Methodology for select the properties of hybrid grinding wheels for the machining of light metal alloys

Metodyka doboru właściwości ściernic hybrydowych do obróbki stopów metali lekkich

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In the publication the features and advantages of using new abrasive tools with innovative adaptive structures and special microaggregates for the machining of light metal alloys was described. There also a complex methodology for selecting the properties of these innovative hybrid grinding wheels was presented.

KEYWORDS: hybrid grinding wheels, abrasive microaggregates

Due to the increasingly widespread use of light alloys, demand for their efficient and accurate processing increased. These materials are difficult to machine because of: filling the space between grains of treatment product, high energy of the grinding and difficulty of stabilizing the properties of the tool within the shelf life at an acceptable level for economic and technological reasons.

Abrasive tools with innovative, adaptive structures and special micro-aggregates allow for more efficient grinding operations than conventional grinding and can be used for light metal alloys.

This new solution provides significant technological advances through the wide variety of tool characteristics that vary depending on the material and process characteristics. In the processing of aluminum, magnesium and titanium alloys, new grinding wheels help to reduce the problems associated with the active surface of the grinding wheel, increase durability, reduce energy and improve machining stability. These tools also improve the grinding performance of other materials, such as high-strength steel and alloy steel.

New abrasive tools will be useful in grinding operations many other materials - such as composite materials [9], materials of high strength materials sensitive to heat, light alloys, new materials and mineral resin or plastic used for optics - where the treatment is presently believed to be difficult to implement.

Abrasive tools with micro-aggregate construction and methodology of their properties selection

Hybrid abrasive tools with micro-aggregation and increased porosity [1, 8]:

- provide a reduction in grinding specific energy, especially in the treatment of light metal alloys;
- eliminates clogging of the workpiece material between abrasive grains;
- may have characteristics that are precisely tailored to specific technological tasks.

The novel solution is that abrasive tools of a certain size, bonded together and forming a porous structure additionally contain special micro-aggregates of substantially smaller size (and also of other materials) than the basic fraction (fig. 1).

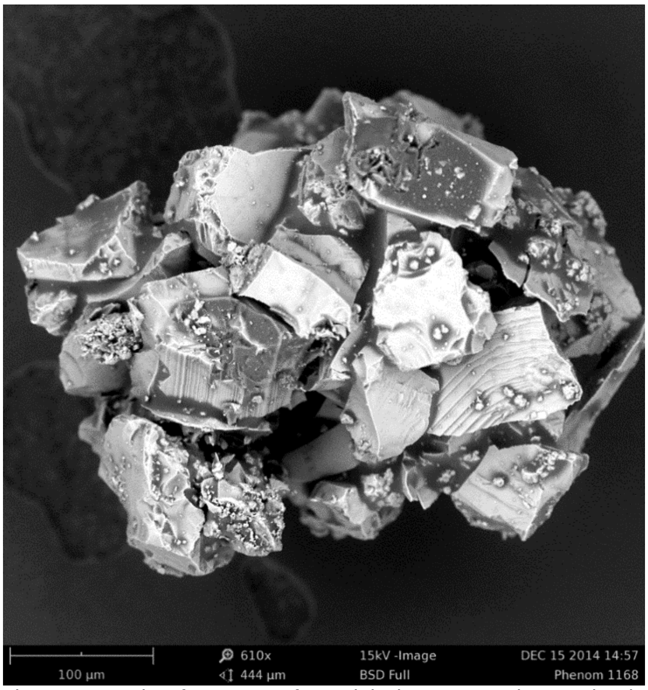

Fig. 1. Example of a group of special electro-corundum grains in abrasive micro-aggregate

Micro-aggregate is formed from micro-grains (in number of a dozen to several dozen - depending on their size and the size of the resulting aggregate) of the combined binder, which have properties suited for the application. These special grain aggregates with the grains forming the base fraction are connected to the main binder and form a porous structure of a hybrid wheel.

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Fig. 2 presents a complex methodology for the selection of tool features with innovative, adaptive structures with micro-aggregates and with differentiated zonal structures for surface grinding. The use of a specific share micro-aggregate allows for a machined surface, which is favorable parameters compared with the stereometric surface treated with a conventional grinding wheel [3-5].

Micro-aggregates ensure the stability of microsurgical processes along the tracks of individual grains. Small blade blades with small apex angles, arranged on different radii in a given micro-aggregate, guarantee a much better repeatability of cutting conditions. similar shape of micro [1, 2, 6, 7]. Large grains in conventional grinding wheels cause significant variations in the conditions of removal of the material and the formation of chips of different shapes and structure. Figs. 3 and 4 show the geometrical forms and features of the microstructures formed after the grinding of the bearing steel with a conventional wheel (fig. 3) and the grinding wheel with micro-aggregates (fig. 4).

