PROVIDING METHOD FOR SELF-SHARPENING OF DIAMOND WHEELS

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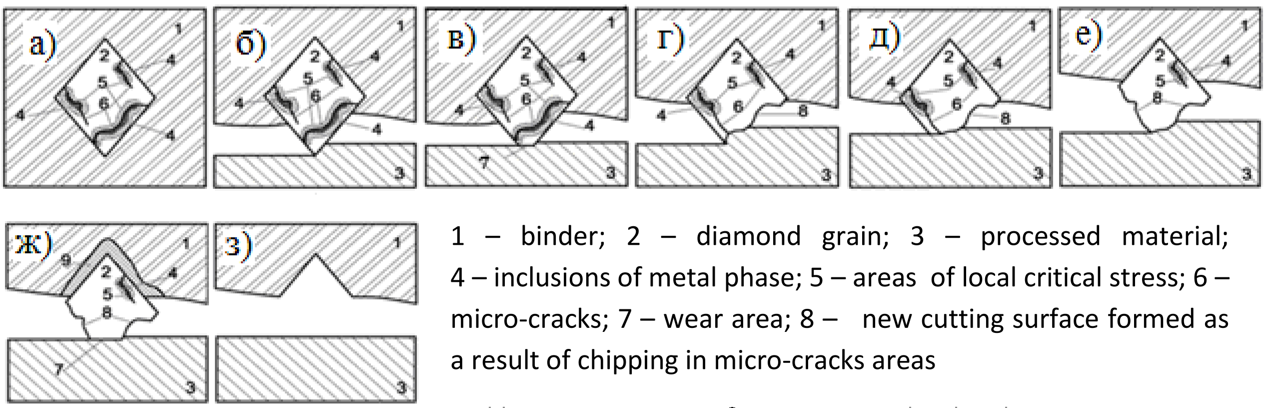
Improving terms of efficient operation of diamond abrasive tools and reduction of specific consumption of diamonds is possible provided the rational self-sharpening diamond wheels for grinding.

In order to implement self-sharpening wheels with ceramic binder a series of modeling and natural experiments, that aimed to developing of the proved choice principles of composition and technological manufacturing parameters of composite diamond-bearing material (CDM), were conducted.

Considered the possibility to provide the rational self-sharpening of the diamonds while grinding, through the formation during sintering CDM specific stress level that is partially retained after cooling and is a reason of appearance of micro-cracks in the grains.

In case when diamond grains are exposed to compressive stresses of the binder, which expanding when heated, destruction of diamonds does not occur. While grains became blunt during grinding process, the local temperatures in the zone of their contact with the processed material begin to increase, which leads to the development of micro-cracks and provides an update to the cutting surfaces.

When diamond grains completely lose their cutting ability they are removed from the work surface under the influence of stresses generated at the boundaries of their contacts with the binder due to increasing of the local temperatures during grinding of blunted grain (Fig. 1).



1 – binder; 2 – diamond grain; 3 – processed material; 4 – inclusions of metal phase; 5 – areas of local critical stress; 6 – micro-cracks; 7 – wear area; 8 – new cutting surface formed as a result of chipping in micro-cracks areas

Fig. 1 - Schematic representation of self-sharpening process of grain while grinding
а) diamond grain inside the binder; б) grain on the working surface of the wheel;
в) blunting of the grain; г-е) updating of the grain cutting surfaces;
ж) grain witch lost cutting ability; з) falling out grain.

Based on the experimental results the empirical dependence for determining the optimum temperature of CDM sintering were established:

$$T = 771{,}637 \cdot K^{0{,}049} \cdot P^{0{,}092} \cdot Z^{-0{,}080}$$

where K – pre destruction coefficient of diamond grains ($V\sigma_{str}/V_{gr}$); P – strength of diamond grain, N; Z – average diamond grain size, μ; $V\sigma_{str}$ – the amount of grain, in which the level of stress exceeds the boundary strength values for diamonds; V_{gr} – the total volume of grain.