should be used according the manufacturer’s instructions including adherence to shelf-life recommendations.

For Monomers and Oligomers:

Monomers, oligomers, amine acrylates and M-Cure® products can polymerize prematurely under improper storage conditions, hence, storage requirements for these materials are provided, in part, to prevent premature polymerization. It is important to maintain a headspace in the storage containers to support the oxygen requirements of the inhibitor(s) and prevent contamination of these products with iron or copper. Periodically checking inhibitor levels is also recommended. Refer to the product’s MSDS for specific storage recommendations.

Refer to the MSDSs for specific storage recommendations for all Sartomer products.

FIRE HAZARDS & PRECAUTIONS

In the event of a fire, chemical products can become inhalation hazards — they can be carried by smoke; vapors and combustion products from burning materials may be extremely irritating. In the case of monomer and oligomer products, amine acrylates and M-Cure products, heat from a fire may also initiate an uncontrolled polymerization, which can cause closed containers of these products to rupture, possibly spreading the fire.

Fire fighters should wear self-contained breathing apparatus in addition to eye, face and body protection. Extinguish fires with dry chemical, foam, carbon dioxide, or water fog and spray from a safe distance or protected location. Extinguishing media should be applied gently to styrene-maleic anhydride resins and metallic coagents to avoid raising dust clouds, which can create an explosion risk. Cool fire or heat exposed containers with water fog or spray from a safe distance.

GENERAL DISPOSAL PROCEDURES

Persons handling empty product containers should wear protective equipment and handle containers in an area away from ignition sources because they may contain residual product. Recommended cleaning

procedures for empty steel drums include washing the containers with a strong soap and water solution, followed by a thorough water rinse. If necessary, a 15% caustic solution followed by a water rinse can be used to further clean containers. All wash and rinse solutions must be disposed of in accordance with federal, state and local regulations.

Properly inhibited monomers, oligomers, metallic coagents, amine acrylates, and M-Cure products are generally not RCRA hazardous wastes. In addition, pelletized styrene-maleic anhydride products and polybutadiene products are generally not RCRA hazardous wastes. However, it is the responsibility of the waste generator to determine if the product meets the criteria of a hazardous waste at the time of disposal (see 40 CFR 261). Disposal options for these products include landfilling solids at permitted sites, fuel blending or incinerating liquids. Disposal must comply with federal, state and local regulations. Metal recovery should be considered for metallic coagents.

A few Sartomer products are considered RCRA hazardous wastes. For these materials, the waste classification is listed on the product's MSDS. Refer to the MSDS for a product to determine its waste classification. Contact Sartomer if you need additional information.

SARTOMER

Our name means tailor-made.™



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