

## Engineering application-specific superabrasive tools

### SIMILAR TO OTHER TYPES

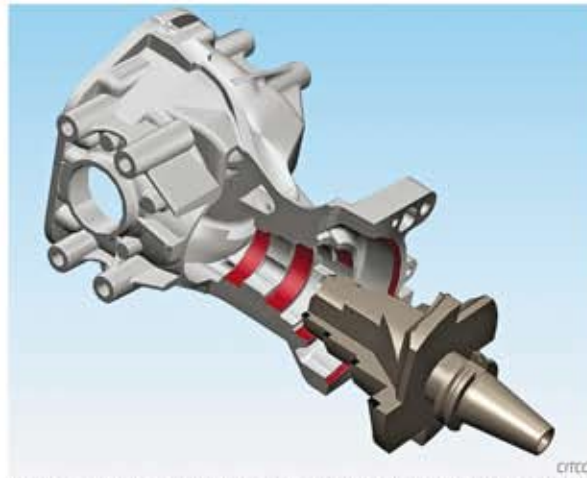
of cutting tools, off-the-shelf superabrasive tools are becoming commodity items. Application-specific PCD and polycrystalline cubic boron nitride specials are an exception, and CITCO Products, Chardon, Ohio, is one toolmaker that produces such tools.

An end user going through an optimization process may feel that his application is completely unique, but it's likely that similarities exist with applications at other manufacturers. CITCO gathers case history information so when it needs to develop specials, that information can help determine what specific tool geometry and PCD or PCBN grade is appropriate based on similar applications, according to Ed Galen, sales manager for CITCO. "We do a lot of testing and database accumulation," he added.

Besides accumulating data about an end user's workpiece material, toolholders and type of coolant—if any—being applied, a customer's equipment capabilities plays a major role in designing superabrasive specials. "In many cases, the equipment itself will dictate to a large extent what you can do with the tools," Galen said.

Purchasing or upgrading a machine tool or other piece of equipment to achieve the process requirements is typically not an option. "Usually, the customer says, 'I've got this job, I want to run it on this piece of equipment and don't tell me I need to buy a new piece of equipment,'" Galen said. If a machine isn't capable of running at the required parameters, for example, or meeting tolerance specifications, CITCO will recommend a piece of equipment that should. "There have been cases where customers said they don't want to do that, and then we say, 'Sorry, we can't help you.'"

Galen said about half of end users switch from carbide to superabrasive tools to achieve their goals, often after testing other carbide tools because sometimes they're trying to avoid costlier superabrasive tools or reduce tool costs even when a superabrasive tool can



**A Dipax D3-grade differential bore finishing tool from CITCO replaced three carbide tools and reduced cycle time from 2.6 minutes to less than 1 minute. According to CITCO, the initial tool has been in operation for 18 months and shows no sign of wear.**

reduce their cost per part.

"We've found, in most cases, that if you can reduce cycle time or increase tool life by a relatively small percentage," he said, "the cost of the tool doesn't mean much of anything in the equation."

Combining multiple operations into a single superabrasive tool can result in a tooling solution with a high acquisition cost, but one that is cost effective when focusing on the cost to use. The percentage being saved to justify switching to a superabrasive special depends on the company and application, but Galen said the rule of thumb is 15 percent. "Some companies realize that a 5 percent savings on something that's costing \$20 million to produce is a huge savings," he said, "but there are others that if they can't show 15 percent, then it gets lost in the shuffle. Ninety-nine times out of a hundred 15 percent will catch somebody's attention. If you're under 10 percent, they'll attribute it to luck."

Cost, however, isn't the only factor when considering switching to an application-specific superabrasive tool. In one application, CITCO replaced a carbide drill for creating a valve hole with a PCBN-tipped drill with a K-land hone. The new drill reduced production costs by only 12 percent. The customer, however, was experiencing a quality problem with valves

sticking, which was eliminated by switching to the slower-wearing PCBN drill.

The PCBN tool costs \$275—\$119 more than the carbide one—but the customer was able to complete 23 parts per hour with the new drill vs. 20 parts per hour previously. The PCBN drill is run at a spindle speed of 4,800 rpm and a feed rate of 21 mm/min., while the carbide drill ran at 2,300 rpm and 18 mm/min.

"He went from 700 parts per tool to 1,000 parts per tool, which hardly sounds like it would be enough to justify almost double the price of the tool, but when you work up the increased output,"

Galen said, "the labor costs went from \$7.25 to \$6.30 per part," using a labor and machine overhead rate of \$145 per hour. He added that the tool cost increased about 5 cents per part for a net savings of nearly 90 cents per part. The customer consumed 35 tools per year for the application, resulting in an annual savings of \$31,454.06.

Sometimes a newly designed tool costs less than the previously applied one and reduces production costs. That was the case when CITCO replaced one PCD tool to machine an aluminum differential housing with a Dipax D4-grade PCD boring tool. The old tool cost \$112 and produced 12,000 parts, and CITCO's is \$89 and produces 20,000 parts.

When switching tools, the customer didn't make any changes in the machining parameters of a 3,200-sfm cutting speed, a 0.008-ipm feed and a 0.020" DOC and therefore the production rate was identical at three parts per minute. But extending tool life meant that the parts manufacturer didn't have to produce as frequently a production-delaying inspection report on the first part machined after a tool change.

—Alan Richter

For more information about CITCO's PCD and PCBN cutting tools, call (440) 285-9181 or visit [www.citcodiamond.com](http://www.citcodiamond.com).