Screws and barrels the focus of energy-savings efforts

By Tony Deligio

With the average kilowatt-hour (kW/hr) price for commercial users up more than 20% since 2000 in the U.S., and Europe's rates rising higher and faster (British utility E.ON lifted rates 9.7% in February alone), rising energy costs are very much on the minds of plastics processors.

"Sales were always output and productivity driven," explains Jeff Kuhman, president and CEO of screw, barrel, and valve manufacturer Glycon (Tecumseh, MI). "When you were quoting or trying to make a sale, you were talking output. It's just been lately that we look at energy."

The new focus on energy will likely be a lasting one given market drivers. In Britain, E.ON's impetus to raise rates was an 88% rise in wholesale electricity costs since February 2007. In the U.S., the Energy Information Administration forecasts that in 2008, the U.S. average for all sectors will be $0.094/kW/hr, with much higher rates in New England ($0.156), the Middle Atlantic ($0.129), and the Pacific ($0.109). Against this backdrop, suppliers of screws, barrels, and barrel-heating technologies have introduced energy-sipping technologies, which in many cases actually increase a machine's output.

Mix masters

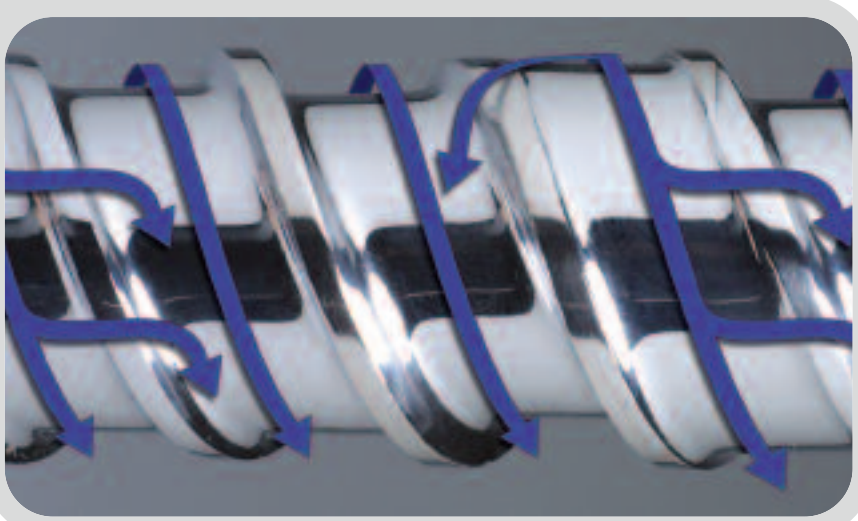
Glycon has undertaken an energy audit of its DM2 (distributive mix melt) screw, with data collection underway at six customers at the time of publication. Attaching power meters to machines before and after installation, Kuhman says his company's goal is to create a benchmark from which to gauge any improvements. The standard metric is the specific rate, or pound of material/hr/revolution a screw processes, giving the melting efficiency. Glycon also looks at the energy ratio, figuring the energy consumed per pound of resin processed.

With the DM2, Kuhman says the design applies thermal energy from the previously melted material to complete melting rather than using shear or external heat from the barrel heaters. This means that resin can be melted with much lower overall temperatures than would be seen with a barrier-type screw, because those screws primarily use high-heating shear to melt. Glycon instead applies "a controlled exchange back and forth between the melted and the unmelted material," according to Kuhman.

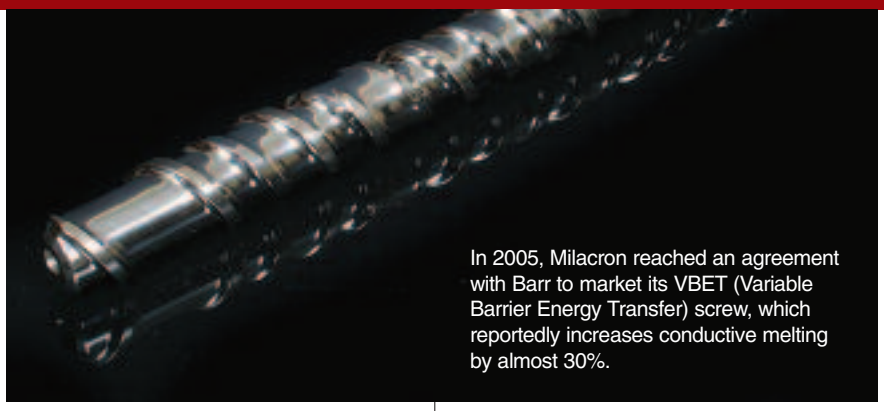
The key is the thermal "crossover zone" where 60-80% of the polymer is melted. This differs from conventional or barrier screws where 90-100% of polymer is melted by high shear. "When barrier screws came out, everyone's outputs went up," Kuhman says, "but so did their melt temperatures because that's a high-shear plastic-melting method in general."

