Uncommon Knowledge

A Sandvik Coromant/Mazak seminar provided counterintuitive information on the metalworking market in general and machining heat-resistant superalloys in particular.

By Bill Kennedy, Contributing Editor

In late July, Sandvik Coromant Co., Fair Lawn, N.J., presented a seminar outlining strategies for machining the heat-resistant superalloys (HRSAs) common in aerospace applications. Sandvik Coromant held the event in partnership with Mazak Corp. at Mazak's Florence, Ky., National Technology Center. The seminar provided valuable cutting tool application information and offered numerous fresh ideas that counter "common knowledge."

Chuck Birkle, marketing vice president for Mazak's Cybertec Div., opened the meeting by questioning the tendency of the general press to report a "sky is falling" negative view of business activity. In contrast to that view, he said most of the markets Mazak serves are healthy; machine sales for the 3 months prior to the seminar were the best for that length of time in the company's history. Birkle agreed that there is weakness in certain sectors—most prominently, automotive and housing-related manufacturing—but said most other areas of manufacturing are steady or growing. Additional growth results from emerging markets such as wind-power equipment, where making generator components up to 92" in diameter present significant opportunities and challenges.

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Sean Holt of Sandvik Coromant outlines milling techniques for heat-resistant superalloys before a live demonstration on the shop floor of Mazak Corp.'s National Technology Center.

Birkle said handling those challenges requires partnerships between metalcutting technology suppliers to maximize their joint capabilities. Mazak's work with partners such as Sandvik Coromant, he said, enables the full potential of machine tools to be achieved.

George Yamane, marketing manager for Mazak, reinforced Birkle's comments about strong activity in machine tool industry, noting that Mazak has developed a "production on demand" strategy for its manufacturing operations. The company's production planning accounts for possible variations of product mix and volume to provide the ability to respond quickly to changing demand. At the same time, modular assembly techniques and other tactics have reduced typical lead times for turning machines from 30 days to 2 weeks, and lead times for vertical machining centers from 45 days to 3 weeks.

Metalcutting Continues

In his introduction to the seminar, Brian Norris, marketing vice president for Sandvik Coromant, also discussed the current state of manufacturing. He said the widespread economic downturn pictured in the press is inaccurate; "people are cutting metal."

He emphasized that the U.S. remains competitive globally, leading the world in technical innovation and research. However, he said, to maintain that competitiveness, U.S. manufacturing must deal with issues that include labor shortages, labor expense, consolidation, increased outsourcing and the trend of big OEMs becoming assemblers and pushing parts manufacturing down to Tier 1 and Tier 2 suppliers.

The U.S. must continue to stimulate innovation and then capitalize on it, Norris said. Echoing Mazak's Birkle, he said suppliers should establish partnerships that maximize the productivity of their separate products. Labor costs, for example, can be moderated through use of technology such as advanced, multifunction cutting tools and multitasking machine tools that produce a part complete in one fixturing.

An example of such an integrated approach, Norris described what Sandvik Coromant calls its "Right From The Start" strategy regarding production planning. Most often, he said, the reason a shop adds a new machine is to machine a new part. Tooling a new machine today, Norris said, "is not like tooling up a machine with stick tools, as in prior years; now it's a project, requiring complex tools." Considering the integrated application of machine tool and tooling systems in a "holistic" approach assures a shop gets the maximum return on investment.

Discussing advanced machining prac-

tices, Chris Mills, Sandvik Coromant's U.S. senior project manager of aerospace development, noted that aerospace is a conservative industry and is often reluctant to change a proven process. However, he said, new approaches are needed to realize maximum productivity. When turning HRSAs, for example, manipulating insert grades and coatings alone "is like having your hands tied behind your back," Mills said. Insert shape is the key, because it determines lead angle, DOC, feed rate and chip thickness, and offers a degree of control over DOC notching, a major failure mechanism when machining HRSAs.

Use of an insert shape and lead angle tailored to an application spreads out cutting forces and reduces DOC notching. Similarly, programming a tool to ramp into a part or vary DOC in operation also spreads the notching pressure over the length of the cutting edge, providing longer tool life and more predictable wear, he said.

Mills also described what he called "trochoidal turning," where part contours are programmed to be cut in stages to avoid a "wraparound" condition. When turning the face and diameter of a part continuously, the work essentially wraps around the insert at the junction of the face and diameter, increasing the DOC and requiring a feed rate reduction to maintain proper chip load. With trochoidal turning, the face and diameter are programmed separately, enabling higher feed rates and maximum productivity to be maintained. This approach is predominately used with round ceramic inserts and was recently rolled out as a solution that includes Sandvik Coromant's CC6060 sialon ceramic grades.

Sean Holt, aerospace industry specialist for Sandvik Coromant, discussed milling HRSAs. He pointed out that the temperature cycling characteristic of interrupted cuts in milling operations requires operators to maintain a certain temperature level to minimize thermal shock to the insert. However, heat must be controlled to the extent that it does not unbalance the ceramic tool material.

When milling HRSAs with ceramic inserts, Holt said, the commonly recommended milling practice of climb or down milling can be counterproductive. In climb milling, the insert enters the workpiece at full chip thickness, which, when milling HRSAs with ceramics can accelerate insert failure due to impact on the hard, but relatively brittle, ceramic material. Instead, the best approach for ceramic milling of HRSAs is conventional or up milling, where the tool enters the workpiece at minimum chip thickness. Chip thickness then increases as the tool progresses through the workpiece. Holt said the change from climb milling to conventional milling can produce a 50 percent increase in tool life in this application. CTE

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