The right plastics for design applications

NYLONS AND ACETALS

by Ticona

In many cases, nylons and acetals are chosen over other materials due to the advantages offered by their unique characteristics. Following are two cases where nylon was chosen for its precision, rigidity and durability; and where acetal copolymer was used for its lubricity, wear and fatigue resistance, and polybutylene terephthalate (PBT) was used for its compatibility with an epoxy adhesive.

Nylon 6/6 selected for retrieval tool

A professional hand tool for picking objects weighing 8 lbs. or less off the ground, the Nifty Nabber from Unger Enterprises, depends on a complex handle made of nylon 6/6 to do its job. The nylon resin was chosen over polyethylene, polypropylene, ABS and polycarbonate because it provides the right combination of precision, rigidity and durability.

The Nifty Nabber is used in outdoor cleaning and maintenance by janitors, landscapers, those in highway departments and others to extend their reach and avoid having to pick up trash by hand. It is also sold to the public to help those who have trouble reaching the ground or retrieving objects from shelves.

Niffty Nabber retrieval tool from Unger Enterprises with handle parts molded from Ticona's Celanese® nylon 6/6 by Mohawk Tool & Die.

The device has a two-part handle, one of which is a four-inch-long cylinder that slips over and press-fits into a one-inch-diameter aluminum tube. The other part is a five-inch-long ergonomic grip that fits into the cylinder and pivots on molded-in pins. A spring-loaded C-clip links the grip to a stainless steel strap running through the tube. Squeezing the grip pulls a strap that closes two rubber-over-molded-steel fingers at the end of the tube via a ratchet gear.

"We redesigned the Nifty Nabber as a multipurpose tool about five years ago and switched to nylon 6/6," said Roy Lusk, vice president of operations. "It was the only material we found that met all our production and end use needs, and it continues to do so."

Lusk added, "The plastic keeps its appearance and integrity in the face of temperature shifts from below 0°F to above 120°F, exposure to rain, snow and mud, and severe mechanical stress. It withstands years of rough treatment exceptionally well and, best of all, we've had no claims for defective handles."

The handle demands a lot from the plastic used. Unger's requirements include abrasion and chemical resistance, sufficient rigidity so the handle has little flex when squeezed, and lubricity so the plastic-on-plastic hinge does not wear out. It also needs a material with a low coefficient of thermal expansion so the cylinder on the tube stays tight as temperature changes.

"We evaluated many resins," said Bernard Bensussan, vice president of product development. "Polyethylenes were not strong enough and abraded too easily, while ABS lacked enough stiffness. Polypropylene was too brittle and turned white from stress when we snap fit the movable grip onto the pins in the fixed part of the handle. Polycarbonate was too stiff for the snap-in.

"We ultimately chose a glass fiber-reinforced grade of nylon 6/6 that met the many requirements we had. This grade also contains a UV modifier to prevent crazing."

The handle is produced for Unger by Mohawk Tool and Die, which also built the two-cavity tool that makes both handle elements simultaneously. Unger designed the part, which has wall thicknesses of about 0.1 inch, to limit tool complexity.

Celcon® acetal copolymer and Celanex® PBT thermoplastic polyester from Ticona are in key mechanical parts of award-winning Morph2 pens from A.T. Cross Company.

Acetal copolymer and PBT in award-winning Cross pens

When A.T. Cross Company, a maker of fine-quality writing instruments, created its award-winning Morph2™ Rollerball Pen line, it adopted acetal copolymer and a thermoplastic polyester (PBT) over acetal homopolymer in four of the pen's most dynamic parts. Acetal copolymer is used in components that propel the refill and adjust the grip so as to gain better lubricity and wear and fatigue resistance. PBT is used in the pen cap insert.

The Morph2 pen is a capless, gel rollerball pen having an adjustable grip that

promotes comfortable writing. Users shape the grip by rotating a dial on top of the pen and move the refill in and out by rotating the pen body. The pen won a 2002 Red Dot Award, which many consider to be the "Oscar" of design awards. The Morph2 pen is offered in three finishes – mercury, smoked vapor and blue graphite.

Acetal copolymer is used in the "mech driver" that moves the refill, because of its relatively low friction and resistance to fatigue. It is also used in the beam, which sits just beneath the grip. The beam has four fingers that expand and contract to alter the shape of the grip. Another part, the anchor bushing, surrounds and aligns the refill. This cylindrical element extends from the mech driver to the front of the pen. It, too, is made of acetal copolymer, because of its exceptionally low wear and elimination of squeaking as the bushing turns.

Another component, the cap insert, which seals the pen mechanism and has threads for the external assembly, uses polybutylene terephthalate. PBT was chosen because it forms a strong bond with the two-part epoxy that glues the cap insert to the pen's outer shell. PBT replaced an acetal homopolymer that tended not to glue well to the outer shell.

"Recently we did a great deal of testing before adopting acetal copolymer to ensure it posed no problems," remarked Vinay Malur, senior plastics engineer in the A.T. Cross Technology Development Group. "The many molding and end use benefits the material offers were so striking that we converted 63 other parts in 17 different product lines to acetal copolymer from acetal homopolymer and other materials.

"We found, for instance, that acetal copolymer has greater lubricity than acetal homopolymer and withstands 100,000 propel-repel cycles in the lab with much less wear and tear. And, unlike the homopolymer, the copolymer does not react with the color concentrates we use in the Morph2, so the parts retain their dimensions and strength better."

Compared to the homopolymer, acetal copolymer allowed A.T. Cross to significantly reduce cycle times in its multicavity molds. Malur says acetal copolymer flows well, has a broad processing window and can remain in the injection molding barrel at temperatures more than four times longer than the homopolymer before degrading.

"The acetal copolymer has greater dimensional stability after molding than the homopolymer," Malur said. "Parts made from the copolymer usually complete shrinking in well under 12 hours after molding, while acetal homopolymer needs 72 hours. We also find that the copolymer is easily recycled, while the homopolymer cannot be recycled readily."

As added incentives, Malur noted that acetal copolymer is available in many more grades than acetal homopolymer. "Beyond the material itself, we have also received strong technical support from the material supplier throughout the design and development process from material selection to molding," he said. "Our R&D group greatly valued their assistance." ■

Ticona, a Business of Celanese, produces and markets a broad range of engineering polymers. For additional information, contact: Ticona, 8040 Dixie Highway, FLorence, KY 41042 USA; (800) 526-4960, fax (859) 372-3125, e-mail: prodinfo@ticona.com, www.ticona.com.