To display the DM2's comparable benefits, Glycon offers the example of a sheet extruder running polyethylene. With a conventional barrier screw, the maximum screw rpms before the melt temperature rises above 500°F would be 55, resulting in 1550 lb/hr of finished product and a specific rate of 28. With the DM2, Glycon says the lower-shear design means that at 55 rpm the temperature is less 430°F, so that when the screw speed is boosted to 65 rpm the melt temperature will still be well below 500°F. Output at this speed is 2300 lb/hr, resulting in a specific rate 25% higher, at 35.

This summer Kuhman and Glycon



Glycon's DM2 (distributive mix melt) screw technology continuously mixes pellets so that already melted ones can be used to melt solid ones.

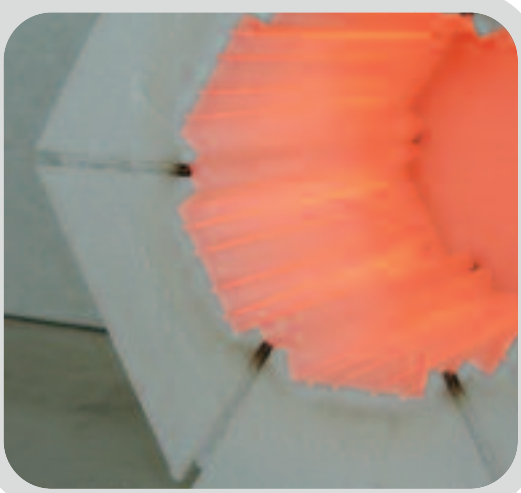


In 2005, Milacron reached an agreement with Barr to market its VBET (Variable Barrier Energy Transfer) screw, which reportedly increases conductive melting by almost 30%.

General Sales Manager John Phelan say they hope to have an improved version of the screw on the market that will boost the stability and open the process window. This will be especially helpful to processors who are running high volumes of post-consumer recycled material or any feedstock that has widely variable bulk density and melting behavior.

Machine-component supplier Spirex Corp. (Youngstown, OH) offers several low-shear distributive mixing devices, including the Pulsar II, which is installed near the discharge end of a plasticating screw. The Pulsar II's feeding and melting mechanism is the same as a flighted compression screw, but Spirex says the mixing is superior. In addition to comprehensive mixing, the company says the Pulsar II results in low melt temperatures and less back pressure, which both save energy.

Using ceramic fibers in a closed system, the TCS system promises to heat barrels faster—with greater accuracy and less energy use—compared to conventional heater bands.



Fully loaded barrels

Milacron (Cincinnati, OH), which offers screws, barrels, and machine components through its Servtek division, announced an exclusive Americas distribution agreement with Rex Materials Group (RMG; Chicago) in May for its TCS technology, which employs ceramic fibers for radiant heating of barrels, with no waste heat.

The Servtek TCS can be retrofitted on installed equipment or chosen as an option on new machines, with customizable fiber formulations and specific densities based on the application. Ritch Waterfield, injection-end product manager for Milacron, says TCS uses a heating element embedded into the surface of a low-density ceramic offset from the barrel. This compares to bands that need a tight fit to the barrel and can come with a jumble of wiring and fasteners. RMG's technology is more than 30 years old but relatively new to plastics processing, with Rex promoting it to the industry for just over three years. The company advertises energy savings from 30-50%, leading to return on investment in as little as 18 months.

Milacron and RMG say the technology is different since the fully encapsulated barrel keeps all the heat inside, allowing the barrel to get to temperature more quickly. This differs from insulated heat bands and water-cooled systems that must heat themselves before any heat can be projected to the barrel. The companies promise temperature control within one degree Fahrenheit, and the system's controls can be integrated into those of the machine.

Milacron Director of Marketing Bob Strickley says Milacron undertook an extensive evaluation of the system in its Batavia, OH plant, as well as at some customer facilities. Milacron is promoting TCS as one of its "earth-friendly technologies," joining the all-electric Powerline and Roboshot machines and Barr VBET screws. "Energy costs are higher, but so are resin prices," Strickley explains. "The increased attention to the issue of energy consumption has also resulted in improved molding accuracy, thus less scrap." The VBET has an established market of its own, with Waterfield estimating there are around 300 installed in the Americas today in use for a wide variety of applications.

At last year's K, machine component supplier Xaloy (New Castle, PA) offered up its own barrel-heating technology (see **MPW** September 2007 for initial report). Called the nXheat, the induction system is aimed for injection molding and promises barrel-heating energy savings of up to 70% compared to heater bands. Xaloy says more energy savings, up to 35%, can come from reduced air-conditioning load. More recently in April at Chinaplas, Xaloy launched the nXmix, which it says provides distributive and dispersive mixing action, inline on conventional single- and twin-screw extruders, but with low shear, process temperatures, and energy consumption.

There's a multitude of technologies on the market, but Milacron's Waterfield says any time used reviewing the offerings would be well spent. "The bottom line is that engineering attention to injection-end technology can make a huge difference for processors."

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