Further Comments on Barrel Profiles

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Many managers may have read the discussion on barrel profiles in the last newsletter ("How To Set Up A Correct Heat Profile" by Tom Black) and quickly calculated that three iterations of the procedure described could result in as much as 21 hours of lost production. With the burden of satisfying daily production schedules and maintaining acceptable levels of quality why "fix it if it ain't broke"? In addition, relations with operators don't need the aggravation of "change for the sake of change". The fact is the production expense is quickly repaid and the second shift operators would be glad to prove that they know what they are doing. With proper care and instrumentation quality will not suffer and could even be improved.

Twenty-one production hours seems like an eternity with anxious customers breathing down your neck. In a continuous extrusion operation at 80% utilization a 2% improvement in rate would pay back the lost production in 55 days. A 5% improvement would start paying for itself in a little over 3 weeks. For a 6" extruder at 2000 lbs/hr a 5% increase means 700,000 lbs/year in increased production. The potential benefits of optimizing a barrel temperature profile seem extremely attractive. There must be a downside.

Many extruders have made significant gains in rate by adjusting the barrel profile only to make "off-spec" product at very high rates. This is obviously to be avoided and in many operations the tools of avoidance are already in place. If not, the further investment in downstream pressure and melt temperature indication will be well justified. In order to insure the product quality, a stable melt pressure and temperature must be maintained. A pressure transducer should be located downstream of any filtration device and preceding the die.

A bulk pressure fluctuation of +1-2% would indicate an extremely stable operation. It is important to locate this transducer downstream to insure that the pressure oscillation due to the flight pulse is avoided. Most extrusion systems have a downstream melt temperature thermocouple. This is typically a fixed depth thermocouple located preceding the die. The fixed position thermocouple will point out any time dependent temperature fluctuations (i.e. machine direction). A variable depth thermocouple located in the same place will give the added benefit of monitoring the position dependent temperature fluctuations (i.e. cross machine direction). These simple devices give the operator a window into the extruder and a real time method of verifying melt quality.

A check of current production practices may indicate a stable head pressure of +1 -2% with a time dependent temperature variation of +1-2% and a position dependent temperature variation of +1-3%. Provided an acceptable product is being made this would be the yardstick against which the rate improvements would be checked. It may surprise many producers to find that the pressure and temperature stability actually improve as the barrel profile and rate are optimized. However at higher rates more of the energy to melt is input from the screw and less from the external heaters which may induce a cross channel temperature variation. Quite often pressure fluctuations are caused by inadequate feeding; optimizing the barrel profile to maximize solids conveying should improve the pressure stability as well.

There will be instances where the rate improvements will result in an overall reduction in melt quality. At this point the processor must determine if the reduction in melt quality creates an acceptable reduction in final product quality. As the final product is the ultimate test it may be that a slight reduction in melt quality is an acceptable price for the improvements in production rates.

With proper instrumentation and attention to the required and acceptable quality of the final product, the extrusion manager should be able to make production improvements with very reasonable paybacks following the simple procedure outlined by Mr. Black.

—Andy Christie

See also:

- Alternatives for extruder barrel construction

- Barrels with integral feed throats
- Causes of extruder surging
- Extrusion evaluation through pressure and melt temperature analysis
- Extrusion technology - some new findings
- How to set up a correct heat profile

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