



# AirMail

TIMELY TECH TIPS AND HOT NEWS FOR OUR GLOBAL POLYURETHANE CAST ELASTOMER CUSTOMERS

## PSP OFFERINGS

- Airthane® Prepolymers
  - Versathane® Prepolymers
- Versalink® Polyurethane Curatives
  - Lonzacure® MCDEA Curative
  - Versalink Oligomeric Diamines

## HELPFUL LITERATURE

Your Air Products PSP team has compiled free current, detailed literature for the global cast elastomers industry. Why not request our excellent business overview offering, the "Polyurethane Specialty Products-Product Reference Guide" (140-03-076-US). Or one of our indispensable brochures:

- "Trouble Shooting Guide for Polyurethane Elastomers" (140-9737)
- "Engineering Properties of Castable Polyurethane Elastomers" (140-9411)
- "Polyurethane Cast Elastomers with Lonzacure MCDEA Curative" (140-9620)

E-mail: cheminfo@apci.com or call 800-345-3148. Please include pub number.

## Everything You Wanted to Know About **Hand Batching**

Hand batching is advantageous for compression molding and when casting small parts with different durometers. Hand mixing is also the choice when the quantity of processed prepolymer is insufficient to justify the cost of a mixing machine.

A hand batch station requires a degas station, a weighing station, a prepolymer oven, a thermocouple to measure temperatures, and a curative heating station. You can arrange the station in whatever way works best for you or your processors. Just remember that fast-curing resins require a quick, smooth sequence, so station components should be in close proximity.

Also, remember safety. Containing materials is an issue with hand batching. For example, cover the work station surface with a metal drip pan capable of containing a 5-gallon spill.

Other possible hand batching items? Don't forget tongue depressors for stirring and weighing, disposable latex gloves, disposable plastic cups with lids, and silicone oil for lowering resin surface tension and helping with degassing.

Make certain that you have cool, dry storage for polyurethane prepolymers and curatives. We recommend something between 40 and 80 °F (4 to 27 °C).

### A STEP-BY-STEP GUIDE

Here's a typical step-by-step guide for hand batching. Use it for Airthane and Versathane TDI prepolymers.

1. Weigh the desired amount of prepolymer into a suitable container that is 2-3 times larger than the volume of the prepolymer.
2. Heat the prepolymer in a convection, forced air or microwave oven. You may also use a hot plate. To prevent overheating with a hot plate, continuously stir the prepolymer.

Temperatures will vary based on the type of prepolymer. Generally, polyether-based materials should be heated to 167 to 185 °F (75-85 °C), while polyester-based materials should be heated to 185 to 203 °F (85-95 °C). Take special precautions to minimize the heat exposure of the prepolymer. At no time should it be heated to above 230 °F (110 °C), as excessive heating can cause the prepolymer to lose NCO content. That will dramatically affect the elastomer physical properties. Refer to your prepolymer product bulletin for specific heating guidelines.



Table 1: Hours Required to Complete Melting Without Rolling Container

Recommended Temperature	POLYESTER PREPOLYMERS		POLYETHER PREPOLYMERS
	Regular 160 °F (70 °C)	Quick Melts 160 °F (70 °C)	160 °F (70 °C)
1-Quart Can	4	2	2
5-Gallon Pail	32	16	16
55-Gallon Drum	72	24	24

3. Incorporate additives, plasticizers, fillers, pigments, and degassing aides into the prepolymer.
4. Degas the prepolymer in a vacuum chamber until vigorous foaming stops. Adding a drop of silicone surfactant will help degassing. Your vacuum chamber should reach 1 to 5mm of Hg vacuum.

## Successfully **Machining Elastomers**

You can machine polyurethane elastomers the same as you machine plastics. Keep these points in mind.

