

Wood cutting made easy

Ceramic kitchen knives are ten a penny. What has become the norm in Swiss kitchens, however, could soon work to industry's advantage, too. Empa scientists have developed a ceramic blade for industrial wood cutting that is lighter than its existing carbide counterparts. The new knife recently made its debut at a joinery in Embrach.

TEXT: Cornelia Zogg / PICTURES: Empa

The milling machine whirs into action, saws through the wood and transforms the thick plank into a ready-made, clean-cut profile for window and door frames. Like at the joinery in Embrach, timber is cut into shape all over the world. Conventional machines work with blades made of tungsten carbide, a hard metal developed around 80 years ago. As the base material, tungsten, primarily comes from China and has now been classified as critical (see box); supply bottlenecks, therefore, threaten Swiss SMEs.

A number of years ago, Empa had teamed up with Oertli Werkzeuge AG and started developing ceramic materials for super-sharp wood cutting blades. The aluminum-oxide-based ceramic composites developed in the first step are extremely hard. However, they have a major drawback for wood processing: ceramic materials are not very good at dissipating heat. Without cooling, the blade would overheat, which would, in turn, leave unattractive burn marks on the wood. This is hardly surprising as temperatures of up to 800 degrees Celsius build up during the cutting process. Nevertheless, the Empa team headed by Jakob Kübler from the Laboratory for High-Performance Ceramics found a solution for this problem: an ultrathin coating that reduces friction and at the same time dissipates heat more effectively.

Reaching the target in several project steps

Last March, Oertli Werkzeuge AG and Kübler's team launched the first practical cutting tests. In particular, they examined the durability of various blades. The blade that turns out to be – literally – a cut above the rest will then go into mass production. At the beginning of the project, production costs were the burning issue, says Kübler: "While the cutter we initially developed was up to five times more efficient than conventional blades, it was simply too expensive for mass production." So the project's goal was readjusted to develop an innovative product at a marketable price. The results of the "field trial", which has now been completed: the new ceramic blades cut just as well as those made of carbide metal, but are a lot lighter and thus faster that they are streets ahead of their predecessors. Instead of 75 to 95 meters per second, the ceramic blades are able to cut through wood at a speed of 120 to 150 meters per second. Moreover, they also more than match up to carbide metal cutters in price.

How research spawns innovation

"For us, cutting tools are clearly an economic factor," confirms Bruno Ehrle, Director of Technology at Oertli Werkzeuge AG. "During this project, we were able to fall back on Empa's expertise and thus launch a marketable innovation as the result of a good collaboration." Empa's Kübler couldn't agree more: "We reached our goal." Now it is the company's job to take over the commercial side of things and work towards launching the product on the market. The support from the Commission for Technology and Innovation (CTI) was also instrumental in the project's success. The collaboration just goes to show how marketable innovations can be realized efficiently if research and industry work closely together. "It was a huge challenge for us to develop new materials and combinations whilst bearing the production costs in mind," says Kübler. And as the price of tungsten has ballooned in recent years, the timing couldn't be better. Many small production companies are no longer able to compete under these conditions. Therefore, it is all the more important to help Swiss SMEs maintain their competitive edge internationally via marketable innovations and alternatives. //

Test run of the newly developed ceramic blades on a milling machine at a joinery in Embrach, ZH. Bottom right: Bruno Ehrle, project manager at Oertli Werkzeuge AG, tests the stability of the new blades with a colleague. Thanks to the cutting technology developed at Empa, wood can be processed three times faster than with conventional carbide blades.



Web tool highlights supply risks for SMEs

Numerous metallic elements are deemed “critical”, i.e. there is a high risk of supply bottlenecks. Swiss SMEs are also affected by this as it is often unclear which materials they depend upon. It is often difficult to find a substitute because factors such as product performance and quality, costs and energy consumption have to be considered. Companies need to know which critical raw materials they use in their processes and products before they can actually operate.

A web tool co-developed by Ernst Basler + Partner and Empa scientists will now provide this kind of information. It enables the supply risks for more than 30 metals, the ecological and social effects, and the company's susceptibility to supply interruptions to be estimated. The “Metal Risk Check light” is soon to appear on the homepage of the inter-trade organization Swissmem.



Video
Ceramic-composites as wood cutting tips

<https://youtu.be/1GKeLf8vzXA>