TECHNICAL MANUAL

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HANDLING AND PROCESSING GUIDE FOR TRILENE® 65 IN COATING AND ADHESIVE APPLICATIONS

General Description

Trilene EPDM from Lion Elastomers represents a class of specialty lower molecular weight EPDM polymers, which are typically used in applications that require a liquid EPDM product for processing, but retain the performance characteristics of conventional, high molecular weight EPDM after being cured. Trilene 65 is an ethylene-propylene-dicyclopentadiene elastomer specially designed for coating and adhesive applications. Major properties of Trilene 65 are listed below:

- **Ethylene/Propylene:** 50/50
- **Degree of Unsaturation (% Diene):** 10.0%
- **Color:** Pale Yellow
- **Specific Gravity:** 0.86
- **Molecular Weight by GPC (Da):** 47,000
- **Brookfield Viscosity (cP, RVT #7 at 60°:** 1,900,000
  at 100°: 177,000
- **Volatiles at 100ºC (212ºF):** <0.5%

Trilene elastomers are available in several packages as described below.

Package Code	Pallet cm (in) L x W x H	Package kg (lbs)	No. of Pack-ages	Gross kg (lbs)	Tare kg (lbs)	Net kg (lbs)	Package Description	Units in 20ft. (6.1 m) Container	Units in 40ft. (12.2 m) Container
4 PACK	156 (61) x 114 (45) x 122 (48)	20 (44)	36	837 (1845)	117 (257)	720 (1587)	4 individual cells (5 kg each) inside each box	14 (1)	22 (1)
CARTON	156 (61) x 114 (45) x 122 (48)	22.68 (50)	36	898 (1980)	82 (181)	816 (1800)	50 lbs inside re-lease coated inner box	14 (1)	22 (1)
DRUM	115 (45) x 115 (45) x 103 (41)	136 (300)	4	615 (1356)	71 (157)	544 (1200)	55 gallon open head drums	20	34
BOX	43 (109) x 43 (109) x 43 (109)	22.86 (50)	18	453 (1000)	45 (99)	408 (900)	50 lbs box with plastic liner	20	40

Handling Procedures

In physical form, Trilene elastomers are pale yellow, transparent, highly viscous liquids. At room temperature, they will cold flow, but the viscosity is still too high for efficient handling in the lab or in production. The viscosity of Trilene 65, for example, drops sharply with increasing temperature, and preheating will enable easy processing and pouring. We recommend a temperature >93ºC (200ºF) for practical handling. Two hours are sufficient to raise the temperature of a 1-4 liter sample, while a full drum will usually require overnight heating. The figure below shows the viscosity change of Trilene 65 with temperature.

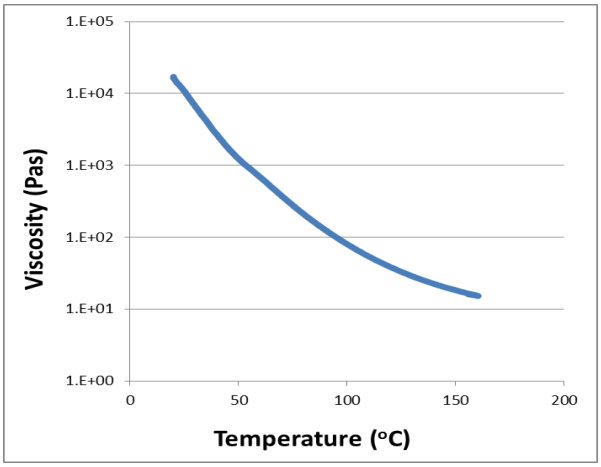

Figure 1. Viscosity of Trilene 65 at various temperatures

1. Drums

Drums can be placed in a hot box or heated with band type drum heaters to raise the polymer temperature to approximately 100ºC (212ºF). The top of the drum should always be loosened to prevent pressure buildup due to expansion during heating. In the case of band heaters, care should be taken to insure that localized hot spots do not occur in the vicinity of the bands.

An example of a typical drum heater is from Benko Products, Inc. with various capacities is shown in Figure 2. The contact information: 5350 Evergreen Parkway, Sheffield Village, OH 44054.

Figure 2. Benko Products Drum Heater Model E8 (8 drums)

Trilene elastomers can be stored at or below 100ºC (212ºF) for up to 2 weeks without adverse effects. However, temperatures should be kept below 105ºC (221ºF) as extended storage at higher temperatures may cause a slight darkening of the elastomer. Polymer changes due to exposure to oxygen during high temperature storage can be further minimized by blanketing the drum with nitrogen.

