

This bulletin is intended for use only as a tool to provide information and address issues that may pertain to the use of additives for Ingeo bottles. Since there are many factors to consider with preform and bottle design, development, and manufacturing, an experimental approach may be needed.

Depending upon bottle application, the use of additives may be desired in order to improve the appearance of the bottle, increase productivity or ease of manufacture, or enhance a specific end-use property.

The items in this bulletin will provide some basic information on the use of additives with Ingeo biopolymer. It will cover issues associated with the additive types, and how they are normally implemented.

Additive Forms

Additives are usually added to the preform during the injection molding step. Typically, these additives are in two different forms, solid or liquid. The solid form is usually comprised of either a waxy prill or a master batch, where the carrier is the same material being used as the main resin in the preform - in this case Ingeo biopolymer. Additives delivered in the liquid form are also available in the market place for Ingeo bottle applications. Liquid additives are usually delivered by a pump and mixer combination where the raw pellets mix with the liquid additive before entering the feed section of the extruder.

Solid Additive Systems

Since Ingeo biopolymer is not compatible with many other resins, it is very important to use a similar grade of Ingeo resin as the carrier in any solid master batch system. There have also been successes with additives that are in a prill form where the carrier is comprised of a wax. It is recommended that experimentation on these prilled systems be done in order to make sure that it does not affect clarity, since this can be a sign of phase separation.

There are many different companies that are in the market of making additives for ISBM bottles. Many of these have experience with PET resin systems. However, there are many additive companies knowledgeable on Ingeo resins and packaging applications. Many of these additive manufacturers also make equipment to deliver the solid additives to the injection molder or specific melt extrusion system. This equipment is basically used to provide accurate letdown ratios and uniform mixing of the master batch within the main resin or resins being used for the application. The guideline is to also use this equipment, if available, when making preforms made out of Ingeo biopolymer. These systems will need to be cleaned and free of any other resins to prevent polymer cross-contamination.

If addition equipment is not available for use with a Ingeo solid master batch, then the use of a "salt-and-pepper" blend of Ingeo biopolymer and master batch could be used as an alternative. It is very important when doing this type of blending that the master batch pellets are close to the same size as the Ingeo pellets. The bulk density of Ingeo pellets is about 44 lbs/ft³. If the pellet size of the master batch is significantly different, separation of the master batch and the main resin can result. This can lead to differences in appearance and performance from preform to preform, especially during preform reheating during reheat-stretch blow molding. Pellet static generation along vessel sidewalls is also something to pay close attention to, as this may also alter the letdown ratio of the master batch.

Liquid Additives Systems

Liquid additives are also usually comprised of active ingredients along with an inert carrier. It is important that the addition equipment recommended by the additive supplier is being used and that the instructions pertaining to letdown ratio are being followed. It is also very important with liquid systems that the carrier/additive combination does not promote screw slipping in the injection molder when being used with Ingeo biopolymer. Screw slipping will eventually result in inconsistent screw recovery times and, sometimes, a complete loss of feed.

Additive Types

Using additives for Ingeo bottles usually depends on the end-use application. Different products have different requirements of the package. Some basic additives for bottles made from Ingeo biopolymer include:

- **Toner & Colorant** - Ingeo biopolymer has a slight yellow hue. To mask this yellowness, a toner may be used to produce a bottle that is clear and has high shelf appeal to the consumer. Toners may also be used to impart a different color to the bottle package.
- **Reheat** - For two-stage ISBM processing, a reheat additive may be desirable in order to improve the heating efficiency of the preform while in the oven prior to blow molding.
- **UV Blocker** - Certain bottled products are sensitive to ultraviolet (UV) light. The addition of a UV absorber or inhibitor in the preform might be needed to improve or prolong shelf-life.
- **Oxygen Scavenger** - To protect products sensitive to oxygen, an oxygen absorber can be introduced into the preform. Usually, these oxygen absorbers are active and work by means of a reaction. They work to prolong shelf-life as long as there is oxygen absorber left to react.
- **Slip or Process Aid** - To reduce the coefficient-of-friction (COF) on preforms and bottles, a slip additive or process aid might be useful. Changing the COF can help reduce scuffing and scratching of preforms and bottles during processing, filling, and shipping.

Additive Suppliers

NatureWorks LLC has worked with various additive suppliers to the plastic's packaging market. Please contact one of these or your local representative for added commercial or technical support. Some customers have also had success working with their current additive suppliers. Many other established master batch and additive suppliers have worked with Ingeo and most likely would be able to supply an Ingeo master batch. If your customer has a preferred supplier, they should go ahead and contact them first and inquiry about master batch additives specifically for Ingeo biopolymer.

NatureWorks LLC makes no warranties or claims of suitability or availability of additives with suppliers, whether listed here or not. The companies listed below are some who NatureWorks LLC has worked with in the past.

Color Matrix Corp.

680 North Rocky River Dr.
Berea, OH 44017-1628
Tel: (216) 622-0100
www.colormatrix.com

Color Matrix Europe Ltd.

Commercial & Tech Center
269-273 Hastelweg
Eindhoven 5652 CV
The Netherlands
+31 402 916 524
www.colormatrix.com

Holland Colours Americas, Inc.

1501 Progress Drive
Richmond, IN 47374
Tel: (800) 723-0329
www.hollandcolours.com

Sukano Products Ltd.

Chaltenbodenstrasse 23
8834 Schindellegi
Switzerland
Tel: +41 44 786 99 35
www.sukano.com

Clariant Corp.

9101 International Parkway
Minneapolis, MN 55428
Tel: (763) 535-4511
Fax: (763) 975-6199
www.clariant.masterbatches.com

PolyOne

33587 Walker Road
PolyOne Center
Avon Lake, OH 44012
United States
Tel: (866) 765-9663
www.polyone.com

Sukano Polymers Corporation

295 Parkway East
Duncan, SC 29334
Tel : (864) 486-1478
www.sukano.com

Polyvel, Inc.

100 Ninth Street
Hammonton, NJ 08037
Tel: (609) 567-0080
Fax: (609) 567-9522

Plastics Color Corp.

142nd & Paxton Ave.
Calumet City, IL 60409
Tel: (800) 922-9936
www.plasticscolor.com

Food Contact/FDA Concerns

Please note that it is the responsibility of both the manufacturers of finished food contact articles as well as the industrial food packers to make sure that their articles in actual use are in compliance with federal, regional, and local requirements and limitations. Any post addition of additives, colorants, or other adjuncts to NatureWorks LLC Ingeo resin requires that appropriate regulations be consulted for complete details on compliance to the appropriate norms. NatureWorks LLC makes no representation on the compliance of reference materials to regulatory requirements. NatureWorks LLC recommends that all manufactures check with their colorant/additive supplier for correct compliance certification to appropriate legal and product stewardship requirements for appropriate geographical areas. We urge all of our customers to perform GMP (Good Manufacturing Procedures) when constructing a package so that it is suitable for the end use.

Safety and Handling Considerations

Material Safety Data (MSD) sheets for Ingeo biopolymers 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 Ingeo biopolymers; 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

Ingeo biopolymers 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 Ingeo biopolymers. Use gloves with insulation for thermal protection when exposure to the melt is localized.

Combustibility

Ingeo biopolymers 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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For additional information please contact NatureWorks via our [website](#) on the tab called [FAQ's](#) or by clicking [here](#).



15305 Minnetonka Blvd., Minnetonka, MN 55345