Blown/Cast Film Processing Guide

Safety Precautions
M•vera™ B5008 is thermally sensitive and must be handled and processed with adequate ventilation and proper personal protective equipment. Temperatures above 200 °C (392 °F) or prolonged exposure to temperatures above 190 °C can result in considerable polymer degradation and the evolution of crotonic acid. Therefore, adequate ventilation should be provided where hot polymer may reside for long periods such as in leak areas, above the die, in screen changers, in vent ports, etc. As with most thermoplastics, exposure to harmful vapors and thermal burns from contact with molten polymer can be potential safety hazards. The B5008 Material Safety Data Sheet provides additional handling and processing information and can be downloaded at www.metabolix.com.

CAUTION: HEATING ABOVE RECOMMENDED PROCESSING TEMPERATURES WILL RESULT IN EXTENSIVE DEGRADATION AND POLYMER CHANGES THAT WILL AFFECT THE PROPERTIES OF THE MATERIAL.

Moisture Content & Drying
B5008 is supplied dry (< 200 ppm) in foil-lined boxes/bags. Under nominal operating conditions, these pellets need not be dried further prior to extrusion. If necessary, drying at 80 °C for 4 hours using dehumidified air (dew point ~ -40 °C) should be sufficient to bring the moisture to a level sufficient for processing. It is advised to re-seal partially-used bags after use (to ensure that the moisture level in the pellets is maintained at reasonably low levels).

Melt Rheology
B5008 pellets and film have a density of approximately 1.3 g/cm³ at room temperature while the melt at 170 °C has a density of about 1.0 g/cm³. The melt rheology and processing of B5008 is quite similar to a blown film LLDPE grade with a melt flow index or MFI of about 1.0 g/10min. Figure 1 compares the dynamic oscillatory rheology (plotted as complex viscosity versus frequency) of B5008 and a blown film grade LLDPE (MFI ~ 1.0).

Extrusion Equipment
B5008 may be processed easily on conventional extruders with either smooth-bore feed sections or grooved-feed sections. Because these polymers experience some molecular weight (and melt viscosity) reduction during extrusion, it is very important to optimize the equipment and process conditions; screw design and temperature settings are particularly important. A low shear screw with a low compression ratio (CR) and a deep metering channel depth is ideal for B5008 processing and film properties. Specifically, a CR of 2.0 - 2.5 with a metering channel depth of about 9-11% of the barrel diameter is recommended. Screws that incorporate a barrier flight to separate the solid pellet bed from the melt pool will provide considerably better melt quality and more stable extrusion operation. Although mixing heads at the screw tip (such as Maddock mixers) are helpful, they should be designed to minimize excessive heat build-up and potential polymer degradation.
Extrusion Profile

Temperature settings provided in the schematic below are starting guidelines and these settings may need to be adjusted appropriately for different equipment. *It is important to maintain the extrusion melt temperature of B5008 below 155 °C (311 °F) and above 135 °C (275 °F) for optimal film processing and properties.*

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**Blown & Cast Film Processing Equipment**

A spiral mandrel die is recommended for blown film processing. The die-gap for blown film processing of B5008 should be in the range of 0.5-2.3 mm (20-90 mils). **B5008 can only be processed on blown film lines equipped to operate in the traditional “low stalk” bubble configuration mode with a dual-lip air ring.** Chilled air supply for the air ring will facilitate a more stable bubble at higher linespeeds. A coat hanger die is recommended for cast film processing. The ideal die-gap for cast film processing is approximately 0.38–0.64 mm (15–25 mils). Low surface-energy roll surfaces will allow higher drawdown ratios to be achieved during cast film processing.

**Start Up Procedure**

The unique melt rheology of B5008 necessitates special start up and shutdown procedures. It is important that feeders, blenders, transfer tubes and other pellet handling equipment be cleaned to prevent contamination by foreign pellets. All residual polymers from prior runs must also be purged or physically cleaned from the extrusion equipment. We recommend purging extruders and dies with LLDPE or LDPE (4–7 g/10 min MFI is recommended) at the normal processing temperature for the original resin prior to reducing the temperature to the desired range for B5008.

**Interruptions and Shutdown Procedure**

B5008 is susceptible to thermal degradation upon prolonged exposure to high temperatures. If the extruder is stopped for a considerable duration, it is recommended that the screw be kept turning at a slow rate (approximately 5 rpm) to continue purging the machine. The extruder can alternatively be purged with LDPE without changing temperature set-points. If the extruder stops with B5008 melt in the barrel, crystallization may occur in lower temperature zones such as the transfer pipe. If this occurs, these sections will need to be reheated to 175°C (350°F) to melt the polymer. The temperatures should then be lowered back to the recommended processing temperatures when extrusion is restarted. At the end of an extrusion run, a LLDPE or LDPE purge similar to the one mentioned in the start-up procedure should be used.