Machinability analysis of cemented carbide

Cemented carbide is one of the hardest known material known to man and is often used as tool material when machining various metals. The twist in the thesis was that cemented carbide was used as workpiece material and instead, diamond was selected as tool material. An experiment was conducted in order to investigate if cemented carbide could be machined in an efficient manner by diamond tools. Today cemented carbide is machined using techniques such as grinding or electro discharge machining, which are relatively slow. If milling or turning could be used instead, the machining of cemented carbide could be achieved in a much more efficient way.

The thesis was performed in collaboration with Sandvik Coromant at one of their plants in Gimo. Sandvik Coromant is the market leader of producing tools for advanced metal cutting. The tools are produced in cemented carbide, however Sandvik Coromant does not produce tools for machining cemented carbide.

Cemented carbide is a type of composite material, where two or more materials are combined in order to create a new material with improved characteristics. The aim is to combine one or more hard, but brittle carbide with a tough binder metal so that the outcome is both hard and tough.

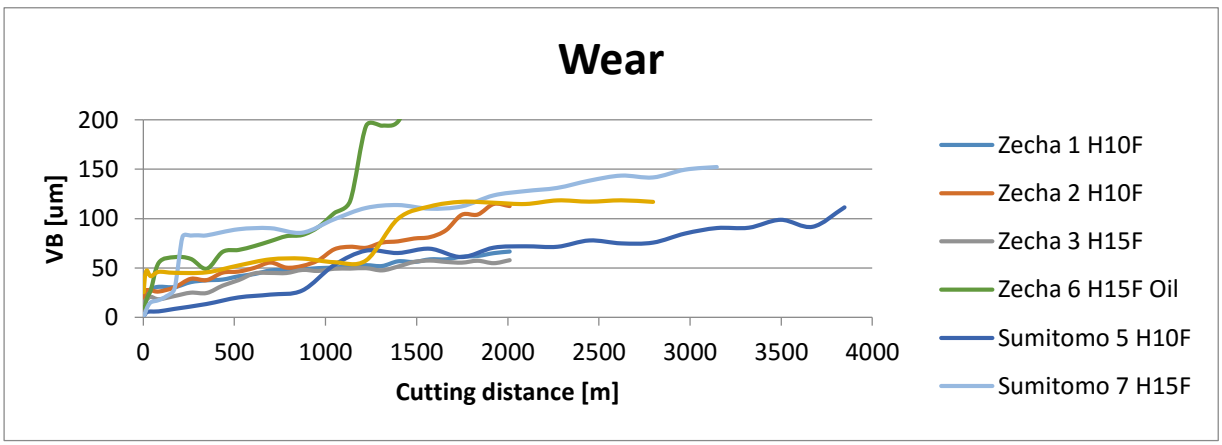
An experiment was designed to investigate if the binder content of cemented carbide affected the tool wear of a milling process. The tests were performed in a 5-axis mill from Mikron HSM200uLP and the tool wear was measured in an optical 3D microscope.

The wear tests were performed in cemented carbide with two different binder contents H10F and H15F. H10F consist of 10% cobalt and 90% tungsten carbide while H15F consist of 15% cobalt, 84.3% tungsten carbide and 0.7% other. Two different types of tools were used in the experiment, a diamond coated cemented carbide ball nose mill from tool manufacturer Zecha and a nano-polycrystalline diamond ball nose mill from Sumitomo.

The tests were executed by milling paths on the surface, back and forth. The tests were stopped in a predetermined interval and the wear of the tool was investigated. By doing so the wear growth was documented. The results of the experiments can be seen in graph 1.

The results show that the machinability is not significantly affected by a change in binder content from 10 to 15% cobalt. Tool life and surface quality are more dependent on tool shape and tool material.

Overall the experiments were successful and show that milling of cemented carbide could be done in an efficient way. The future of machining cemented carbide will definitively contain exciting developments and push the boundaries of what is possible forward.



Graph 1- Tool wear (VB) plotted against cutting distance for all used tools.

Oskar Sörén