



Fig. 4-1. Schematic figure of extruder. (Courtesy Davis-Standard)

extruder's performance and will be discussed in more detail in a later section. Much of the performance gains made by extruder manufacturers over the past 35 years have been due to improved screw designs. Numerous types of screws have been introduced over the years, some of them of great advantage while others are good for marketing but do little to improve the extruder's performance. Processors must recognize the benefits or shortcomings of particular screw design offerings to protect their interests and avoid the purchase of an ineffective design.

The extruder must produce its output (extrudate) within certain stipulations, as defined by the material, the end-product, and the process being accomplished. The extrusion goals and problem areas for various processes will be considered in a later section.

This section will cover the extruder's various functions and some ideas about how these functions can most effectively be accomplished. The basic function discussions will include feeding, melting, melt pumping, mixing, devolatilizing (venting) and the effects of some extruder add-on devices such as melt pumps, melt filters, and material preheaters.

Feeding and Solids Conveying

The extrusion process begins with the introduction of the material to the feed opening (feed throat) of the machine. The feed throat is lo-

cated in a section of the extruder placed between the gear reducer and the barrel. This feed section typically is made from cast iron with cooling passages molded into the unit, and is designed to accept a material container (hopper) over the feed opening. This part of the extrusion process is of extreme importance because the failure of a consistent feed source will impact negatively on the stable performance of the extruder. Often in production situations, an unstable product gauge or dimension results from some poor feeding factor due to the material, screw design, or extruder feed area design. Most extrusion processes today are using polymers in solid form, either pellet, cube, powder, or granule. These require the full plasticating (melting) abilities of the extruder and will be the material forms of most importance to this discussion. Alternate forms of feed, including premelted material, rubber strips, re-ground material, and so on, will be touched upon as appropriate.

The conveying forward of the solid particles of material along the early portion of the screw is initiated by friction between the material and the feed section's bore. The conveying forces theoretically can become very high in a short distance and hence could lead to very high pressures. Actually, the pressures in the first portion of the barrel typically are 500 to 4000 psi. There are some materials that can exhibit very low pressures in the rear of the extruder due to poor solids-conveying efficiencies.