GRAHAM ENGINEERING

High-Temperature & Corrosion Resistance Extruder Conversion - Does it Make Sense?

A Graham Engineering White Paper

Marketplace Pressure

With the long lead times/shortages for FEP heat shrink tubing in the marketplace, we have had quite a few customers inquire about converting their machines to high temp (HT)/corrosion resistance (CR) so they could make their fluoropolymer products. This transition is an expensive proposition, and one would have to weigh the costs of modifying or purchasing a new machine based on capacity constraints and other factors.

Why HT & CR are Necessary

The modifications are necessary because most fluoropolymers require a high melt temperature that exceeds the standard for most heating systems. Components must be corrosion-resistant to ward off the effects of acidic outgassing while processing – hydrogen fluoride (HF), carbonyl fluoride (COF2), tetrafluoroethylene (TFE), hexafluoropropylene (HFP), and perfluoroisobutylene (PFIB), as well as others.

SEE: Guide to Safe Handling of Fluoropolymer Resins, Fifth Edition, Plastics Industry Association

HT & CR Extruder Features

We at Graham Engineering generally offer two models of extruders in the medical market, the Compact Modular and the Ultra MD. The Compact Modular is designed to change the barrel module, and feed throat insert in a few minutes. Customers can order a high temp/corrosion resistance module, though it is still expensive (especially in today's economic environment).

The Ultra MD is a more traditional style extruder. Converting the Ultra MD requires all the features one would find designed into a high temp/corrosion-resistant modular design.

- **Electrical**: The standard cast-in aluminum barrel heaters have a maximum temperature rating of 650°F, which is not high enough for the higher melt temperature grades such as FEP or PFA, nor are they resistant to the processing fumes. The barrel heaters will need to be upgraded to cast bronze, offering corrosion resistance and higher watt densities that will be rated for 900°F. This design will also provide a long lifespan vs. ceramic heaters.
  - Due to the higher wattages, the electrical drawing for the machine will need to be reviewed to ensure the system can handle the higher electrical load (wire gauge, SSRs, etc.).
- **Feed Section Liner**: The typical Ultra MD design uses a replaceable feed throat liner, for which Graham Engineering offers various designs. For Fluoropolymers, this will need to be changed to an Inconel version not only for corrosion resistance but also to help protect the screw from galling. A vertical stainless liner is added to the vertical opening to protect the casting.
- **Barrel**: The barrel needs to have an Inconel backing in the areas where there are threads for transducers and/or rupture disks. If not, no threads may be left within a year or two. The most common barrels used are either the Xaloy 800 series with full Inconel backing or the Wexco BO55 with Inconel backing at the discharge end.

Standard Considerations

- **Clamps**: Nickel plated for corrosion resistance.
- **Breaker Plate and Screens**: The breaker plate will need to be changed to Inconel, and the screens converted to Monel.
- **Screw**: The feed screw must be appropriately designed and made from an Inconel billet (usually with Colmonoy flight hardening).
- **Barrel Fans**: Due to the higher temperatures, spacer blocks are added to the barrel cooling fans, so the motor connection solder joints do not melt.
- **Barrel Hood**: Due to the high temperatures, a dual-layer insulated Stainless Steel hood is installed to protect the technician.
- **Transducers and Rupture Disc**: These need to be replaced with Inconel tipped and high-temperature versions.

Other Things to Consider for a Conversion

- **Tooling**: You will need to convert your die assembly to a nickel-based corrosion-resistant material (Inconel preferred).
- **Die Heater Zones**: Let us know the heater wattages you intend to use, so we can review the electrical drawings to ensure compatibility.
- **Changing L/D**: Some customers have asked about converting from a 24:1 to a 30:1. This would require an extensive redesign of the Ultra frame to move the barrel support to a new location. It may be better to have a new machine quoted at that point.

Non-machine Considerations

- **Outgassing/Fumes**: While all materials have outgassing/fumes from processing, fluoropolymers can be especially harmful.

Ensure that your manufacturing area has proper ventilation to exhaust the fumes from processing. We take many steps to ensure the machine metals are protected from processing fumes. Think about what those fumes can do to your personnel. Please refer to the link provided above if you are considering processing fluoropolymers.

How Can Graham Engineering Help?

Note that conversions and barrel modules can take time as vendor/industry lead times can be long. The Graham Engineering lab has fluoropolymer-compatible equipment (1" extruder) and head assembly (Guill 712), and we can develop your tools and processes to shorten your time to manufacturing after your conversion or module is completed.

Don't hesitate to contact your local Graham Engineering Regional Sales Manager or email us at sales@grahamengineering.com

GRAHAM ENGINEERING COMPANY, LLC | 1203 EDEN ROAD | YORK, PA 17402-0673 USA
+1 717.848.3755 | Fax +1 717.846.1931 | www.grahamengineering.com