# Extruder Surging


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Instability of melt pressure and flow rate at the discharge end of an extruder is usually referred to as "extruder surging". This problem is easy to detect by monitoring melt pressure at the screw tip or in the die adapter with a high quality pressure transducer and fast response pressure indicator or recorder. The problem also may be observed by measuring product dimensional variations (but product variations also may result from other sources such as non-uniformity of cooling or haul-off speed).

Surging often can be eliminated by changing extruder screw design or by changing the extruder operating conditions. Usually, reducing screw RPM will reduce the surging problem: but this reduces the extruder output, which often cannot be tolerated. In designing the screw often a longer shallower meter section will help to reduce surging, but this design approach will sometimes result in overheating the polymer melt and reduce the output per RPM. Mixing sections, controlled melting barrier sections, or dual channel wave metering sections often can improve the melting rate, melt uniformity and melting process stability. Where screw melting capacity is a limiting factor, incorporating one or more of these special screw design features often will reduce the surging.

Many investigators have published technical papers that include measuring pressure stability at various downstream locations along the length of the extruder barrel wall. Typically, the pressure stability is much worse near the feed end of the extruder and progressively becomes more stable approaching the screw tip (for a single stage screw). Screws that typically operate stably over their normal RPM range often will become highly unstable as the screw speed is greatly increased to where the melting capacity of the screw is exceeded.

Of course, the feed and tapered transition section must be reasonably well matched to the meter section for surge-tree operation, but downstream metering and mixing sections often can do much to dampen out the pressure surging observed in the upstream tapered transition section of the extruder barrel. Some successful screws have much shorter tapered transition sections than others (extruding the same polymer), but an extremely short or extremely long tapered transition section is usually undesirable. Of course the preferred design depends greatly on the polymer being extruded. However, an extremely long transition section robs the screw turns available for feed, meter, and mixing sections. An extremely short transition section, even when following a very long feed section, usually leads to surging at high screw speeds.

No matter how well the extruder screw is designed, surging can arise from non- uniform feeding. For example, if the polymer bridges in the feed hopper sporadically and does not always fill the screw feed flights uniformly at constant bulk density, the screw will not perform uniformly. Most pellet feedstocks are sufficiently free-flowing to fill the feed flights uniformly except perhaps for some very small extruders or poorly designed extruder feed ports. On the other hand, powdered feedstocks or poorly mixed or excessively fluffy regrind blends may result in extruder surging, although the surging problem often can be minimized with a crammer-feeder or metered starved feeding.

— George A. Kruder

See also:

- Causes of extruder surging
- Correcting flow instability in coextrusion
- Feed throat cooling
- Flow surging
- Flow surging in single-screw, plasticating extruders
- Notes on polyethylene extruder surging
- Surging

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