Extruder controls

When embarking on a modernization program or setting up new equipment for extrusion, it is necessary to decide how far to extend the "computer revolution" into plant operations. In many cases, it can be highly advantageous to extend process monitoring and to automatically correct processing deficiencies in response to sophisticated sensing devices and control programs. However, some control features are quite expensive and may prove to be inadequate unless problems are corrected that extend far beyond the optimization of electronic circuitry.

Usually, elaborate control systems can not correct for problems caused by a worn screw and barrel or inadequate drive torque or a poor screw design for the application. Likewise, such systems will not yield good temperature control unless all features essential to good control are well maintained. Obviously, burned out heating elements cannot be tolerated. Another common deficiency for liquid cooled extruders is "fouling" of some of the plumbing or an inoperative solenoid valve. When a barrel zone temperature controller maintains its set point within 1 degree F., this only means that the thermocouple position is being well controlled and not necessarily the whole zone.

It is generally recognized for single screw extruders that severe pressure fluctuations at the screw tip are highly undesirable. Unless a gear pump is installed at the end of the extruder ahead of the die, major output fluctuations will result from these pressure fluctuations. Fortunately, instrumentation is now available to sensitively monitor these pressure fluctuations in commercial extrusion operations, but many control systems are not set up for such monitoring. In fact, I have seen systems where the operators are less likely to notice pressure fluctuations than with an ordinary pressure gauge mounted at the head of an extruder.

I recently examined a sheet line with a widely sold extruder control system, where the management assumed they now had good control. Unfortunately, they had replaced the pressure gauge at the extruder head with remote sensing back to their consolidated control panel where a CRT would display pressure up in one corner of the "tube" if the operator selected one of several display options. The characteristics of the pressure fluctuation were fairly well damped out and seldom being noticed any more although they were much more severe than could be tolerated.

With the best of conventional controls an operator, foreman, or extrusion engineer can casually glance at a conventional control panel and gauges around the extruder and note (with fair certainty) whether the extruder is operating normally. He should be able to do the same and much more with "state-of-the-art" computerized process monitoring and control features. It is especially desirable that everything important in extruder control be displayed at all times or else that displays appear sequentially at frequent intervals (or be easily inspected in frequent data printouts). Otherwise, some thing important may go unnoticed unless signaled by an automatic alarm system.

If everything important is not displayed frequently, people walking up to the extruder can’t inspect how it is operating over an extended period of time without tying up the operator. If they start pushing the buttons themselves to call up various CRT displays, the operator may be left wondering whether they are changing his extrusion conditions unless he is standing at their side.

Ideally, extrusion should be a steady state process, but feedback control loops can be very worthwhile to compensate for process variations. Automatic adjustments to maintain product thickness control are especially worthwhile in many applications. However, no problem should be buried in a feedback control loop without communicating its existence and providing encouragement to minimize it. For example, it would be much more useful if the process monitoring identified a burned out barrel heater instead of adding more heat in adjacent heaters trying to maintain the zone barrel thermocouple set point.

In conclusion, progress in process control involves much more than the adoption of ever more sophisticated instrumentation and computers. Also, it is extremely important to understand how best to apply such equipment to our various extrusion processes.

- George A. Kruder

See also:

- Back to basics for profile extrusion

- Gear pumps - answers to questions
- Process uniformity
- Shop foremen

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