Real World Routing Solutions: Part 2

This article is the second in a four part series of articles designed to bring to light some common routing problems and the tooling and/or process changes that became the solutions to the problems.

Sometime in the early 1980's, dedicated router tooling for plastics began to take shape. Since then there have been leaps in technology from all areas in the primary plastics market including material composition, fabrication, machines, and machining. Each area has gone through growth spurts that has surpassed the capabilities of the other areas, which in turn has led the other industry sectors to improve their R&D work and leap ahead again. While this rapid growth has created a large and viable plastics market, it has also lead to confusion about methods and practices when it comes to producing these in-demand plastic products. With an ever increasing burden on the plastics fabricator to produce parts faster and with better finishes, companies are looking for more and more technical assistance from suppliers in solving these problems.

Onsrud Cutter has spent twenty years visiting these plastic producers and plastic fabricators as well as the machinery manufacturers that utilize the router tooling market in order to gather information to help with both advanced tooling design and application support. Over this time, a number of application problems have been observed that are significant to a large segment of primary and secondary fabricators. In line with this experience, OC presented three scenarios in the last issue and will present nine more over the course of the next three articles that illustrate real life applications and the actual tooling solutions that were implemented to solve either a manufacturing problem or a production problem.

SCENARIO 1

Material Cut: ABS and extruded Acrylic
Product: Covers for surveillance cameras
Router Type: 5-axis CNC
Feeds & Speeds: 18,000 RPM at 100ipm
Initial Tooling: Straight flute generic plastic tooling

Problems:

Initial call to Onsrud Cutter was placed because of supply problems related their current tooling vendor.
No tooling complaints were initially presented.

This scenario is very typical of what happens in many manufacturing and fabrication shops: Tooling users become comfortable with a particular tool and do not continue to look for newly developed advanced tooling that can increase production and bottom line profits. After an on-site visit with this fabricator and some experimentation, a new tool was found that allowed significantly increased feed rates and at the same time exhibited increased surface finish quality and cutter life.

Using a standard spiral "O" flute with geometry modified to allow it to cut both ABS and soft acrylic, the customer was able to increase feed rates from 100ipm to 250ipm (decreasing part production cycle times and cost) and was also able to drop spindle speeds from 18,000 RPM to 16,000 RPM (increasing cutter life). This was all accomplished with an improved surface finish on the final part and using ¼" diameter and smaller tooling.

A second problem brought to light in this scenario was the desire by the customer to use a single tooling style (with various diameters) to handle machining of multiple types of plastic. Normally this is against the trend of tooling suppliers developing advanced tooling that is very application specific. As feed rates increase and surface finishes becomes more and more important, there will be a significant decrease in the availability of “generic” plastic tooling. New tooling is designed for specific applications and it is extremely difficult to find an optimum cutter geometry when multiple materials being cut require different machining parameters. This customer was lucky, but this scenario is going to become the exception, rather than the rule, as feed rates and CNC router technology continue to advance.

SCENARIO 2

Material Cut: Lexan
Product: Fabricated parts for the electrical industry
Router Type: Newly purchased 3-axis CNC
Feeds & Speeds: 2,500 RPM at 25ipm
Initial Tooling: Plastic End Mill

Problems:

The new (and expensive!) CNC router was not paying for itself.

As more and more people leave the metal-working industry and move into the primary and secondary plastics fabrication market, these problems will continue to appear. CNC mills are designed to machine metals and they are very efficient at it. Fifteen years ago or more, their use in the plastics industry began to sky rocket. They were able to make intricate, multi-axis cuts on a large variety of soft and hard plastics and were typically much more efficient and effective than other methods available for producing complex finished parts.

Unfortunately, these were the days when CNC routers were not common technology and those that existed did not have the multi-axis capabilities and/or rigidity required for complex parts and acceptable surface finishes. With the router technology today, feed rates are 5 to 10 times faster and these feed rates are achieved with higher surface finishes and much less programming effort. In order for these processing parameters to be realized, however, proper tooling must be used. End mills are designed to run at end mill speeds (up to 10,000 RPM and 150ipm) and do not complement a CNC router that is capable of spindle speeds beginning at 9,000RPM and approaching 30,000 RPM with 1000ipm feed rates or higher. It is impossible to justify the cost and return-on-investment for a machine that’s cost can exceed several hundred thousand dollars when it is run the same as a CNC mill.

By convincing the customer (and the machine operator) that router tooling was designed to perform best at high spindle speeds and feed rates, Onsrud Cutter was able to show the increased chip extraction available as well as the subsequent productivity and surface finish improvement. The end result was the use of a ¼” diameter dedicated plastic straight “O” flute with feed rates at 150ipm and spindle speeds at 16,000 RPM.

SCENARIO 3

Material Cut: Acrylic and ABS
Product: Vacuum formed parts of various configurations
Router Type: 3-axis CNC

Feeds & Speeds: 18,000 RPM at 90ipm
Initial Tooling: 3-wing slotting cutter with arbor

Problems:

Part damage and programming concerns

This scenario is similar to the first in that the customer was unaware of new dedicated plastic tooling that was designed to be an “instant fix” to their problem. The customer was using a slotting cutter designed for wood to remove flash from a variety of formed parts. The geometry of the slotting cutter, as well as the large retaining nut at the bottom, were causing numerous problems such as material melting, scarring, and occasional damage when the programmer failed to check for adequate clearance between the retaining nut and the material.

The solution was to use dedicated plastic saws designed specifically to run on a CNC router through the use of an arbor. Tooling such as this is being constantly designed and marketed to prevent plastics manufacturers and fabricators from having to “make-do” with tooling that was designed for another industry or application. By increasing the tooth count to 10 or 20 teeth (ABS and acrylic respectively) on a 4-1/2” arbor mounted saw, the customer increased feed rates to 150ipm and eliminated virtually all post-cutting inspection and rework operations. (As a side note, their CNC programmer was much happier as well!)

The preceding three scenarios all illustrate two important facts about router tooling: 1) Router tooling is designed for very specific applications and must be chosen and run accordingly. 2) There is continuing advancement in the router tooling industry (just as there is in the machine industry) and plastic manufacturers and fabricators must constantly scan the market place for application specific tooling to solve their problems or increase their productivity.