

3 Extrusion

This chapter describes some practical ways of improving energy efficiency when processing thermoplastic materials by extrusion. It covers:

- The extrusion process
- Reducing energy consumption in the extrusion process
- Action points for an energy efficient operation
- Case studies illustrating best practice and potential savings

3.1 The Extrusion Process

Extrusion is a continuous process used for the production of semi-finished goods such as films, sheet, profiles and pipes. Extrusion is a very broad technology that includes a great number of very different types of processes. Although the design of the die and some components of an extrusion line differ depending on the type of extruded product, in each case, the same stages of production can be found.

Plastic pellets are fed into an extruder through the hopper or through a gravimetric feeder if blends are used. The material is continuously fed this way into a heated barrel and carried along by a rotating screw. As it is conveyed it is compressed and melted. The screw is moved mechanically by a motor. The softened plastic is then forced out thorough a die, which turns the melt into the required shape, and directly into cool water where the product solidifies. An extrusion line typically involves six main stages (**Figure 3.1**).

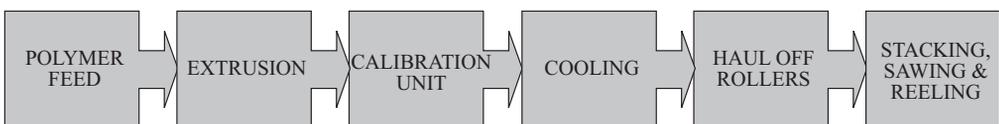


Figure 3.1 The six stages of the extrusion process

The two first stages are practically the same for all extrusion processes, but the other four stages can differ a great deal depending on the type of extrusion process.

From the previous stages, it can be seen that the extrusion process uses electricity in motor drives, extruder line ancillaries (e.g., heaters and handling), and general utilities such as cooling water, vacuum or compressed air. For the extrusion process itself (the process of melting and compressing the polymer in order to be feed it into the die), there are two main ways in which electricity is consumed: for heating and melting the polymer and for moving the molten polymer forward by the use of a screw connected to a motor. In the calibration unit, the main electricity consumption comes from the vacuum systems usually used for calibration and also for heating and cooling.

During the cooling stage, the main electricity consumption comes from the equipments required to keep the temperature of the refrigerating fluid cold (coolers, chillers, and so on). In the other two stages, the haul-off rollers and the stacking, sawing and reeling units - the main electricity consumption comes from the motors used for the movement of the rolls, the compressed air used for closing the rolls and, in some cases, from heating or cooling to keep the rolls at a certain temperature if needed.

3.2 Reducing Energy Consumption in the Extrusion Process

The first step, when implementing an energy reduction programme, is to detect where, when and why energy is being used and how much is being consumed. Producing an energy site map will help discover the points at which the greatest amount of energy is being consumed. In order to carry out this easily, these are some points that can be studied in order to define which areas have the largest energy consumption or where there is more energy waste:

1. Which areas have the largest load?

The largest extruders are most likely to have the largest motors and create the largest load when used. If it is not possible to reduce energy consumption in every single item or machinery inside a plant, then it is a good option to focus the energy reduction measurements in those areas that contribute the most to the total energy consumption.

2. Are the extruders adequately insulated? If not, why not?

Insulation prevents the heat from dissipating and therefore improves the efficiency of the heating and cooling systems. Moreover, if the equipment is well insulated, it is easier to keep the melt inside the die at a constant temperature which helps