SUCCESS STORY

IC-MPPE
Integrated Computational Materials Process and Product Engineering.

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Programme line: FFG Basisprogramm & COMET-K2 Centre

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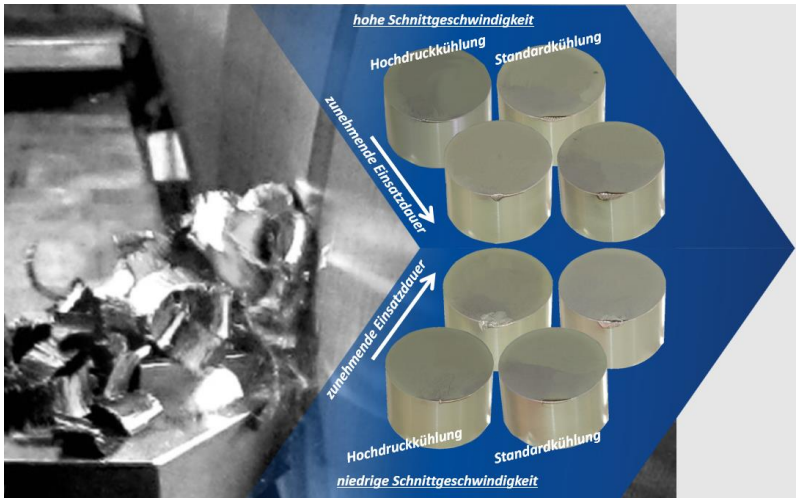

Turning applications with ceramic tools
Images: Ceratizit Austria GmbH (left) & Materials Center Leoben MCL (right), Compilation: MCL

CERAMIC CUTTING TOOLS AND THEIR POTENTIAL IN METAL CUTTING

PURE CERAMIC TOOLS REDUCE DEMAND FOR RARE METALS

During machining processes such as the turning of nickel-based alloys in the aerospace industry, tools are subjected to high loads. Nickel-based alloys have a high hardness. As a result, tungsten carbide-cobalt hardmetal tools only have limited process parameters when machining these alloys.

There is a risk of early, unpredictable tool damage that requires an environmentally and cost-unfavorable tool change. Tool damage in production leads to economic disadvantages of several 100,000 euros per company every year. Moreover, the high demand for critical raw materials such as tungsten and cobalt for tool manufacture must be taken into account.

Ceramics for production increases in the field of Nickel-based alloys

Ceramics consist to a large extent of silicon and aluminum, which are the second and third most common elements in the earth's crust, after oxygen, with 25% and 8% respectively. Materials Center Leoben (MCL) and Montanuniversität Leoben investigated two ceramic tool materials: (1) silicon-aluminum oxide nitride (SiAlON) and (2) aluminum oxide reinforced with thin silicon carbide crystal fibers (Al_2O_3+SiC_W). Both are technical ceramics that are remarkable for their high temperature, wear and chemical stability. The material properties and the development of damage on the cutting edges were analyzed under different cooling conditions and cutting speeds.

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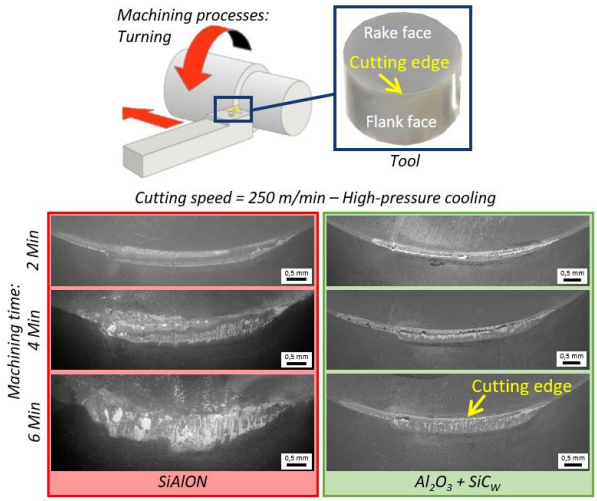
The results show that Al_2O_3+SiC_W exhibits far less breakouts, material adhesion and wear compared to SiAlON. Thus, a better tool life and workpiece surface quality was achieved with Al_2O_3+SiC_W than with SiAlON.



Development of damage over the service life in the area of the cutting edge of two ceramic tools: SiAlON and Al_2O_3+SiC_W.
Image: MCL

Impact and effects

Replacing hardmetal tools with purely ceramic tools increases productivity and extends tool life in the machining of components made from nickel-based alloys. Due to the higher cutting speed (+20%), a cost reduction of 15% per component can be achieved. In addition, the use of purely ceramic tools can reduce system downtimes caused by tool changes. In addition, the need for critical raw materials, such as tungsten and cobalt, and the amount of environmentally harmful cooling lubricants can be reduced.

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Project partner

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- Montanuniversität Leoben - Chair of Structural and Functional Ceramics, Austria

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