melting process suggests that this melting continues in a well-defined pattern with the melt pool increasing in size as the solid bed declines in size until all is molten. This full melt condition optimally would occur before the material reached the die system to ensure a good end product. The screw channel does not normally maintain an organized melt and solid bed arrangement (as shown in Fig. 4-4) but instead exhibits a random breakup of the solid bed.

The breakdown of the melt/solids relationship in the screw channel leads to several potential extrusion problems. First, stability is adversely affected because of pressure surges created when the solids break up. This pressure variation typically is seen to start in the early (near feed section) to mid-barrel locations through the use of pressure recording devices. Should the pressure variations be large enough, the upsets can be seen all along the barrel and into the die system. Pressure variations in the die system relate to output variations and hence product irregularities. A second concern of the breakdown is that a less-than-efficient melting situation created by solids breakup can cause unmelted material to find its way farther down the screw and sometimes into the die system. Screw design can control the melting situation and/or damp out the negative performance aspects to some extent. (Screw features will be discussed in the screw design section.) The effects of solid bed breakup are magnified as screw speed is increased on conventional screw designs, a fact that has led screw design to today's specialized screw geometries.

The melting capacity of the extrusion screw must be satisfied by an ample amount of feeding capacity. This is handled through screw design.

Material Effects On Melting Performance. The materials being extruded have a great effect on melting performance, just as they can affect feeding efficiency. The amount of heat developed in the melt film is a function of the viscosity of the material and the effects of any additive. Just as lubricating additives can disrupt the solids friction that drives the feeding, they can have an effect on melting performance.

The melting rate of the material has a determining effect on extrusion melting performance. This melting rate is determined by such properties as thermal conductivity and specific heat. Any fillers in the material usually will alter the melting and conveying performance of the material to some extent. Polymer blends are quite popular today because of the properties available from each of the components. The makeup of the blend will affect the melting performance because of the varied melting characteristics of the blend's basic materials. These blends can create sizable screw design challenges in the efficient handling of the melting performance.

Inconsistencies in the material also pose a threat to extruder output consistency. The use of reground extruder scrap and off-spec product can lead to inconsistency due to varying feed particle sizes and differing percentages of the regrind as time passes. When regrind is used from thin gauge sheet or film extrusion, the bulk density of the feed material has an effect on the material's hopper flow and how the screw's feed flights are filled, which can lead to output reduction and at some point a starved screw. In processes that are controlled by feeding limitations, such as the starved screw case in low-bulk-density reground films, it is generally difficult to maintain good output consistency and high output rates as screw speeds are increased. Inconsistency of the base material due to its manufacturing accuracies can yield a feed material that will process with variations as the lot of material is used. The extruder's feeding and melting performance can be noticeably altered by these variations in the feed materials.

The form of the material being introduced to the extruder also has an effect on solids conveying and melting efficiency. The material forms available include pellets of various sizes, granulate (like sugar consistency), powders of various particle size, regrind of various sizes, and strips (as in rubber extrusion or some melt extrusion). The shape of the feed material usually is determined by either economics (cost/pound) of material manufacture or extrusion performance features. For example, the most economical form of rigid PVC is powder,