
PLA Filament Texturing Process Guide

This information is intended to be used only as a guide for the Manufacture of PLA textured fibers. Because production of fibers is a complex process, an experimental approach may be required to achieve desired results.

1.0 Safety and Handling Precautions

All safety precautions normally followed in the handling and processing of melted thermoplastics should be followed for NatureWorks® PLA resins.

As with all fibers, downstream processing and the wide range of temperatures and finishes or lubricants used potential smoke or fumes may result. It is recommended appropriate air testing be performed to ensure degradation products are maintained at acceptable levels. To aid in this control, appropriate process area point source remediation measures such as primary heater exhausts or other measures are typically recommended.

PLA is considered non-hazardous according to DOT shipping regulations. For further information, consult the appropriate MSDS for the PLA grade being processed.

2.0 Fiber Storage Recommendations

PLA fibers should be stored in an environment designed to minimize moisture uptake. Product should also be stored in a cool place at temperatures below 50°C (122°F).

As with all filament fiber products, storage should be provided to minimize the chances of physical yarn damage that may result in poor processing.

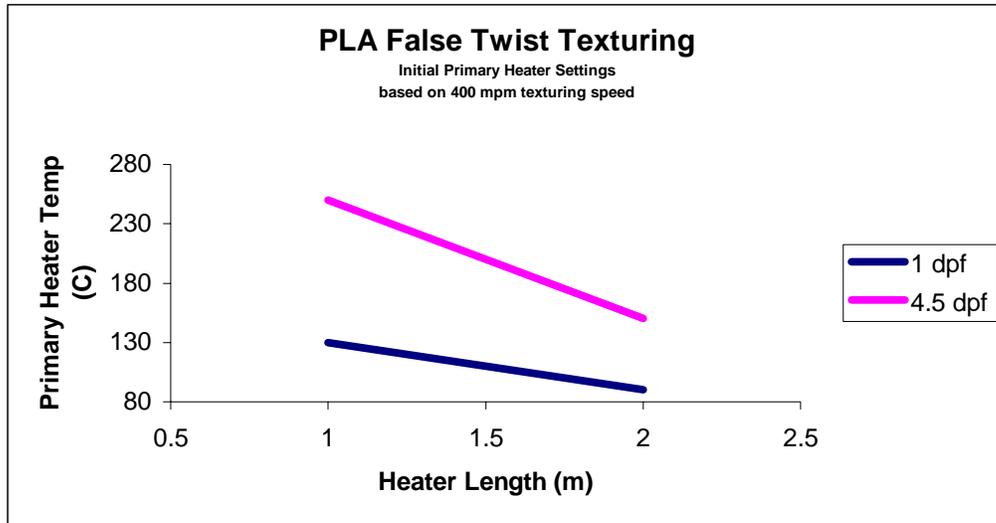
3.0 Materials of Construction

Standard materials of construction are recommended for PLA texturing. No special needs have been identified.

4.0 False Twist Texturing Parameters

4.1 Primary Heater Temperature

An optimum primary heater temperature for PLA draw texturing is dependant on several factors including, processing speed, heater length and heat transfer method (direct contact, convection). Depending on these variables, optimization can be performed through experimentation. In general, the following graph should be used as a guide for determining initial primary heater settings as a function of primary heater length and fiber denier per filament.



4.2 Disk Configuration

PLA can be successfully textured using disc materials ranging from ceramic to polyurethane. Generally, a 1/4/1 configuration is recommended for initial trials. PLA has successfully been textured with configurations ranging from 1/3/1 to 1/5/1. Optimization can be performed based on specific product counts, properties desired and specific operational philosophy.

For Murata machines (nip twist design), an initial setting of 90 degrees is recommended for the twist angle.

4.3 D/Y Ratio

For PLA, it has been found that D/Y ratio has a minimal effect on product parameters. A starting D/Y ratio of 1.7 is recommended. Adjustments can be made to optimize D/Y ratio and tensions. Generally PLA texturing tensions are lower than those for a comparable PET fiber.

For belt type machines a velocity ratio of 1.2 is recommended for the initial setting. Optimization can be performed based on product denier and target properties.

4.4 Draw ratio

To provide optimal PLA texturing performance, POY can typically be drawn at draw ratios ranging from 1.5 to 2.0 depending on the characteristics of the POY and the final target product properties. Tenacity and elongation response to draw ratio is significantly less for PLA as compared to PET.

Generally, due to low texturing tensions associated with PLA draw texturing, increased draw ratio results in increased twist insertion.

4.5 Tensions

PLA texturing tensions will generally be lower than those for comparable products. Tension ratios will depend on a number of variables. Optimum values will depend on final product and process specification.

4.6 Speed

For initial evaluations, a starting point for texturing line speeds of approximately 400 meters/min is recommended.

5.0 Finish Application

Spin finish should be selected based on planned downstream processing. Goulston Technologies, Inc or Takemoto Oil and Fat Company LTD can recommend and provide finishes for PLA that have been proven for a variety of applications. Due to the frictional characteristics of PLA, higher levels of finish are typically found to offer better processing.

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.

NOTICE: No freedom from any patent owned by NatureWorks LLC or others is to be inferred. Because use conditions and applicable laws may differ from one location to another and may change with time, Customer is responsible for determining whether products and the information in this document are appropriate for Customer's use and for ensuring that Customer's workplace and disposal practices are in compliance with applicable laws and other governmental enactments. NatureWorks LLC assumes no obligation or liability for the information in this document. **NO WARRANTIES ARE GIVEN; ALL IMPLIED WARRANTIES OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR USE ARE EXPRESSLY EXCLUDED.**

NOTICE REGARDING PROHIBITED USE RESTRICTIONS: NatureWorks LLC does not recommend any of its products, including samples, for use as: Components of, or packaging for, tobacco products; Components of products where the end product is intended for human or animal consumption; In any application that is intended for any internal contact with human body fluids or body tissues; As a critical component in any medical device that supports or sustains human life; In any product that is designed specifically for ingestion or internal use by pregnant women; and in any application designed specifically to promote or interfere with human reproduction.