Polymers can be removed from the hot drum by pouring. However, great care should be exercised to insure that workers do not touch the hot drum and that their skin does not come in contact with the hot elastomer as it is poured. The recommended method of transfer is to pump the material from the drum. At Lion, polymers like Trilene 65 and 67 are routinely pumped from storage tanks at 80º-100ºC (176º-212ºF) at rates of 15-25 lb (7-11 kg) per minute using gear pumps. The particular pumps used in our facility are manufactured by Maag Pump Systems.
(P. O. Box 38, Matthews, North Carolina 28106, Phone: 704- 841-3537 or Fax: 704-841-3547).

Figure 3. Illustrated Gear Pumps from Maag Pump Systems

In a second example of a pumping method, a Trilene polymer with a viscosity of 100,000 cP once heated is removed from an open-head drum using a Graco transfer pump. Transfer rates of 17 lb (7.7 kg) per minute are obtained using a 2.5 cm (1 inch) I.D. line. The pump's draw distance was minimized to prevent cavitation by submerging the pump in the polymer. A follower plate can also be used, but polymer leakage may occur around the edge of plates.

2. Cartons, Boxes and Plastic Packages

Trilene is available in several types of packaging. Options include, 22.7 kg (50 lb) release boxes and compartmented boxes with low melt bags, each containing 5 kg of product. The bags are made from an ethylene/vinyl acetate copolymer with a melting point of 102º-105ºC (215º- 221ºF). The bags contain 6% vinyl acetate polymer and will melt under mixing conditions in a Banbury between 93º-104ºC (200º-220ºF) due to shear and temperature developed during the mixing process. Therefore, the bag may be dropped into an internal mixer directly. We do not recommend using the bags in mill mixed rubber stocks because there is not enough shear and heat developed to soften and melt bags well enough to thoroughly disperse in the rubber stock.

To remove the Trilene from the release box, open the outer liner, turn the box upside down, and remove the Trilene from the inner box. Return the inner box to its upright position. Using a broad blade metal scrapper dipped in a lubricant, separate the top edge of the polymer from the release box. Pull down firmly on each side of the release box to separate it from the polymer.

Wearing disposable PVC gloves wiped with the lubricant, remove the Trilene from the bottom of the inner release box. A "block" of Trilene is released which can be put into mixing equipment or cut up into smaller pieces. The separated Trilene block should not be left unattended for extended periods of time as it will cold flow, particularly in warm environments.

Many types of suitable lubricants can be used to reduce the tack of Trilene to tools and gloves. While straight water can be used, a detergent solution is recommended. A detergent which has been used in Lion's labs is Fisher brand Versa-Clean Liquid Concentrate diluted 1 part with 5 parts water. This product is available from Fisher Scientific at (800) 766-7000 (International: 1-973-467-6511). However, there is a wide choice of commercial and household detergent solutions which will also work effectively.

Volume users will prefer 55 gallon (208 liter) drums which are suitable for heating and pumping of product into mixing equipment.

Dissolving Trilene® 65 in Solvents

Trilene 65 is designed for coating and adhesive applications where dissolution is required for processing and the manufacture of the final products. Saturated hydrocarbon solvents, like mineral spirits, naphtha, and aromatic 100 are good solvents for Trilene 65. Figure 4 shows the change of viscosity with various levels of Trilene 65 dissolved in mineral spirits.

Concentration	Viscosity
Pure Mineral Spirits	0.30 cP
20% Trilene 65	17 cP
40% Trilene 65	185 cP
60% Trilene 65	6680 cP

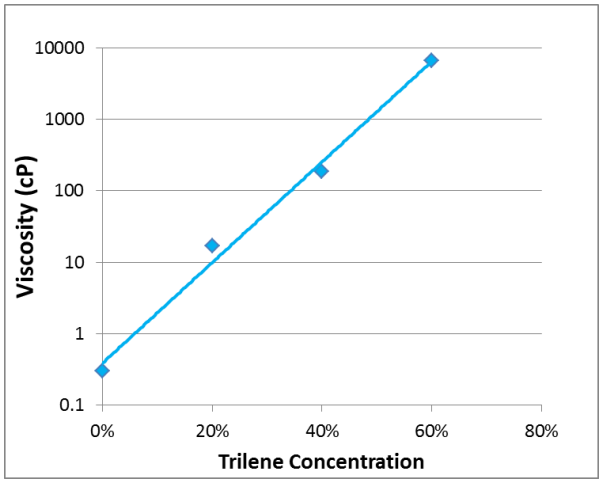

Figure 4. Viscosity of Trilene 65 in mineral spirits (23°C)

Below is a typical procedure for preparing a Trilene 65 solution in a typical lab environment:

1. Use a well-ventilated lab hood to conduct the dissolution process;
2. Weight desired amount of Trilene 65 into a container (bottle, flask etc.);
3. Weight the right amount of solvent into the container;
4. For a 20-40% of solution, mixing may not be necessary. Just put cap on the container and the polymer will dissolve in 24-48 hours.
5. For a higher solids concentration or faster dissolution, a shear mixer can be used. However, due to the highly evaporative nature of solvent, an open mixing system is not recommended.
6. A closed mixing system, such as the SpeedMixer™ Laboratory Mixer System from FlackTek Inc., is ideal for processing and blending a Trilene mixture.
7. Apply common laboratory practices for lab safety and personal protection, especially when handling the solvent.

