AIR PRODUCTS

summer 2003

AirMail

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

Welcome to AirMail

Back by popular demand is our helpful PSP team newsletter, AirMail. We've gotten feedback about how important our technical information has become.

That's why we'll be sending AirMail to you regularly. We'll keep it short and sweet, and full of information that will make your job much easier. We welcome your requests and questions. We welcome your suggestions for topics. So call us. Or e-mail us. Or send us airmail!

Together we can make some of the best elastomers in the world. ▲

What is Blowout?

Blowout occurs with parts used in dynamic applications, including wheels, tires and rollers. When polyurethane elastomers undergo cyclic loading and unloading, mechanical energy is transformed into heat energy and the elastomer will heat up. If this heat buildup is too great, the polyurethane can melt and the part can experience blowout.

Here are considerations to help avoid blowout:

1. System Choice

Some polyurethane elastomers have inherently better dynamic performance than others do. High-performance polyether systems are generally preferred for optimum dynamic performance; however, some systems perform better than others do. Many applications use TDI/Mboca/PTMEG elastomers with great success. Products such as Airthane® prepolymers are usually the highest performance materials in this class. Alternative curatives have also been developed which offer improvements over conventional curatives. Consult your supplier for recommendations on the appropriate system.

2. Elastomer Hardness

With dynamic applications, the greater the cyclic deflection of the elastomer, the greater the heat buildup. Generally, an in-use deflection of 5-10 percent is acceptable, although a deflection of fewer than 5 percent is desirable. If the deflection is higher than 5-10 percent, the part has a greater chance for blowout. Specifying a harder elastomer is usually recommended to minimize this deflection. However, there are typically other performance attributes that also need to be considered, such as ride comfort or traction, where use of a softer formulation may be desired.

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Certain Polyurethane Elastomers OK for Dry Food Handling

The type of curative used for polyurethane elastomers determines whether or not they are approved for dry food handling applications.

Polyurethane elastomers (both polyester- and polyether-based) made with Air Products' Airthane® and Versathane® prepolymers include components that are on the approved list of substances for producing polyurethane resins for usage in contact with dry food, as outlined in U.S. Food and Drug Administration (FDA) regulations, Code of Federal Regulations (CFR), Title 21, Part 177.1680.

FDA APPROVED CHEMICAL COMPOSITION CURATIVES FOR DRY FOOD HANDLING:

- TMP (trimethylol propane)
- ethylene glycol
- propylene glycol
- 1,4 BDO curative (butanediol)
- Versalink® 740M curative (trimethyleneglycol di-p-aminobenzoate)

FDA NON-APPROVED CHEMICAL COMPOSITION CURATIVES FOR DRY FOOD HANDLING:

- MBOCA
- Ethacure® 300 curative
- Voranol® 234-630 curative

Certain prepolymers are also acceptable polyurethane resins for repeated contact with food. ▲

Summer's Humidity Presents Unique Issues

During the summer with its higher humidity, you may encounter a unique set of processing issues. This is when it's more important than ever to keep all raw materials as dry as possible. Prepolymers can react with water in the atmosphere, leading to adverse processing behavior. Many curatives, plasticizers, fillers, and pigments can also absorb water.

Processors often report their material is difficult to degas or its pot life has shortened. These difficulties are frequently due to prepolymer exposure to moisture. Exposure to a combination of water and heat causes a prepolymer to start reacting in the drum, and by the time it's processed, chemical cross-links have formed, leading to increased viscosity.

CO_2 gas also forms in this reaction, so increased foaming may be seen. Because the cure process has already started, you'll see a decrease in pot life, but the demold time will probably be longer. In addition, if the part isn't pigmented, it may appear more translucent. And, the hardness of the final part may be several points lower.

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Make Sure All Molds Are Clean

QUESTION: My system processes beautifully, but when I demold, I notice surface defects ranging from shrink marks, to voids, to mottling and knit lines. Why does this happen?

ANSWER: There are many causes, but improper mold release application and a dirty mold are common culprits. Using too much mold release is as bad as using too little. Too much leads to a buildup on the molds, and if they're not cleaned and conditioned properly prior to being put back into use, your parts will have voids, mottling and craters.

Cold molds are a leading cause of surface shrink marks, particularly with MDI systems, which are quite temperature sensitive.

Cold molds are often an issue late in the day when you may not allow enough time for the mold to reheat. Problems can also occur during seasonal changes if adjustments aren't made to your preheating schedule. Also, different types of molds have different thermal properties. For instance, steel molds take longer to heat up than aluminum, but steel also retains heat better.

Knit lines occur when a material starts to gel before it has completely flowed around an insert or core. This can be avoided by using a prepolymer with a longer pot life and lower viscosity, such as an Airthane prepolymer. ▲

What is Blowout?

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3. Stoichiometry Effects

With most systems, the dynamic performance of an elastomer is optimized in the 90-95 percent stoichiometry range. Performance will decline as a formulation moves significantly away from this stoichiometry.

4. Part Loading

Even when the correct formulation has been used, the loading on a wheel, tire, or roller can be uneven, leading to localized meltdown and blowout in the region of maximum load.

This happens frequently with rollers when the ends are tightened down to increase the nip pressure. It also happens with tires and wheels that have an improper crown. Proper installation of the part into service is critical. Loading across the face of the part should be as uniform as possible, and crowning of a wheel or roller may be required.

5. Load/Speed Considerations

Dynamics are a function of load and speed. If either is too great, then the part may not be able to dissipate the heat fast enough to avoid a blowout. This can happen even with a properly designed part. Sometimes it may be necessary to redesign the application. This can be accomplished by redesigning the wheel/roller to have a larger diameter, effectively reducing the speed. The part can also be made wider to distribute the load over a wider area. Also, additional wheels/tires can be added to spread the load. In some instances, the part can be redesigned to more readily dissipate heat away from the polyurethane.

We suggest you get a copies of two Air Products' technical papers: **"Optimization of High-Performance Elastomer Properties"** (140-9503) and **"Designing PUR Elastomers for Dynamic Applications"** (140-9205). E-mail cheminfo@apci.com or call 800-345-3148. ▲

Summer's Humidity Presents Unique Issues

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Many liquid curatives, or those that melt below 100°C, as well as plasticizers, adhesives, primers, and pigment carriers are hygroscopic. That means they pick up moisture from the air. They appear normal when processed, but when demolded, bubbles can be seen in the finished part. These bubbles are from the CO_2 gas that forms when the NCO in the prepolymer reacts with water. When this happens, the final part is usually softer than expected.

Molds, hubs, and inserts should also be kept well above 100°C, since moisture may condense on the surface if the metal cools below the boiling point of water. Moisture can cause voids to form on the surface or at the bond line. The bubbles that form are typically visible in clusters and appear as if they were moving to the top of the mold.

The best protection from moisture contamination is the use of dry nitrogen. Each time a material is opened and resealed, nitrogen padding should be applied. Whenever possible, liquid curatives and additives should be degassed before addition to the prepolymer, and solid additives should be heated above 100°C. ▲

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