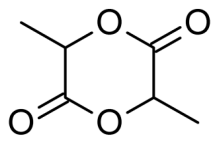
NatureWorks
TECHNICAL DATA SHEET

INGEO LACTIDES

Monomers & Chemical Intermediates

DESCRIPTION

Ingeo™ lactides are high-purity di-lactones useful for the synthesis of polymers, copolymers, and grafted substrates. They are also useful as reactive chemical intermediates for other synthesis and manufacturing purposes.



cyclic di-ester of lactic acid

Formula: $C_6H_8O_4$

Chemical Name: 3,6-dimethyl-1,4-dioxane-2,5-dione

Molecular Weight: 144 g/mol

CAS Registry Number: 95-96-5

COMPOSITION & PHYSICAL PROPERTIES

ATTRIBUTE	TYPICAL VALUE(1)					METHOD
	L-LACTIDES		MESO-LACTIDES			
	L50	L1000	M700	M3065	M3002	
Grade	Polymer	Polymer	Polymer	Reagent	Reagent	
Stereochemistry (D-lactic equivalent)	≤ 0.5%	< 3%	> 40%	≤ 35%	> 35%	GC
Color	White			White to light yellow		Visual inspection
Overall Lactide Purity	≥ 99.5%	≥ 99%	≥ 99.5%	≥ 96%		GC
Melting Range (Peak) (°C)	95–98		54–56			DSC at 20°C min^{-1}
Specific Gravity: Solid at 25°C	1.36		1.33			Pyknometer
Specific Gravity: Liquid at 130°C	1.16		-			Hydrometer
Specific Heat Capacity: Solid at 25°C (J g−1 K−1)	1.3		-			DSC
Specific Heat Capacity: Liquid at 130°C (J g−1 K−1)	2.2		-			DSC
Heat of Vaporization (kJ mol−1)	~63		~56			

(1) Typical composition and properties are not to be construed as specifications.

SAMPLES

Ingeo lactides can be supplied in 1-litre and 5-litre containers for laboratory-scale evaluations, and in 5-gal (19-litre) and 55-gal (225-litre) stainless steel drums for pilot-scale evaluations. They can also be supplied at a commercial scale in bulk tank-trucks and jacketed iso-containers.

BULK STORAGE RECOMMENDATIONS

The resin silos recommended and used by NatureWorks 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 ºC), 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 fullface 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 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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