SINGLE-SCREW EXTRUDER - OPERATOR'S MANUAL

SPREADSHEET FOR EXTRUSION CALCULATIONS (Excel file)

1. Apparatus.

The extruder assembly consists of a screw pump equipped with a motor and a die, with instrumentation to control and measure temperature and pressure. The pump (SIESCOR) is a single screw, 3/4" diameter with a L/D ratio of 20. It is driven by a 1/4 HP DC motor (MINARIK). The motor is provided with a single reduction worm gear reducer with a ratio of 31:1.

Familiarize yourself with the extruder and its instrumentation before proceeding. The hopper feeds the pellets into zone 1 of the extruder; zone 2 is further along the screw. The die, a cylindrical hole of 2 mm diameter and 12.5 mm length, is attached to the extruder tip. Temperature and pressure of the melt at the die are sensed by the transducer located at the top of the die. Some safety precautions: The die is hot and should not be touched. The exhaust fans for the lab should be ON.

There are two heaters, one for each zone. Zone 1, zone 2 and die temperatures, and the die pressure, are displayed on the front panel. Temperatures are set by the operator; refer to the handout for appropriate values. The panel also displays the speed in rpm of the screw. Speed is controlled by a rheostat -- turning the dial from 0-100%.

2. Start-up Procedure.

1. Turn the exhausts (top and bottom) ON when you are ready to power up the extruder.

2. Make sure that the motor switch is OFF. Then turn the main switch ON.

3. Set the required temperature profile.

4. After the temperatures of all the settings reach their set points, wait for a minimum of one hour to melt the polymer inside the extruder. This is called the "heat-soak"; it is important because any solid left in the melt will exert undesirable high pressure on the die and foul up pressure readings. This procedure should be performed prior to class if possible.

5. After the heat-soak, you are ready to make a run.
6. Fill the hopper with polymer pellets and switch the motor ON. There are 2 switches. Run for 10-15 minutes before collecting data so that fresh polymer comes through the die. Periodically check the hopper.

7. Measure the flow rate by cutting and weighing the extrudate mass exiting between measured time intervals.

3. **Shutdown Procedure.**

   1. After collecting your data turn OFF the extruder motor switches.

   2. Next turn OFF the main switch. **BE SURE TO TURN OFF THE MOTOR SWITCH FIRST BEFORE TURNING THE MAIN SWITCH OFF.**

4. **Troubleshooting.**

   (1) **Pressure build-up**: You don't want the die pressure to rise above 2000 psi under normal operating conditions. If you observe pressures above 2000 psi turn the speed control down somewhat. If this condition persists even at low speeds (< 50 RPM, e.g.), check if the temperatures are set too low. Report to the lab instructor unusual pressure build-ups.

   (2) **Pellets in extruder discharge**: You should get polymer melt discharge from the die. If you observe pellets as a whole being pushed from the die, **stop the motor immediately**. You may not have allowed for sufficient heat-soak, or the die may require insulation.

   (3) **Degradation**: If the polymer stands at elevated temperature for a long time it will degrade. The color will turn yellow. The melting point and viscosity will be lowered. To get consistent readings don't keep the polymer at elevated temperatures while not running the extruder (except for heat-soak).