

Ingeo™ Biopolymer 10361D Technical Data Sheet

Binders and Adhesives

Ingeo biopolymer 10361D, a NatureWorks LLC product, is a thermoplastic binder or adhesive-grade resin derived from annually renewable resources. Available in pellet form, 10361D is designed for use as a binder or adhesive component in formulated products where an amorphous/low melting, high-flow resin is desired. Ingeo biopolymer 10361D can be utilized in a broad range of binder or adhesive products. See table at right for typical polymer properties.

Typical Material & Application Properties ¹		
Physical Properties	Ingeo 10361D	ASTM Method
Specific Gravity	1.24	D792
Relative Viscosity	2.5	NTR Internal Viscotek Method
Melt Index, g/10 min (210°C)	70-85	D1238
Melt Density (230°C)	1.08	
Glass Transition Temperature (°C)	55-60	D3417

(1) Typical properties; not to be construed as specifications.

Applications

Potential applications for Ingeo biopolymer 10361D include:

- Binder for inorganic pigments, dyes or colorant products for plastics, paints and coatings or printing applications.
- Binders for bonding cellulosic materials or natural fibers.
- Components or base for adhesive formulations for hot-melts, emulsions or dispersions.

Processing Information

Ingeo biopolymer 10361D will process on conventional extrusion equipment with thorough cleaning, since PLA is not compatible with a wide variety of polymers. 10361D can also be used as a component in hot melt systems, but care must be taken due to the hydrolytic sensitivity of the polymer.

Machine Configuration

General-purpose screws with L/D ratios of 24:1 to 30:1 and 3:1 compression ratios are recommended. However, screws with mixing sections or shallow metering channels may overheat the melt at high screw speeds. Typical melt processing temperatures are 195 – 240°C. Extruder feed throat and/or screw cooling is generally required to provide proper pellet feeding.

Drying

In-line drying capabilities are helpful to process Ingeo biopolymer 10361D, which is supplied with moisture content of less than 0.040% (400 ppm). The recommended moisture content to prevent viscosity degradation and potential loss of properties is less than 0.005% (50 ppm). Typical drying conditions are 8-12 hours at 40°C [104°F] with a dew point of -35°C [-30°F], with an airflow rate of greater than 0.5

cfm/lbs per hour of resin throughput. Drying at higher temperatures will cause the pellets to stick together, as they are amorphous. To prevent moisture regain, the resin should not be exposed to atmospheric conditions after drying. Unless the polymer is kept free of moisture during processing, long time exposures (greater than 5-10 minutes) at high temperatures (>230°C) can lead to hydrolytic breakdown as well as viscosity and property loss.

Bulk Storage Recommendations

The resin silos recommended and used by NatureWorks LLC are designed to maintain dry air in the silo and to be isolated from the outside air. This design would be in contrast to an open, vented to atmosphere system that we understand to be a typical polystyrene resin silo. Key features that are added to a typical (example: polystyrene) resin silo to achieve this objective include a cyclone and rotary valve loading system and some pressure vessel relief valves. The dry air put to the system is sized to the resin flow rate out of the silo. Not too much dry air would be needed and there may be excess instrument air (-30°F dew point) available in the plant to meet the needs for dry air. Our estimate is 10 scfm for a 20,000 lb/hr rate resin usage. Typically, resin manufacturers specify aluminum or stainless steel silos for their own use and avoid epoxy-lined steel.

Safety and Handling Considerations

Safety Data Sheets (SDS) for Ingeo biopolymers are available from NatureWorks. SDS's 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. SDS's are updated regularly; therefore, please request and review the most current SDS's 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. Pellets or beads may present a slipping hazard.

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. 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.

Good general ventilation of the polymer processing area is recommended. At temperatures exceeding the polymer melt temperature (typically 175°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 (or goggles) to prevent exposure to particles, which could cause mechanical injury to the eye. If vapor exposure causes eye discomfort, improve localized fume exhausting methods or use a full-face respirator.

The primary thermal decomposition product of PLA is acetaldehyde, a material also produced during the thermal degradation of PET. Thermal decomposition products also include carbon monoxide and hexanal, all of which exist as gases at normal room conditions. These species are highly flammable, easily ignited by spark or flame, and can also

auto ignite. For polyesters such as PLA, thermal decomposition producing flammable vapors containing acetaldehyde and carbon monoxide can occur in almost any process equipment maintaining PLA at high temperature over longer residence times than typically experienced in extruders, fiber spinning lines, injection molding machines, accumulators, pipe lines and adapters. As a rough guideline based upon some practical experience, significant decomposition of PLA will occur if polymer residues are held at temperatures above the melting point for prolonged periods, e.g., in excess of 24 hours at 175°C, although this will vary significantly with temperature.

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 option is to recycle into the process 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. Disposal must be in compliance with Federal, State/Provincial, and local laws and regulations.

Environmental Concerns

Generally speaking, lost pellets, while undesirable, are benign in terms of their physical environmental impact, but if ingested by wildlife, 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 environment.

Product Stewardship

NatureWorks has a fundamental duty to all those that 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, and then take

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appropriate steps to protect the environment and the health of our employees and the public.

Customer Notice

NatureWorks encourages its customers and potential users of its products to review their applications 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 literature should be consulted prior to the use of the company's products.

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15305 Minnetonka Blvd., Minnetonka, MN 55345