The abrasive particles present in the hybrid-construction tools may contain a mixture of super-hard grains, which allow the processing of extremely difficult workpieces. It is also possible to produce tools that consist of micro-aggregate compositions formed from different types of abrasive materials. of the developed surface of micro-aggregates.

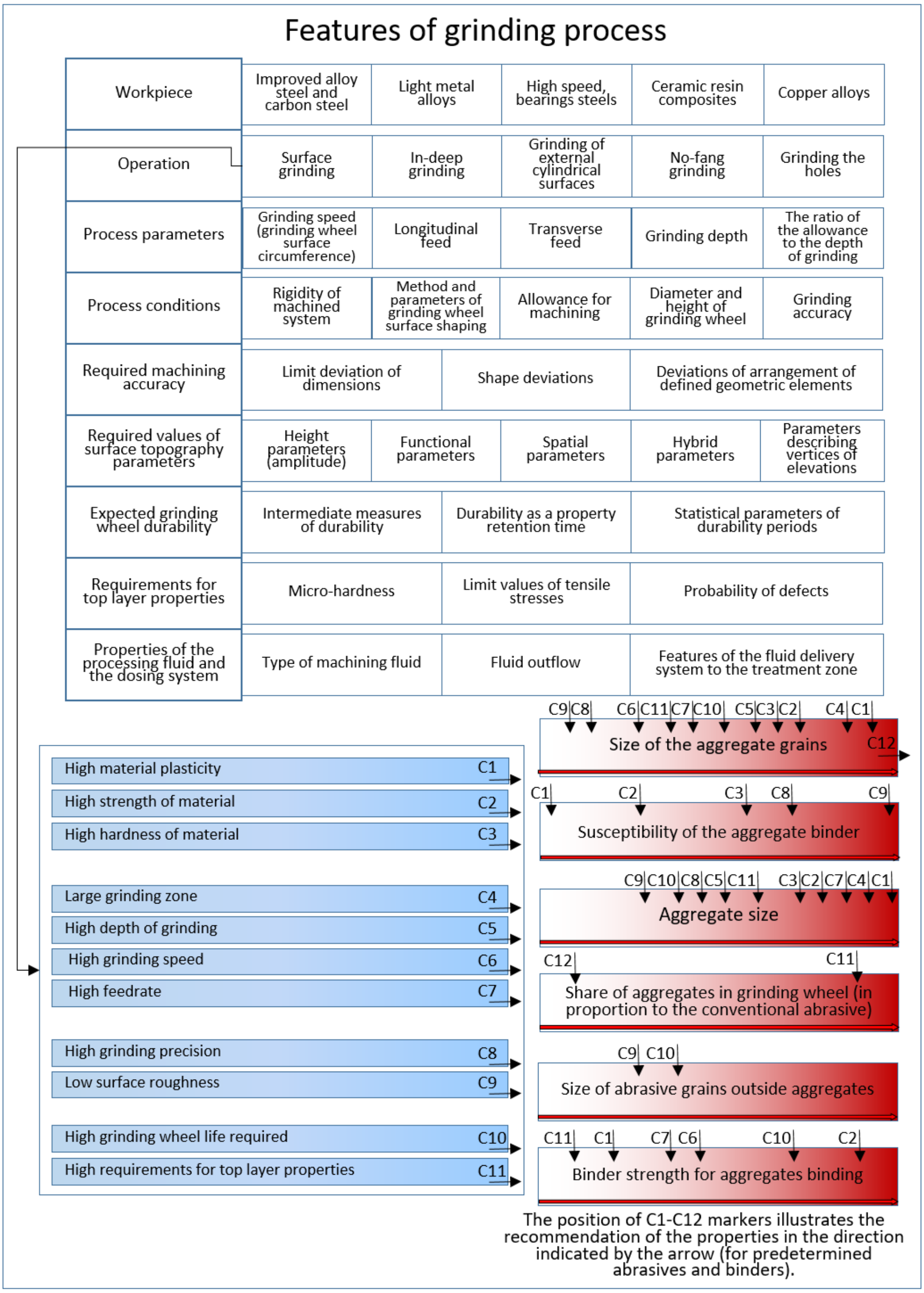

Fig. 2. Diagram of selection of tool features with innovative, adaptive structures with micro-aggregates and zone differentiated construction