Example Procedure to prepare a 1-gallon Lab Coating Formulation

Below is a typical procedure for preparing a standard 1-gallon Trilene 65 coating formulation.

UV Formulation

Material	*Function*	*Supplier*	*Weight*
Trilene® 65	Binder resin	Lion Elastomers	28.37
Ricon® 156	Curing Co-agent	Cray Valley	2.36
Mineral Spirit	Solvent	Various	37.83
DisperBYK® 118	Dispersant	BYK	0.70
Kronos® 2300	White TiO_2 Pigment	Kronos	9.46
Coupsil® 6508	Reinforcing Filler	Evonik	9.46
Omnirad® 819	Photoinitiator	IGM Resins	2.36
Toluene	Photoinitiator Solvent	Various	9.46
Total			100.00

The mixing process of UV formulation is as follows: (1-gallon size)

1. Add Trilene into 1 gallon can;
2. Add liquid components - solvent (mineral spirit), other solvent(s), Ricon 156, and BYK 118 (dispersing agent) into the can;
3. Apply mechanical mixing until Trilene is fully dissolved. An overnight mixing at 1000 RPM might be necessary. A heating to up to 50°C will reduce the solution time.
4. While mixing, add pigment (TiO_2) in several batches to make sure TiO2 is dispersed;
5. While mixing, add fillers (Coupsil 6508) in several batches to make sure fillers is dispersed;
6. Keep mixing for another 1-2 hours at 2000 RPM.
7. By this time the solution might be hot – turn down the mixing to a speed below 1000 RPM until solution is cooled to below 50°C to avoid evaporation of the solvent;
8. Premix photoinitiator into toluene at the ratio in the formulation;
9. Slowly add the above mixture in step 8 into the mixture from step 7;
10. Maintain 1000 RPM for another 30min;
11. Add solvent (mineral spirit) to compensate for the weight loss during processing. The amount of extra solvent depends on the total weight in the final can.

Peroxide Formulation

Material	*Function*	*Supplier*	*Weight*
Part A			
Trilene® 65	Binding Resin	Lion Elastomers	31.50
Ricon® 156	Curing Co-agent	Cray Valley	5.25
Mineral Spirit	Solvent	Various	41.99
DisperBYK® 118	Dispersant	BYK	0.80
Kronos® 2300	White TiO_2 Pigment	Kronos	10.50
Coupsil® 6508	Reinforcing Filler	Evonik	7.87
12% Cobalt Ten-Cem	Crosslinking Initiator	OMG	0.26
18% Zinc Ten-Cem	Crosslinking Accelerator	OMG	0.26
Part B			
Peroxan® PIN	Crosslinker	Pergan GmbH	1.57
Total			100.00

The mixing process of Peroxide formulation (Part A) is as follows: (1-gallon size)

1. Add Trilene into 1 gallon can;
2. Add liquid components - solvent (mineral spirit), other solvent(s), Ricon 156, and BYK 118 (dispersing agent) into the can;
3. Mechanically mixing until Trilene is fully dissolved. An overnight mixing at 1000 RPM may be necessary. Heating to up to 50°C will reduce the dissolution time.
4. While mixing, add pigment (TiO2) in several batches and make sure the TiO2 is well dispersed;
5. While mixing, add fillers (Ultrex 96) in several batches to make sure fillers are well dispersed;
6. Keep mixing for another 1-2 hours at 2000 RPM.
7. At this time the solution may be hot – slow down the mixing to below 1000 RPM until solution has cooled to below 50°C to avoid the evaporation of solvent;
8. Slowly add the Cobalt and Zinc catalysts to the above solution;
9. Maintain 1000 RPM for another 30min;
10. Add solvent (mineral spirit) to compensate for the weight loss during processing. The amount of extra solvent depends on the total weight in the final can.

Note: Part B - The Peroxide formulation can be purchased as a 30% peroxide solution directly from Pergan or other organic peroxide suppliers.

The mechanical mixer used in Lion's lab is a typical blade mixer. The size is about 1/3 of the diameter of the paint container.

Disposal of Trilene® Polymer

The low toxicity of Trilene liquid polymers presents no unusual disposal problems. Local, state and federal regulations regarding disposal of polymeric waste should be observed. Possible methods include incineration, conversion to solid polymeric waste by crosslinking, or absorption on inert solid filler or ash.

For Further Technical Information

Please contact Lion Elastomers' Technical Center at 225-673-8871.