

▶ BY ALAN ROOKS, EDITORIAL DIRECTOR

Greenleaf C4 milling cutter in action. The cutter is using WG-300 whisker-reinforced ceramic inserts and is cutting hardened steel.



Greenleaf Corp.

Cutting Carbide?

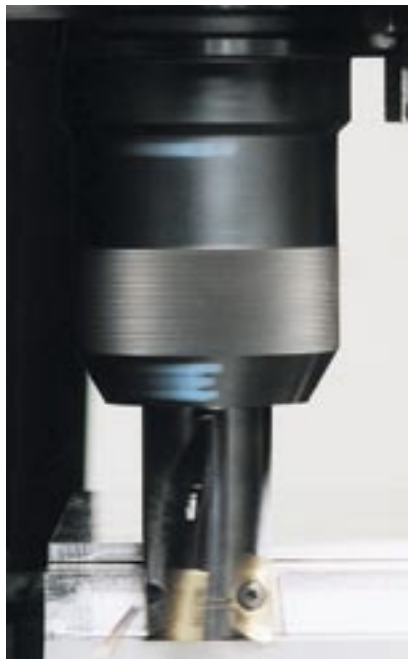
Sky-high carbide prices add momentum to indexables trend.

For John Greenman, tool crib manager at Classic Turning Inc., Jackson, Mich., the main problem with solid-carbide tooling is obvious. "Today's prices are ridiculous. Every time I order another piece of carbide it seems like I'm paying more for it than the last time."

This is a major incentive for change, he said. "We will look at new indexable product at any time. We are running only about 35 percent indexables right now, so we still use a lot of solid carbide, but any time there is new indexable technology out there, we try it."

Greenman's views are on the mark. According to several reports, solid-carbide tool prices have jumped 60 to 70 percent over the past 2 years due to skyrocketing prices for ammonium-paratungstate powder, which is used to make WC (tungsten carbide). Prices for indexable inserts, on the other hand, are relatively stable. The price problem grows exponentially with solid-carbide tools over 1/2" in diameter.

Cost and other factors have led tool users to take a renewed look at indexables and other cutting tools that



Kennametal Mill1 cutter with a replaceable insert.

Kennametal

use replaceable inserts. Advocates cite benefits such as flexibility, ease of use, higher productivity, lower inventory requirements, and reduction or elimination of tool change-outs, resetting and reconditioning.

Several cutting tool manufacturers and machine shops interviewed for this article noted a steady trend toward indexables, which has accelerated over the past 2 years. They characterized solid-carbide tool sales as "stable" or growing slightly, while claiming annual sales increases ranging from 50 percent to 200 percent for indexable tooling.

However, this doesn't signify the end of solid-carbide tooling. Many applications—including mold and die work—still require solid carbide. And the benefits that made the hard metal a standard in the first place—such as rigidity and low vibration levels—are still valid today (see Figure 1).

A Multifaceted Market

Tim Marshall, global product manager—milling, for Kennametal Inc., Latrobe, Pa., doesn't think the trend away from solid carbide is due to higher raw material costs alone. "I'd say it's because there are more [size] options available, with end users choosing indexable tooling for smaller diameters," he said.

Bill Greenleaf, marketing communi-

cations manager for Greenleaf Corp., Saegertown, Pa., said high carbide prices have created a new openness to trying indexable tools, such as his company's ceramic inserts. "Cost is a driver, but the need to improve productivity is perhaps even greater," Greenleaf said. "I can't think of anyone who has come to us looking to convert from solid carbide for price alone. Instead, we see customers who want to improve productivity. These customers are pleased to discover the stable prices of indexable ceramic tools when compared to carbide."

The productivity advantage is a critical factor in the success of indexables and other inserts since tool costs are actually a small percentage of total shop costs—about 2 to 3 percent. According to Bob Jennings, product manager, Ingersoll Cutting Tools, Rockford, Ill., using indexables and other inserts instead of solid-carbide tools maximizes production time by dramatically reducing time needed to change cutting edges. For example, to replace a solid-carbide drill, the operator takes the old one out, puts in a new or reground drill, reprograms the machine, touches

Figure 1: Guide to using indexable vs. solid-carbide endmills.

When to use indexable endmills	When to use solid-carbide endmills
Facemilling cuts: roughing and finishing	Precision cuts
On high-horsepower, rigid machines	Fine finish, low rms requirements
Multistep roughing cuts, where tolerances are open and no specific finishes are required	1½" dia. and smaller tools, where greater than 1 diameter axial cuts are required
When larger diameter tools are used	On low-horsepower, lighter-duty machines
	On older, less rigid machines

Source: Kennametal

off the part and resets the Z-axis. This process can take up to 30 minutes. With a replaceable tip drill, the operator changes the tip and restarts the machine in a minute or two.

Furthermore, indexables are the preferred method for taking a small DOC, according to Classic Turning's Greenman, "Any time you are going to do quarter radiuses, you definitely want to go with indexables over solid carbide. Honing radiuses on a piece of solid carbide [prior to using it] takes a lot more time than just putting in a new insert."

At Northern Precision, a Swiss machine shop in Fairfield, Ohio, indexables already represent 85 percent of the shop's cutting tools. Still, Howard Jarvis, president, is looking for ways to continue reducing solid-carbide tool-

ing. "We've used indexable turning tools and grooving inserts since we've been in business, but for endmills the best thing we can do today is to use stub tools, which reduce the amount of carbide we have to buy," said Jarvis. "You want to get the shortest endmill possible. I haven't really tried indexable drills because we run a Swiss machine with very small-diameter drills."

