## Monitor screw & barrel wear to avoid quality, production woes

A hard fact about plastics processing is that feed screws and barrels wear and need to be repaired or replaced in order to maintain production and quality levels. The clearance between the screw flights and surface of the barrel in a molding or extrusion machine is critical and should be closely monitored. "When part quality starts to fall off, the likely culprit is barrel or screw wear. Too much clearance can also affect a machine's performance, efficiency, and energy consumption.

Monitoring screw and barrel wear is a great troubleshooter--probably the first thing a processor should do if he is having mixing problems, because the melt is most likely moving back over the screw flights rather than being pushed out by the screw. The material starts to burn, resulting in dark specks and other defects in the molded or extruded parts. Feeding problems, loss of output, and an array of other problems can arise from worn barrels and screws. In an injection molding machine, wear problems can result in increased cycle time. In extruders, higher screw speeds would be needed to maintain output to compensate for wear.

Screws should be pulled and the flight OD and barrel ID checked on a regular basis as part of routine maintenance. Precision screw and barrel wear measuring instruments are highly accurate and easy to use, even by unskilled people. Portable electronic bore gauges can be fitted with extension handles, enabling them to be inserted into barrels over 30 ft long with additional supports to measure wear along the entire length. A mechanical head incorporates a transducer to convert the measurement data into electronic signals.

Prior to taking measurements, the screw and barrel should be thoroughly cleaned while still hot. Use a purging compound prior to pulling the screw to make removal easier, then use a wire brush and copper gauze to remove any plastic remaining on the surface of the barrel or the screw. Once a barrel is cleaned and allowed to cool to room temperature, a single operator can insert the electronic bore gauge in one end and take readings at every inch mark along its length to generate data on its condition. A foot pedal facilitates data acquisition.

A cable connects the bore gauge head to a digital display and/ or a portable printer. Each measurement can be seen on the display, and the data can be logged directly into a PC for further analysis or printed it out for a permanent record. User-friendly data-acquisition software allows immediate measurement data analysis and feedback. Electronic bore gauges are available in various sizes and capabilities.

Flight micrometers are used to measure wear on screw flights. Digital versions of these "mikes" are designed to quickly and efficiently measure the OD and depth along the screw. A single operator can take readings with a digital mike and log the data into a computer or print it out. The latest devices have large LCD readouts and provide absolute and incremental measurement modes, with readings to 0.001 in. The accuracy of these wear measurement devices is certified by their manufacturers.

Dial gauges can also do the job but are not as accurate, efficient, or easy to use. A regular mike and a parallel bar can also be used to measure flights, subtracting the bar width after each measurement--a tedious process. This normally takes a second person to write down the dimensions. Using a flight mike facilitates the process greatly.

Precision dial and electronic flight mikes range in price from less than $300 to about $1400 for very large flight micrometers. Electronic bore gauges start at under $2000 for models that measure bore ID from 2 to 6 in. and lengths of up to 20 ft. The price for an advanced model capable of measuring bore ID from 2 to 12 in. and barrel length of 30 ft or more runs about $6500. Additional extension handles are available for longer barrels.

These devices enable a processor to know the exact wear condition of the bore so that he can stay within the recommended clearances. For a new 2-in. screw/barrel, for example, the minimum wear clearance is 0.004 in., and the maximum clearance is 0.006 in. For a 6-in. barrel, the minimum clearance is 0.012 in. and maximum clearance is 0.014 in. A good rule of thumb is one thousandth per inch, per side. Screws should be rebuilt when they significantly exceed the maximum clearance.

If measurements are taken on a regular schedule, the processor can compare the readings to determine how much wear has occurred over the course of each period. With that information, he can predict when the screw or barrel will need to be replaced and can plan ahead for the required downtime before the machine is too far gone to make acceptable product. Taking wear measurements on a regular basis can also help maintain compliance with ISO 9000 and QS-9000 quality standards.

How often should you gauge? It depends on the processing operation. Some people will start losing production when the components wear beyond a certain point, so they inspect frequently and carefully monitor the condition of barrels and screws. That is especially important when producing medical tubing and components for medical devices, for which part quality is critical. Even if a plant is running black drain pipe, where quality is not the overriding issue, you still want to get good production out of that machine. High fill rates, of course, can accelerate wear, and the components thus need to be checked more often.

Productivity is the key. Why run three machines that are eating up energy when you may be able to tune them up and get them producing 40% more--so you can shut one of the machines down? Keeping the screw/barrel clearance between the recommended minimum and maximum readings is the way to do that.

**REPAIR OR REPLACE?**

At some point the processor has to make a decision whether to repair or replace barrels and screws. Repair services can do an excellent job of giving renewed life to worn components at less cost than replacing them. Barrels for injection molding are commonly resleeved in the worn sections and become serviceable again relatively inexpensively. Extruder barrels, however, often have to be resleeved along the full length, which is an expensive proposition. Unless the wear is limited to one end or the other, it isn't worth resleeving an extruder barrel.

The same thing applies to the screw. But once a screw has worn past a certain point, screw wear and barrel wear accelerate because so much of the melt is coming back over the flights. A worn screw can waste a lot of plastic material. It can be cheaper to replace a screw than to continue running the machine with significantly reduced production. It has been estimated that a 10% decrease in an injection molding machine's screw OD can result in up to 25% less output from the machine.

The return on investment for precision wear measuring instruments can be short in plants running many machines. They enable the processor to know when it is time to rebuild or replace a screw or barrel that has started costing money due to reduced throughput and high energy consumption.

Third-party, on-site service is available as an alternative to purchasing wear-measurement devices. A nationwide network of service providers can bring the precision measuring equipment to the processing plant and do the job there. That is a more cost-effective solution, with less downtime, than sending barrels and screws out to be inspected and measured off site. Regardless of who docs it, monitoring of screws and barrels should become a routine procedure at every plastics processing plant.

**ABOUT THE AUTHOR**

Ron Anderson is president and founder of Flite Technology Inc., Cocoa, Fta., a supplier of screws, barrels, and wear instrumentation devices. He can be reached at (800) 327-9310 or flitetech@gmail.com.

By Ron Anderson, Flite Technology Inc