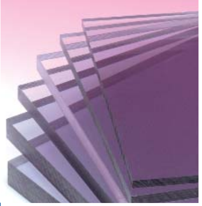

productfocus

Routing polycarbonate material

POLYCARBONATE

by Van Niser

Polycarbonate was commercially developed in the 1950s, and has proven to be a versatile material for use in the plastics fabrication industry. Thermoformers and sheet fabricators utilize polycarbonate for a variety of applications because of the outstanding impact strength and excellent machining characteristics of the material.

Tooling

In terms of routing, polycarbonate can best be categorized as a soft plastic. This necessitates the use of "O" flute tools, which are distinguished by a half moon design in the face or flute area of the router bit. These single and double edge tools are manufactured from high-speed steel for hand fed applications, and solid carbide for CNC machinery. The high-speed steel material is only available in straight flute configuration, while the solid carbide material utilizes straight and spiral flute geometry.

The choice of straight or spiral flute router bits depends greatly on how the user wants to influence the chip. A general rule to follow regarding influencing the chip is to use "O" flute straight or downcut spirals on thermoformed parts where lifting the part can be problematic.

Sheet fabricators on the other hand are more concerned with chip removal, and should employ upcut spirals with "O" flute geometry to adequately remove chips from the workpiece. These general recommendations can be further quantified by visiting www.plasticrouting.com. This web site, which is jointly sponsored by IAPD and Onsrud Cutter, provides specific tool recommendations based on a variety of manufacturers offering polycarbonate material.

> Visit www.plasticrouting.com to help you select the proper tool for a specific plastic material. It also includes many routing tips, material information and advice from Van Niser.

Figure 1. Single edge "O" flute straight (61-000P series)

Figure 2. Double edge "O" flute straight (56-600 series)

Figure 3. Single edge "O" flute spiral (63-750 series)

Figure 4. Double edge "O" flute spiral (52-600 series)

After the proper tool has been selected, there are other considerations including rigidity, and of course, programming for the CNC user to provide a successful routing operation. The tool selection process can be for naught if proper techniques are not followed in the aforementioned areas.

Rigidity

Rigidity is key regardless of hand fed or CNC applications. Rigidity applies equally to the machine itself and to the fixturing of the components to be routed. Machine rigidity for hand fed application where electric or air routers are employed mostly involves the maintenance and replacement of the collet system. However, the air router requires the replacement of bearings and spindle vanes on regular intervals to maintain rigidity. Also, the air router must have a minimum of 90-PSI air pressure to maintain horsepower and utilize tools properly toleranced for air routers to insure rigidity.

In CNC routing, properly lubricated and maintained machine slides and drive systems are essential to optimizing feed rates and productivity. Preventative maintenance of CNC routers is critical to long-term operation where part surface finishes are critical.

While machine rigidity is vital to consistent performance, fixturing is equally important to the surface finish on each machined part. Fixtures should be rigidly built and mounted to the work surface. Vacuum supply should be oversized whenever possible and hard fixturing should be securely mounted without opportunity for movement. When dealing with 5-axis fixtures, unsupported edges should be minimized and vacuum distribution should be maximized at the cut area. Also, friction enhancements such as rubberized coatings and gasketing sheet foam may be utilized. A previous article in the February/March 2002 issue of *The IAPD Magazine* (pages 36-37) can be reviewed to further explain the importance of spoilboards and fixturing in the machining of plastic.

Programming

Once the tool selection process has been finalized and all facets of the operation are rigid, programming the feed and speed along with the tool path become paramount. The feed and speed of the machine not only dictates cycle time, but it dictates the creation of chipload. Chipload is the actual thickness of the chip and is influenced by the feed, speed, and number of cutting edges on the router bit. (Chipload = feed rate/(rpm x # cutting edges).

The optimum chipload to achieve the best finish seems to be in the range of 0.004 to 0.012. In the case of polycarbonate or a soft plastic, this provides the best finish by properly curling the chips during the routing process. The web site, www.plasticrouting.com, not only provides tool selection, but also quantifies feed and speed and thus proper chipload for a variety of polycarbonate materials.

Another important programming feature is the choice of tool or feed direction. In machining, there is climb cutting (clockwise direction) and conventional cutting (counter-clockwise direction). In most cases, conventional cutting provides a better part, but the user should always compare the finish of the scrap to the finished part to identify which edge is better. If the scrap is better, reverse the cut direction.

Cutter entry and scrap can be particularly problematic in routing plastic. Plunging directly into the part gives no path for chip removal and can cause chip wrap, deformity or melting of chips to the part. This can be avoided by programming the machine to enter the part from the side or ramp into the part, thus providing a path for chip removal and avoiding all the problems mentioned with plunging. Scrap should be minimized to avoid part ejection, vibration, poor finish, and quite possibly, tool breakage.

Conclusion

Polycarbonate is relatively easy to machine when the proper tool is selected. Best results are achieved when good routing practices such as rigidity and proper programming are utilized. ■

For further information, contact Onsrud Cutter LP, 800 Liberty Drive, Libertyville, IL 60048; (800) 234-1560, fax (847) 362-5028; www.onsrud.com or www.plasticrouting.com.