The trend has led to expanded use of indexable tools and the development of new tools that cut down on the use of solid carbide, according to Konrad Forman, milling products manager for Ingersoll Cutting Tools. "In traditional indexable products, we've seen a trend toward single-row indexable endmills," he said. "They don't have the length of cut that a solid-carbide tool does in this single row orientation, but the feed per tooth can be substantially greater than with solid-carbide. Our company has gone a step further and made long-edge cutters [5/8", 3/4" and 1"], and those are going head-to-head with solid-carbide applications and winning that battle very nicely."

Forman is also an advocate for new products such as carbide drills and endmills with replaceable, molded solid-carbide tips that screw into a carbide or steel shank. "They have a little more depth of cut (1/2" or 5/8"), but really look like part of a solid-carbide endmill," he said. "They are so accurate that you can get repeatability of 0.0005" both axially and radially. And, since the tips are so much smaller [than solid-carbide tools], they are much less expensive to coat."

Improving cycle time is another way that indexable tools can improve shop productivity. "We can document dramatic cycle time improvements when using indexable ceramics to replace solid-carbide endmills," said Greenleaf. "For instance, with solid carbide, you

Conserving carbide in circuit-board drills

Circuit-board-drill manufacturers have been conserving carbide for years by producing stainless steel and solid-carbide composite products.

Tokyo-based Union Tool Co., for example, produces drills consisting of a solid-carbide, fluted rod inserted into a stainless steel shank. The company uses a proprietary process to attach the rod without glue. At least one other circuit-board-drill manufacturer glues the carbide tip onto the stainless steel shank.

Union Tool's basic printed-circuit-board drill bit is 38.1mm long (overall). Diameters range from 0.05mm up to about 6.35mm. In operation, cutting speeds reach 500 sfm at 300,000 rpm for the microdiameter sizes.

"Any circuit-board drill 1.6mm or smaller we have always made using this composite technology," said Jonathan Hay, vice president, sales and marketing for U.S. Union Tool Inc., the company's U.S. subsidiary based in Buena Park, Calif. "One of the reasons we went with the stainless steel shank is that it allows us to invest in very high-grade carbide at the cutting end. And, since these tools are typically being changed every 10 minutes, the stainless steel shank is a kinder fit in the tool steel collet than a solid piece of carbide, which has a higher hardness and sharp chamfered corners."

Union Tool claims a 38 percent global share of the circuit-board-drill market and produces about 20 million drills per month. —A. Rooks

Union Tool inserts a carbide, fluted rod into a stainless steel shank to produce this 0.10mm microdrill.



do most of your roughing with the part in a soft state, send it out for heat treating, set it up again and then go in with solid-carbide endmills to do the finishing work. We recommend hard milling with ceramics and finishing with carbide in a single setup. Indexable inserts let you do this with a single tool.”

Ingersoll’s Jennings focuses on the issue of tool float. With solid-carbide tools that require sharpening and re-coating, a shop may have four drills on a machine, four backups in the tool-room, four on the way to be sharpened and four being sharpened. “You’re looking at three to four times the amount of tools you need compared to an indexable system, where you have a tool on the machine, a backup and a few boxes of inserts,” he said.

Solid Case

While high prices may have increased interest in alternatives, replacing tools can be complex. For example, when drilling, the requirements of the hole to be produced—not tool cost alone—has the most impact on whether an indexable or solid-carbide drill is chosen. In many cases, solid carbide is the tool material of choice.

There are size limitations for indexable tooling. Some companies produce indexable tools down to 0.484" for endmills and drills, while other companies produce indexables under 0.250".

Despite improvements in indexables, solid-carbide drills still impart finer hole finishes and achieve tighter tolerances, noted Chet Parzick, senior product manager, holemaking team for Kennametal. “Customers still regard an indexable drill as a tool to get the material out of the hole fast, and then come

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U.S. Union Tool Inc.

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back with a secondary operation if necessary,” he said. “When the finished hole requirements are not demanding from a quality or size standpoint, then the indexable makes sense from a cost-per-hole basis. Depth-to-diameter ratio is another factor, as solid-carbide drills offer greater depth capabilities.”

Greenman agreed that a solid-carbide tool provides superior hole finish. The rigidity of solid carbide surpasses HSS tool bodies and produces less vibration, allowing the operator to impart a better finish, he said.

The tool manufacturers interviewed for this article indicated that operating challenges in converting to indexables are minimal and focused mainly on re-programming machine tools. “Unless the manufacturer has extremely old equipment, it is likely that [programming] adjustments are well within the capability of the machine tool,” said Matt Neuman, design engineer for OTM, a unit of Manchester Tool Co., Akron, Ohio. “For rotating-tool applications, some machine tools may be limited by their maximum spindle speed, or, perhaps, shrink-fit holders

will be needed to maintain tool stability during high-speed machining.”

Kennametal’s Marshall added that the growing versatility of indexable endmills makes programming more complex. “Most [indexables] can handle ramping, facing, periphery milling, slotting or channeling, and helical interpolation. Some can even plunge to certain depths in the Z-axis. The benefit is not as many tools will be needed to completely process the workpiece.”

When using indexable drills, speed increases and feed per tooth decreases because most indexable drills have one cutting edge. A typical solid-carbide drill has two cutting edges and cuts at a higher feed per revolution, according to Kennametal’s Parzick. “However, the inches per minute of feed are generally higher with indexable than solid-carbide drills,” he said.

In today’s market, manufacturers must consider different approaches that make them more productive. “Question the use of the solid carbide,” Forman said. “Where it absolutely should be utilized, give it a green light. But don’t just do the same old, same old.” △