General Processing Guide

To Make Elevated-Temperature-Cure Polyurethane Elastomer

This document is for manually hand-batching to test high-performance elevated temperature-cure polyurethane casting resin materials. It contains very basic information for handling and processing such materials. Each formulation system has somewhat different processing parameters. Please consult Northstar Polymers for specific question pertains to your application.

Safety

The component materials are industrial-grade chemicals. Please keep the materials in a secure place and prevent access from unauthorized individuals.

The personnel who handle these materials need to read the Safety Data Sheet (SDS) for detail information on safety and handling of the material. The SDS for each component is sent with the shipment of the material.

When using this material, be sure to operate in a well-ventilated area. Wear rubber gloves, long sleeves, and protective eyeglasses to prevent skin/eye contact of the material.

When your operation involves spraying of the material, and if you expect the isocyanate content level in the work place atmosphere may become above the threshold regulated by OSHA or by other appropriate working place safety standard, we recommend, in addition to the above, installation of a proper hooded dynamic ventilation system and/or using an appropriate type of respirator (such as a full-face respirator equipped with OSHA approved HEPA filters for particulate and organic vapor) to prevent inhalation of the fume.

Direct contact of polyurethane raw materials to skin/eye, as well as ingestion may lead to health problems. No eating or smoking should be permitted in the working area. The operator(s) should wash hands well with soap and water after handling the materials. Follow the procedures of the Standard Industrial Hygiene Practices. Please refer to the SDS for each component for the detailed health information.

If the chemical gets on to your skin/eye, wash it off with soap and water as soon as possible. A washing facility should be readily available. Read the Safety Data Sheet (SDS) for more information. SDS will be sent together with the each component. A digital copy of SDS will be available upon request.

Terminologies

You make this polyurethane elastomer by mixing the two components; we call the isocyanate components "**prepolymer"** and polyol components "**curative"**.

The prepolymer is also called **part-A**. The curative is called **part-B**.

The name for the part-A/part-B combination to make a product is called **system.**

*Please note that other suppliers may call part-A/part-B in different names.

Required Items

1. Containers

The mixing container must be smooth surfaced plastic or metal cups, buckets, or cans. Do not use paper or wood container as they carry high moisture level. Make sure the inside of container is clean, dry, and free of any solvent. The polyurethane materials stick to the surface and may be hard to come. Disposable containers may be more convenient.

2. Scale

Precise weighing is important in this process. A digital scale with one or two below decimal point is recommended for lab scale batches. To avoid conversion error, using gram scale (instead of pounds and ounces) is recommended.

3. What to Wear

To handle any polyurethane material, you need to wear rubber gloves. Latex or nitrile rubber chemical handling gloves are recommended.

Operator(s) must wear rubber gloves, long sleeves, and protective eyewear to avoid skin/eye contact of the liquid component materials. See the Safety Data Sheet for the details.

4. Stir Stick

Plastic or stainless steel flat-end spatula is recommended. Do not use wood pain stick or any other wood or paper products. For larger batches, you may use a lab mixer or hand-held powder mixer with paint mixing fins.

5. Mold Release

In most of the cases, you must use mold release agent to prevent the resin to stick to the mold surfaces. Northstar Polymers carry and recommend 100% pure silicone release agent for non-foam elastomer parts molding.

6. Oven

Most of high-performance polyurethane systems must be processed at an elevated temperature between 140 ˚F and 200 ˚F.

Sample material kits are typically shipped in tin paint cans, and they should fit into common kitchen ovens or small lab ovens.

Pails are about 16 inch tall. This may require a larger industrial oven. Our pails are rated with maximum temperature of 200 ˚F. Pails need to be placed in an oven away from heating elements to prevent melting.

7. Vacuum Chamber

Without degassing the liquid components, you cannot make good non-foam elastomer parts. After the part-A/B components are mixed, the blended resin needs to be put into a vacuum chamber for degassing.

Many high-performance polyurethane materials have short pot-lives. If you are manually mixing and casting non-foam elastomer, your vacuum setting has to bring the vacuum level to 29" Hg or higher within 1 to 2 minute.

Usually vacuum chambers (or vacuum vessels) and vacuum pumps are sold separately. A larger vacuum chamber requires a vacuum pump with higher power. You must select the right combination of vacuum chamber (vessel) and pump so that the 29" Hg level vacuuming is achieved within 1 to 2 minutes.

Vacuum chamber with a heating capacity (vacuum oven) may become handy when you work with materials required to be processed at elevated temperature.

If vacuum chamber is not available while you test a high-performance elastomer, your parts will contain many bubbles.

However, you may still make decent parts for your preliminary tests. If you do not vacuum, mixing quickly and pouring the material into the mold soon after can alleviate the bubbles. In this way you are provide a longer time for the liquid state material to bring the bubbles to the top of mold to pop.

7. Cleaning Items

Unless you use all disposable tools, you need to clean your tools after your test pour.