- Polyurethane elastomers have much lower thermal conductivity than metals. Cutting tool heat stays close to the tool and raises the polyurethane temperature rapidly. Control this heat. Melting occurs at 550 °F (228 °C).
- Provide proper cutting tool clearance since elastic recovery occurs during and after machining. Without compensation, expansion of the polyurethane after cutting will result in increased friction between the cut surface and the cutting tool, and, ultimately, in excess heat buildup.
- Elastic recovery after machining may also result in smaller internal and larger external diameters than were measured during cutting.
- Polyurethane elastomers are resilient and can easily be distorted (modulus of elasticity). Take special care to avoid distortion with cutting and/or holding forces.
- Gumming, poor finishes, and poor dimensional control can easily occur due to accumulated excess heat. Proper tool geometry, feed rates, and cutting speed—along with coolants—usually controls such problems. Water-soluble cutting and/or light machine oils are good coolants for polyurethane elastomers. ▲



## Processing and Handling Guidelines: General Procedures for Handling Prepolymers

The general procedures used to process prepolymers apply to both polyether and polyester types; however, differences do exist in regard to temperatures employed.

### STORAGE

The prepolymer should be stored in its sealed container at 50 to 90 °F (10 to 32 °C) and protected from water. Partially used containers should be purged with dry nitrogen before they are resealed.

### SHELF LIFE

When stored under proper conditions, the prepolymer will have a shelf life of two years.

### MELT TIME

Before using a polyurethane prepolymer, it is usually necessary to heat the product in its container in order to reduce the viscosity sufficiently to allow for pouring or pumping.

A circulating hot air oven is recommended, although commercially available drum warmers can be satisfactory if temperature control is sufficiently maintained to prevent localized overheating. Rotating the drum while heating will ensure the even distribution of heat and will reduce the time required to melt the product. For melting guidelines, see details in the story on hand batching in this issue.

### HEAT STABILITY

Polyurethane prepolymers are heat sensitive and can be damaged by excessive exposure to high temperatures, causing a loss in NCO and an increase in viscosity. To avoid this, the total heat exposure before processing should be less than 7 days at 160 °F (70 °C) for polyester types, and 7 days at 140 °F (60 °C) for polyether types. The prepolymer should not be held at the processing temperature (212 °F, or 100 °C) for more than 8 hours. ▲

## Everything You Wanted to Know About **Hand Batching**

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5. Weigh the correct amount of curative. Heat the curative to the recommended temperature. Liquid curatives such as Versalink 1,4 BDO and Ethacure® 300 curatives can be used at room temperature. Solid curatives, on the other hand, like MBOCA, Versalink 740M, and Lonzacure MCDEA should be heated to the temperature specified in the product literature.
6. Reheat the degassed prepolymer to the desired mixing temperature. Note that the mixing temperature will vary based on the type of backbone, and it will affect the length of the pot life. The higher the temperature, the shorter the pot life.
7. When the prepolymer has reached its mixing temperature, add the curative and mix the material thoroughly. Scrape the walls of the container during mixing to ensure a homogeneous mix. Swirls should not be apparent when you are finished mixing.
8. To obtain the best results, return the mixture to the vacuum chamber to remove air entrapped during mixing. This second degassing step can be done in 1 to 2 minutes. Systems with pot
- lives of less than five minutes cannot be degassed after mixing.
9. Pour the mixture into a preheated mold that has been treated with a release agent. The mold temperature will vary based on the type of system. Generally, TDI systems using diamine curatives (MBOCA, Versalink 740M, Lonzacure MCDEA, or Ethacure 300 polyurethane curatives) will require mold temperatures of 212 °F (100 °C), while polyol-cured systems (Voranol 234-630 curative) will require mold temperatures of 248 °F (120 °C).
10. Mold temperature should be maintained until the cured elastomer has obtained sufficient strength to be demolded. Based on the system, this may occur as soon as 15 minutes, or in several hours. A good rule of thumb is that the shorter the pot life, the shorter the demold time.
11. After demolding, the finished part should be subjected to appropriate post-cure. TDI systems can be post-cured at 212 °F (100 °C). ▲



**(Editor's Note:** For more details on hand batching, request the Air Products™—“A Guide to Hand Batching Polyurethane Prepolymer Systems” (140-9618). E-mail or call us at cheminfo@apci.com or 800-345-3148. Include the pub number. Ethacure is a registered trademark of Albemarle Corporation.



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