Screw Flight Wear

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Screw Flight Wear
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Screw flight wear is an ever-present problem to all concerned with extrusion. I am asked frequently to consult on a problem of a screw which is significantly undersized due to abnormal wear.

Why does a screw wear at all? If on extruder screw were a perfectly straight and rigid member cantilevered into a perfectly straight barrel, screw wear would likely be a predictable figure. The facts of the matter are clouded by a deflection relationship for a horizontal cantilevered beam which equates deflection to the weight per unit of length, the fourth power of the length and inversely to the modulus of elasticity of the beam material and its section moment of inertia.

Three of these factors have changed little since extrusion with a flighted screw was begun. The weight per unit of length, the steel modulus of elasticity, and the section moment of inertia of a screw of a specific diameter is essentially the same today as it was from the beginning.

One dimension in screw technology which has changed significantly in recent years is the length of the screw cantilevered from its upstream support. Some of us remember the 4:1 and 8:1 L/D extruders of twenty or more years ago. Now we face the problems of a 28:1 or 36:1 L/D as an everyday occurrence.

Since deflection changes with the fourth power of the screw length, it is obvious that as screws have lengthened, their tendency to deflect into contact with the bottom of the barrel has increased exponentially. For this reason, a current standard length screw rotating inside a barrel may provide two unlubricated metallic surfaces in intimate sliding contact. This is a prime condition for galling.

Fortunately, most thermoplastic melts function as a lubricant between the screw flight land and the barrel to prevent destructive galling and rapid wear.

The problems inherent in establishing an acceptable rate of screw flight wear include:

1. Screw flight land width.
2. Screw to barrel radial flight clearance.
3. Screw flight hard surface alloy.
4. Apparent viscosity of the plastic melt being extruded.
5. The chemical corrosive activity level of the plastic.
6. The abrasive nature of any fillers compounded into the plastic.
7. Temperature of the barrel and screw flight land during operation.

A particularly vulnerable location for rapid screw wear occurs along the flights of the first stage transition and the upstream flights of the metering section. Many theories hove been advanced concerning the cause of this selective wear.

We will attempt to highlight a number of extrusion problems of this nature in the future.

- R. B. Gregory

See also:

- Barrel and screw wear
- Extrusion screw wear
- Feed screw temperature control in the single screw extruder
- More on screw flight wear
- Old vs. new extruders
- Vector forces in extrusion design

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