Use paper towel to clean off residues. You can use isopropyl alcohol (rubbing alcohol) for cleaning the resin residue. A product that is 91% isopropyl alcohol with 9% water, which is typically available at a pharmacy, can be used for cleaning. Be sure to dry the alcohol before using the tool.

If you need to remove cured (solid) urethane from your tool, you can use MEK. MEK is highly volatile and fire/health hazardous. Please follow the safety information by the supplier.

8. Nitrogen Gas or Argon Gas

The component materials are highly sensitive to moisture. Specially, isocyanate components (prepolymer/ part-A) are very sensitive to moisture. Each time after opening the container, the head space must be purged with dry nitrogen gas or argon gas.

If you do not have any of those gasses, you need to obtain one of them. If you only need a small amount for testing you can purchase a pain-preserving gas product in aerosol cans such as Bloxygen. Typically you can find a local supplier for those gasses for industrial purposes when you start handling larger amount of materials for your production.

After opening the container to dispense the resin, you must purge the head space by squirting the gas into the can for 5 to 10 seconds for paint can samples, 10 to 30 seconds to pails to purge. After purging you can close the lid or cap back to store the material.

9. Thermometer

The temperature of the materials, molds, and curing oven should be tightly controlled for successful operation. An inferred type thermometer will be easy to quickly find the temperatures.

10. Mold

Molds can be made of die-cut aluminum, fabricated sheet metal, silicone rubber, urethane, epoxy, formed plastic sheets, fabricated plastic die, and may other materials.

When processing elevated temperature cure materials, you need to deal with the shrinkage factor. When liquid polyurethane is curing, it typically creates exothermic heat. The solid part in mold is typically hot when it is just cured. Most of solid materials take larger volume when they are hot, and as they cool down, the volume reduces. This causes the shrinkage. If the part needs to have a tight tolerance, the shrinkage must be compensated by making the mold cavity slightly larger.

Silicone and other plastic, rubber, resin molds expand more with heat, and expansion rates can be different in different parts of the mold. If deformation of flexible mold is an issue, you may need to use some other mold materials. Silicone and epoxy products made for mold-making often have fillers to improve the heat property to address this issue.

11. Note Pad

You should record the processing parameters during your test. The batch weight, temperature, timing for mixing/degassing/pouring, demolding time, and other notes will help adjusting your process and quality control later on.

Procedure

The component materials and mold should be at recommended temperature. For the full-prepolymer high-performance systems, typically, part-A component needs to be heated. For the quasi high-performance systems, typically, part-B component needs to be heated. The mold for elevated temperature systems needs to be heated most of the time. Please check the Technical Data Sheet (TDS) for the formulation you are using.

Apply the mold release on the mold. If you are using spray type mold release, follow the instructions to properly dry it before casting urethane.

Calculate the correct amounts of each part-A and part-B material according to the Technical Data Sheet.

Place a mixing cup on the scale.

Pour the correct amount part-A component. Be sure to purge and close the part-A container.

Pour the correct amount of part-B component on top of part-A as you weigh it. Close the part-B container.

Mix with a dry/clean mixing tool. Agitate thoroughly to mix the components as you scrape the side and bottom of mixing container. If a vacuum chamber for degassing is available, degas the material in the chamber.

Check the pot life of the formula on the Technical Data Sheet. You must finish pouring within the specified pot life. Often, elevated temperature curing systems have very short pot life. Casting a large part by manual mixing may be very difficult. Lowering the material temperature may provide slightly longer pot life.

Pouring after degassing may be difficult due to the short pot life. You may pour the resin in the mold, and put the mold with resin into the vacuum chamber, you may have a better result.

After the resin in mold is strong enough, you may remove the part out of mold. Refer the Technical Data Sheet for recommended demolding time. Depending on the part/mold design, you may need a longer time to demold.

Note: The demolding time can be shortened by addition of catalyst. However, shortening the demolding time also shortens pot life. While you are manually processing, it will be difficult. You need to use a proper dispensing machine if you need faster mold-cycle.

Put the part in a curing oven at a temperature between 180 ˚F and 200 ˚F. The duration of post cure can be several hours to overnight. If shorter post cure time is preferred, you need to test to find the optimum post cure time.

Some materials increase the hardness in 3 to 5 days stored at ambient temperature. We believe this occurs because it takes time for the cured molecules to line up to the equilibrium state. You may find this phenomenon more prevalently with softer range materials. We recommend physical tests and evaluation being done at least 3 to 5 days after the part is made.

Other Information

Each formulation has unique processing parameters. Please check the Technical Data Sheet or the processing information provided by Northstar Polymers to find the particular processing parameters of the formulation.

Northstar Polymers often modifies the existing formulations to fit better into the customer's processing requirements. We also custom-formulate to create the optimum formulation for each individual application.

Please feel free to contact Northstar Polymers for any question.

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