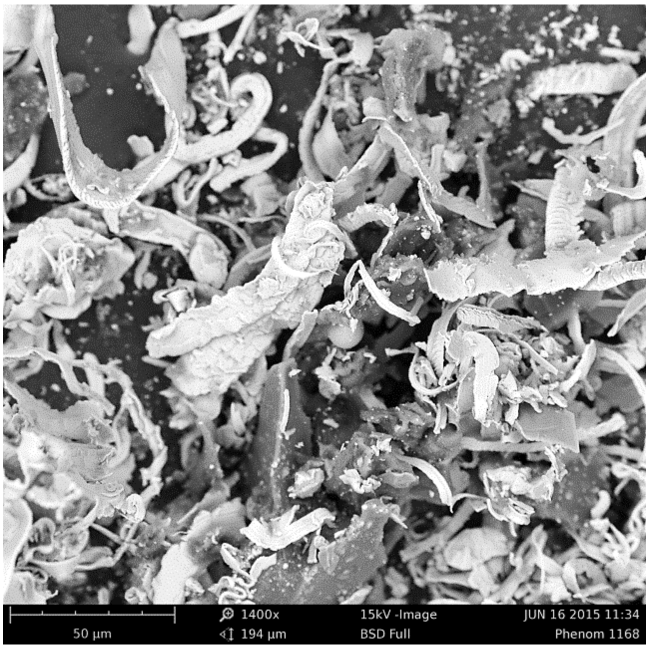

Fig. 3. Characteristics and geometrical features of micro-chips after grinding of bearing steel with conventional grinding wheel

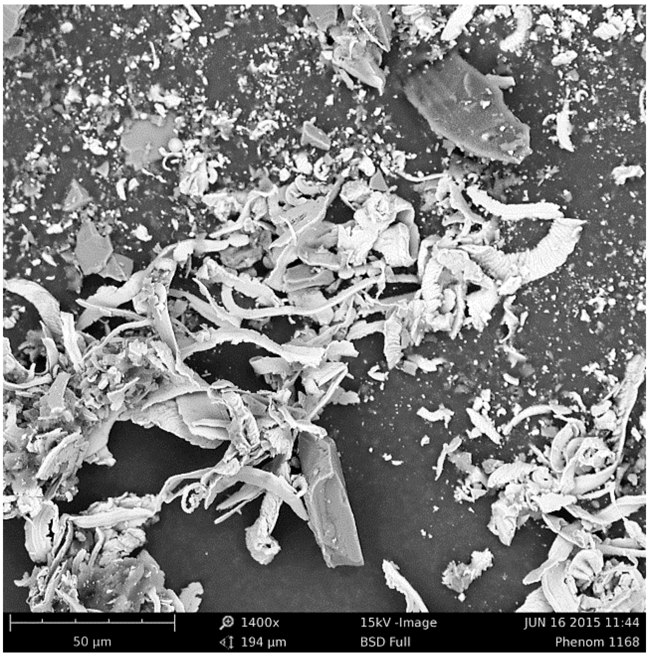

Fig. 4. Characteristics and geometrical features of micro-chips after grinding of bearing steel with micro-aggregates

Conclusions

Hybrid-construction abrasive tools, that incorporate micro-aggregate compositions of different properties - selected for specific applications, provide beneficial grinding results, especially for light metal alloys. It is worthwhile to use the following tools when selecting the features of these tools:

- The use of micro-aggregates increases slightly the value of the grinding force components and decreases their elongation at the end of the machining time, and also contributes to the favorable parameters of the stereometric structure of the treated surface. The limit of the weight of the aggregates from the electrolyte grains should be 30%.
- For grinding of HH15 (1.3505) hardened steel (65 HRC), use of micro-aggregate tools with P hardness or higher (due to wear of abrasive tool).
- If instruments with a higher proportion of micro-aggregates are needed, the size of these micro-aggregates should be smaller or inter-granular bridges in micro-aggregates should have greater strength.
- For grinding of aluminum alloys and magnesium alloys it is preferable to use grinding wheels with micro-aggregates at the level of 40%.
- For grinding of titanium alloys it is preferable to use grinding wheels with micro-aggregates of the order of 40÷50%.
- Micro-aggregates ensure stable grinding operation along the tracks of individual grains. Small blades with small angles at different angles in a given micro-aggregate provide comparable cutting conditions and the formation of similarly shaped micro-chips, while large grains along the cutting tracks form shavings that differ in shape and structure.

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