Preparing for Plastic Routing
Part 2

As companies make the transition from the routing of wood or aluminum to the machining of plastics, there are a number of preliminary procedures and considerations that can help ease the conversion and ensure a smooth transition. Periphery factors in the routing of wood and aluminum can become some of the most significant aspects of plastics machining. Good planning and preparation can help ease these factors and the costs associated with the startup of a new machining process.

This article is the second of a two part series that discusses the need to have active preparation when making the transition from wood routing to plastic routing. Part 1 discussed the CNC router and its associated hardware. Part 2 will discuss tooling and material selection as well as programming considerations.

Material Selection

Depending on the customer's requirements, fabricators may have leeway in specifying exactly what material they will have to rout. This is an important option and should be taken advantage of whenever feasible in order to reduce machining headaches down the road.

Some plastic sheet manufacturers produce variations of their common sheet goods that are marketed as having improved machining characteristics. By all means, try these. They typically produce better chips, do not melt or scar as much and can sometimes reduce the problems associated with chips wrapping on the cutters during plunging operations.

Various grades of the same type of sheet can exhibit tremendously different routing characteristics. UV protectants can inhibit good chip formation, fillers can cause premature cutter wear, and different sheet colors can affect the quality of the edge finish. Some grades may even be listed as co-polymers. These co-polymers may be listed as a single sheet type but frequently contain a second plastic in the formulation. It is better to test cut new grades before estimating tooling costs and routing times because of these issues.

Another characteristic to verify with sheet manufacturers is if the material exhibits different machinability going in the extrusion direction or across it. This can be thought of as cutting with the grain or cross-grain. Most plastics do not react differently in regards to extrusion direction, but the few that do have caused some fabricators many headaches.

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Tooling Selection

Tooling selection should be considered early during the preparation process. While it will be nearly impossible to gage tool life (and therefore costs) if it is a new process and/or material, tooling selection may greatly impact cycle times, fixturing costs, programming needs, and material waste. Across the major tooling manufactures in the U.S. today, there are over 90 style of dedicated plastic tooling with 700-800 tools to choose from. Narrowing your choices down to 1 or 2 tools or styles of tools from a particular manufacturer can help you determine material removal rates, chip extraction direction, and the best diameters for your applications. This can factor in heavily when later trying to design fixtures and determine optimum cycle times.

Programming

The very first consideration during programming is cut direction. For almost every plastic used by fabricators, conventional cutting will yield a superior edge versus climb cutting. The exceptions are typically composites or combined materials. While conventional cutting is very often the norm in routing (as opposed to climb cutting during milling), nesting software that seeks to increase raw material yield and cycle time by reducing the number of cuts per plastic sheet can force tooling into a climb cut configuration. If this style of software is used by fabricators, test cuts should be made to determine whether or not the climb cut edge finish is acceptable. If it is not, raw material usage and cycle times need to be re-evaluated.

Another programming consideration is plunging. Many soft plastics can exhibit severe chip wrap on the cutter after repeated plunges. Many hard plastics can craze or "spiderweb" depending on tool geometry, plunge speeds, spindle speeds and fixture support.

The most reliable method for solving chip wrap is ramped cutter entry. This prevents the chips from forming in a continuous curl and will work 100% of the time. Ramped entry requires special attention to the location of entry holes and the location of nearby cut paths. Other methods of solution involve pre-drilling of entry areas and specially designed router bit point geometries.

Similar to soft plastics, poor plunge finishes on hard plastics can be solved through a variety of methods. Ramped entry will once again yield consistent finishes but is not the only method. Craze-resistant grades of many popular plastics are available and can withstand the plunge pressures of standard router bits. Solid fixturing with support directly underneath the entry point can also improve the consistency of plunging operations. Special point geometry on cutting tools is typically the last resort in these types of materials. The best thing to remember when cutting holes in hard and soft plastics is that router bits are for making traversing cuts and drills are for making repetitive holes. The geometry of drills is far superior to that of router bits for plunging and they should be used whenever possible.

A final programming consideration should be to part fixtures. High quality, rigid fixturing methods are essential to maintaining premium edge finishes and there are programming methods that can enhance the adhesion power of various hold-down methods. In three axis routing, a common method of increasing holding power is to leave the paper masking on sheet goods and to rout through the plastic, but not the bottom masking sheet. This ensures that the vacuum is not lost and provides extra vertical and lateral grip on small pieces. Routing in this method requires extremely flat spoilboards and may require frequent surfacing of the spoilboards to maintain their surface dimensions depending on humidity and temperature variations.

Five axis routing programs can benefit from higher spindle speeds that reduce the size of the chips being formed and consequently can reduce the force being applied against the fixtures. Multi-flute tools can also be used to achieve this benefit, but they are susceptible to increased instances of melt and accelerated cutter wear.

The order of operations in the CNC router program should also be examined for areas of improvements. Small cuts and pockets should be made first to utilize the vacuum area under scrap material. By making large part cut-outs last, scrap material can be fixtured the same as finished material and assist in part hold down. Multiple depth cuts, skin cutting or tabbing can also be utilized during programming to improve part hold-down, edge finishes, and feed rates.

Advanced planning in the areas discussed in this article and the last article - Materials, Tooling, Programming, Runout, Collets, Vacuum, Dust Collection, Coolant - can help prevent some of the common missteps that are associated with startups of new jobs or processes. Addressing these issues can ensure that the tools, equipment, and programs are ready for use when the job begins and that the run costs are inline with the estimated costs.

Van Niser
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