MODERN PLASTICS WORLDWIDE

Wear-resistant cladding helps compounder overcome problems

By Robert Colvin

Engineering resin compounder Solvay Advanced Polymers (Augusta, GA) found that by investing money it actually came up with a money-saver to protect extruders.

The company compounds semi-crystalline polyphthalamide filled with additives such as TiO_2 and up to 50% glass content on Coperion Werner & Pfleiderer (Stuttgart, Germany) extruders for value-added applications in automotive, electronics, medical, and construction. The only downside is that the abrasive ingredients cause premature wear in the extruders, slowing feed rates, and delivering inconsistent physical properties of the end product—the Amodel-brand family of PPA compounds.

Ken Bowles, equipment asset coordinator at Solvay says the company has been compounding such products since the early 1990s and worked with its OEM suppliers to improve the processes during the years. "Specifically, as we gained a greater understanding of our processes, we saw that wear caused by high levels of glass filler in our compounded products induced a lot of variability into our process," Bowles explains. "Over time we found our operation wasn't as repeatable from day-to-day as we'd like."

The processor needed to make regular adjustments to the extruder to compensate for wear but "it's never a desirable thing when you start to make changes from the norm to compensate for any factor," he says. During the first three years, the focus was on 'accepting' wear and dealing with operational changes to compensate for wear while trying to achieve the same production rate and product quality. Therein lies the rub, he says, since it is very difficult for operators to sustain these qualities during a four-shift, 24/7 operation.

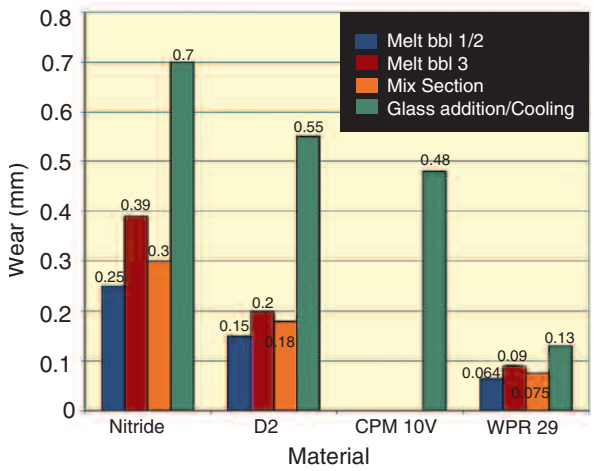
Bowles says wear data are just one part of the whole picture. The company needed to learn what the situation was and look at the cause/effect relationship of process variables. "Until the day we developed a disciplined program for measuring our barrel internal-diameter (ID) wear and our extruder element outside diameter (OD) on a continuous basis, we never knew what we had until we went off the chart," he says. "Then we'd begin to scramble and spend a lot of time making changes—at significant cost: but it was already too late. We already were out of control."

Customers want a very dense PPA product without entrapped air. Kelly McVey, marketing director at a provider of brazed tungsten carbide cladding for wear-protection applications, Conforma Clad (New Albany, IN), says Solvay customers need product consistency since they are often molding parts with only two or three pellets/piece, thus the concern over air entrapment.

Bowles says pellet density is a direct indicator of polymer density. As the extruder barrel begins to wear in key sections, shear is not eliminated from the introduction of glass in 3 mm average lengths produced from chopped strand. Higher shear results in a melt temperature increase to the point where the unit is 'out of spec' on pellet density. Oxidation can cause yellowing.

"When this happens, the only thing the operator can do is start to dial down the feed rate," says Bowles. "Obviously that's never positive, because in today's market, profitability dictates that we be able to run at optimum rates every day." Solvay therefore wanted to know at which point the process was no longer acceptable, either because of negative impacts on compound quality or lower output. The drop in output can be significant the company says, as much as 50%.

To adequately monitor the process, Solvay technicians measured the barrel ID and element OD and then correlated those measurements to their 'out of control' threshold. "We also had to look at other variables to make sure we'd truly



Results of different materials' wear potential as calculated in various sections of Solvay's extruders compounding high-glass-filled PPA show WPR29 brazed tungsten carbide cladding comes out on top.

defined a predictable cause-effect relationship for the process," Bowles says.

The first five years of research were spent defining the control point-of-no-return and understanding it through each barrel section (melting, mixing, cooling, or pumping).

Technicians characterized the wear rate of different barrel materials that were provided by its supplier, which included nitrided barrels, D2 tool steel barrels, and CPM 10V tool steel barrels and elements. "We found that as we got into a proactive approach, we were replacing barrels in key sections of our extruder...more than once a year," he says. "We sustained a significant cost of about $15,000 to $18,000/barrel. On average, two modular barrel sections had to be replaced on the extruder in less than a year so we had a $30,000 maintenance cost and a frequency that probably was closer to eight or nine months."

'Is that acceptable?' was the question Solvay had to ask itself but since the company had expanded from a single compounder to multiple extruders, the cost had gone up by a factor equal to $30,000 times the number of lines it has. Downtime, typically a two-day project to replace a barrel (cool down, clean, service, reheat, startup) was impacting Solvay's operations.

At this point the company decided, based on previous experience with WPR29 wear resistant cladding from Conforma Clad, to see if WPR29 could lower wear in selected extruder barrels. Bowles says Solvay was able to extend the lifecycle of key sections of its barrels with wear-resistant cladding from eight to 48 months. Out-of-spec material, downtime, and barrel replacement were costing the company up to $250,000 a line/yr. The first Conforma Clad WPR29 barrels were put into service in 1998. In 2001 Solvay established an extruder specification calling for cladding to be used on all barrels in new projects used for compounding operations.

"We don't necessarily apply cladding to every section that we have," Bowles says. Glass is introduced into downstream sections of the barrel following sections where the polymer, additives, and colorants are melted, mixed, and homogenized. In these upstream sections cladding doesn't have such a significant lifecycle benefit as where abrasive fillers and additives are introduced. "In our market, product quality is everything," he says.

"We put a better barrel in and it may cost slightly more up front," Bowles says. "But we don't have to worry about process changes needed to try to adjust for wear because now we have something that's going to last four times as long as what we had before."