

Extrusion Processes

The earliest extruders were used predominantly in rubber processing. The machines were short extruders because that process does not require melting per se as with plastics but merely softening and pumping through a shaping die. The traditional feed form of rubber is strips, which must be pulled into the screw by the screw's feeding flights and the feed section design features.

As plastics were developed, the extruder's design started to change in order to meet the new melting requirements. Barrel lengths increased, and heating of the barrel was more critical as the extruder needed to be heated in the 300–500°F range as opposed to the 100–200°F range for most rubber processing. The screw design for conveying rubber had to be noticeably altered to process the new polymers. Plasticating extruders as they are known today were first developed in the 1930s and 1940s as altered rubber extruders. Since that time understanding of the melting process has grown, as has processing experience with the various materials, leading to much more efficient designs of the extruders and the accompanying equipment.

Extrusion Concepts

Extrusion of thermoplastic materials can be accomplished through various means, depending upon the product being manufactured. Typically, extrusion with polymeric materials (plastics) involves a continuous operation as op-

posed to making a product with an intermittent process as done in injection molding. The various products made by extrusion include pipe, tubing, coating of wire, plastic bottles (blow molding), plastic films and sheets, various plastic bags (blown film), coatings for paper and foil, fibers, filaments, yarns, tapes, plastic plates and cups (thermoformed sheet), and a wide array of profiles.

Extrusion is accomplished by melting the material and forcing the melt through a forming die. The polymer material is fed to the extruder through a feed opening and can be introduced to the extruder in pellet (or cube) form or alternately as a powder, a granulate, or, in some processes, a melt. Extruders used in rubber extrusion and with some adhesives must accept a strip as the feed form. The extruders that are fed a melt are used for pumping to pressurize and to force the material through the die system or to aid in such parameters as cooling the melt from a melting extruder. The typical extruder is required to take a solid feed material and to melt, homogenize and pump the melt through the die system with acceptable output uniformity. The output consistency is measured by the uniformity of the dimensions of the finished product.

The extruded melt is continuously shaped and cooled by downstream equipment placed after the extruder. This sizing/cooling equipment can be comprised of cooling rolls, water tanks, vacuum sizing fixtures, air cooling tables, pulling devices, cutting equipment, coiling or winding equipment, and so on.

The extruders used to produce these products are overwhelmingly of the single screw vari-

By William A. Kramer and Edward L. Steward, Davis-Standard, Pawcatuck, CT.