

Bulletin Covering Preform Design for NatureWorks® PLA Bottles

This bulletin is intended for use only as a tool to provide information and address issues that may pertain to the perform design for NatureWorks PLA bottles.

ISBM bottles made from NatureWorks PLA, in a lot of respects, share the same attributes of bottles made from PET. They look and feel very similar to each other with regard to clarity and toughness. Also, bottles made from these 2 resins are made essentially the same way. First, a preform is injection molded, then it is conditioned or reheated, then with the use of a stretch rod, the preform is blow molded into the final bottle.

Despite the obvious similarities of PLA and PET, there are some differences. The biggest one of these is processing temperature. Typical melt processing temperatures for PLA range from 200-230C versus 270-290C for PET. The glass transition temperature of PLA is also about 15C lower than typical bottle grade PET. This lower glass transition temperature means that a PLA preform requires a lower temperature for blowing than PET.

Questions have arisen as to what the optimum preform design is for PLA. NatureWorks has stated that PLA can be injection molded and blown using typical PET tooling and equipment. This is essentially also true for preform design. For the most part, with just changes in some processing parameters like temperature and blow timing, a high quality PLA bottle can be made from a preform designed for PET.

Below are some recommendations that have been made with regard to typical stretch ratios for PLA.

- **Areal Stretch Ratio** 8-10
- **Axial Stretch Ratio** 2.8-3.2
- **Radial Stretch Ratio** 3-4

It has also been found that preforms with shorter, less abrupt transitions work well for PLA. Preforms with transitions that are abrupt where the wall of the preform goes from thin to thick, are less forgiving when made from PLA. Preforms with a thinner end-cap also work well since it helps from getting too much material in the base.

NatureWorks LLC has teamed up with Husky and Plastic Technologies Inc. for technical development purposes specifically related to preforms and PLA stretch blow molded bottles. The contacts at either of these companies can be used as a resource for one gaining experience with NatureWorks PLA.

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Phone: (419) 867-5400

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Safety and Handling Considerations

Material Safety Data (MSD) sheets for PLA polymers are available from NatureWorks LLC. MSD sheets are provided to help customers satisfy their own handling, safety, and disposal needs, and those that may be required by locally applicable health and safety regulations, such as OSHA (U.S.A.), MAK (Germany), or WHMIS (Canada). MSD sheets are updated regularly; therefore, please request and review the most current MSD sheets before handling or using any product.

The following comments apply only to PLA polymers; additives and processing aids used in fabrication and other materials used in finishing steps have their own safe-use profile and must be investigated separately.

Hazards and Handling Precautions

PLA polymers have a very low degree of toxicity and, under normal conditions of use, should pose no unusual problems from incidental ingestion, or eye and skin contact. However, caution is advised when handling, storing, using, or disposing of these resins, and good housekeeping and controlling of dusts are necessary for safe handling of product. Workers should be protected from the possibility of contact with molten resin during fabrication. Handling and fabrication of resins can result in the generation of vapors and dusts that may cause irritation to eyes and the upper respiratory tract. In dusty atmospheres, use an approved dust respirator. Pellets or beads may present a slipping hazard. Good general ventilation of the polymer processing area is recommended. At temperatures exceeding the polymer melt temperature (typically 170°C), polymer can release fumes, which may contain fragments of the polymer, creating a potential to irritate eyes and mucous membranes. Good general ventilation should be sufficient

for most conditions. Local exhaust ventilation is recommended for melt operations. Use safety glasses if there is a potential for exposure to particles which could cause mechanical injury to the eye. If vapor exposure causes eye discomfort, use a full-face respirator. No other precautions other than clean, body-covering clothing should be needed for handling PLA polymers. Use gloves with insulation for thermal protection when exposure to the melt is localized.

Combustibility

PLA polymers will burn. Clear to white smoke is produced when product burns. Toxic fumes are released under conditions of incomplete combustion. Do not permit dust to accumulate. Dust layers can be ignited by spontaneous combustion or other ignition sources. When suspended in air, dust can pose an explosion hazard. Firefighters should wear positive-pressure, self-contained breathing apparatuses and full protective equipment. Water or water fog is the preferred extinguishing medium. Foam, alcohol-resistant foam, carbon dioxide or dry chemicals may also be used. Soak thoroughly with water to cool and prevent re-ignition.

Disposal

DO NOT DUMP INTO ANY SEWERS, ON THE GROUND, OR INTO ANY BODY OF WATER. For unused or uncontaminated material, the preferred options include recycling into the process or sending to an industrial composting facility, if available; otherwise, send to an incinerator or other thermal destruction device. For used or contaminated material, the disposal options remain the same, although additional evaluation is required. (For example, in the U.S.A., see 40 CFR, Part 261, "Identification and Listing of Hazardous Waste.") All disposal methods must be in compliance with Federal, State/Provincial, and local laws and regulations.

Environmental Concerns

Generally speaking, lost pellets are not a problem in the environment except under unusual circumstances when they enter the marine environment. They are benign in terms of their physical environmental impact, but if ingested by waterfowl or aquatic life, they may mechanically cause adverse effects. Spills should be minimized, and they should be cleaned up when they happen. Plastics should not be discarded into the ocean or any other body of water.

Product Stewardship

NatureWorks LLC has a fundamental duty to all those that make and use our products, and for the environment in which we live. This duty is the basis for our Product Stewardship philosophy, by which we assess the health and environmental information on our products and their intended use, then take appropriate steps to protect the environment and the health of our employees and the public.

Customer Notice

NatureWorks LLC encourages its customers and potential users of its products to review their applications for such products from the standpoint of human health and environmental quality. To help ensure our products are not used in ways for which they were not intended or tested, our personnel will assist customers in dealing with ecological and product safety considerations. Your sales representative can arrange the proper contacts. NatureWorks LLC literature, including Material Safety Data sheets, should be consulted prior to the use of the company's products. These are available from your NatureWorks LLC representative.

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In Europe, call 31-(0) 35-699-1344
In Japan, call 81-33-285-0824



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