CLASSIFICATION OF POSSIBLE MODELS THE DIAMOND GRINDING WHEELS DESTRUCTION

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A classification of possible models the diamond grinding wheels destruction in the form of local breaking, shifting, and rotation of diamond grits, taking place independently, in sequence or in one time, has been presented. One has been stated, that destruction of the diamond wheels on the resin and metal bonds occurs generally as a result of local rotations of the diamond grits in the bond, the number of which amounts 50% of total number of grits, nonparticipating in the process of cutting.

Key words: diamond wheel, diamond grit, grinding, resin bond wheels, metal bond wheels.

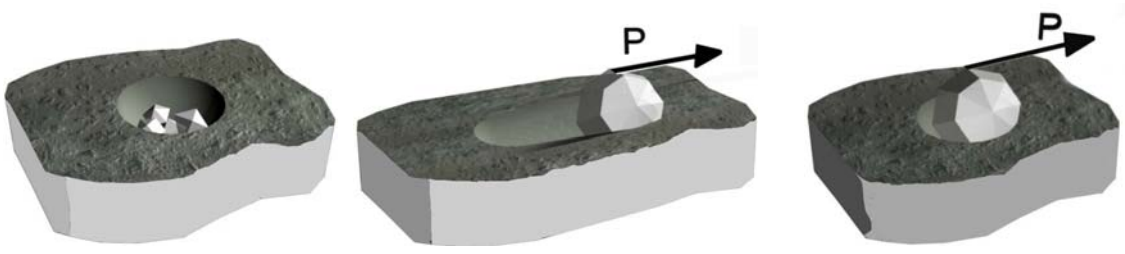
1. INTRODUCTION

The diamond grinding wheels are in wide use in industry. Design of new grinding wheels with long wheel life necessitates a study of the wheel destruction process essence in order to clear up the possibilities of its deceleration. At present the published data as to the relationships of different destruction models are absent.

2. METHODS OF EXPERIMENTS

A classification of possible models of diamond grinding wheels destruction in the form of local breaking, shifting, and rotation of diamond grits is proposed in given work.

The first destruction model is characterized by forming of a crater on the wheel's working surface with the leavings of broken diamond grit inside the crater (Fig. 1a). It is assumed, that in this case the diamond grit destruction occurs because of the ultimate load exceeding on the grit.



a) b) c)

Fig. 1. Working surface of the diamond grinding wheel: after the grit breaking (a); after the grit shifting (b); after the grit rotation in the bond (c).

Second destruction model is characterized by forming on the wheel's working surface of the elongated crater, without the leavings of broken diamond grit inside of it (Fig. 1b). It is assumed in this case, that the bond destruction behind the diamond grit occurs because of exceeding of the ultimate load on the bond in this area. At that the diamond grit is not broken.

It is shifted under the feed effect along the bond, forming the elongated crater. After that the grit is removed away from the wheel's working surface due to the centrifugal forces action.

Third destruction model is characterized by forming on the wheel's working surface of the crater, the form of which coincides with the diamond grit's form, without the leavings of broken diamond grit within of it (Fig. 1c). It is assumed, that the destruction in this case proceeds along the "diamond grit – bond" interface in view of the grit local rotation conditioned by destruction of its joining with the bond. At that the crater on the wheel's working surface coincides with the grit form [1]. After local rotation and destruction of the joining between the grit and bond the grit is removed away from the wheel's working surface due to the centrifugal forces action.

Most likely, these processes may proceed independently, in sequence or in one time.

Analysis of the destruction models listed above is based on the research of the diamond wheels efficiency with different bonds at the grinding of different materials. The cemented carbide was ground by the resin bond wheels of 1A1 form 100×6×3 mm with the diamond grits size 106/90 mkm and 100% concentration at the wheel peripheral speed 25 m/s, feed rate 2500 mm/min, and depth of cut 1 mm with use of the coolant fluid on the water base. The glass was ground by the metal bond wheels of the same form with the diamond grits size 106/90 mkm and 100% concentration at the wheel peripheral speed V =25 m/s, feed rate S = 1500 mm/min, and depth of cut 1 mm with use of the coolant fluid on the water base. Using the microscope, the number of grits on the wheel's working surface, nonparticipating in the cutting process, was determined. The grits, nonparticipating in the cutting, were classified by the outward appearance, typical for every destruction model (Fig. 1). The number of grits was counted in the microscope ocular sight with the area 0.4 mm^2. One was classified 250-300 grits, nonparticipating in the cutting, for every meaning of the abrasive toughness.

3. RESULTS OF EXPERIMENTS

Fig. 2 shows the total dependence of the relationship of basic destruction models of the resin bond diamond grinding wheels, working in the self-sharpening condition, upon the grits toughness after treatment of 30 g cemented carbide. It follows from the results obtained, that, for example, at the abrasive toughness 10 N the number of rotated grits amounts 53% of total grits number, nonparticipating in the cutting process; the number of failed grits is about 35%, and that of shifted grits – 12%. The resin bond diamond wheels are produced, in general, with use of abrasives with toughness of the order of 5÷15 N. Analysis of the dependencies obtained for this case has shown, that the destruction of such wheels occurs mainly as a result of local rotations of the grits in the bond, the number of which amounts 40÷65% of total grits number, nonparticipating in the cutting process. At that the numbers of broken and shifted grits amount 25÷30% and 10÷15%, respectively. Thus, it is most efficiently to decrease the number of locally rotated grits for prevention of destruction of the resin bond diamond wheels, working in the self-sharpening condition in the process of cutting**.**

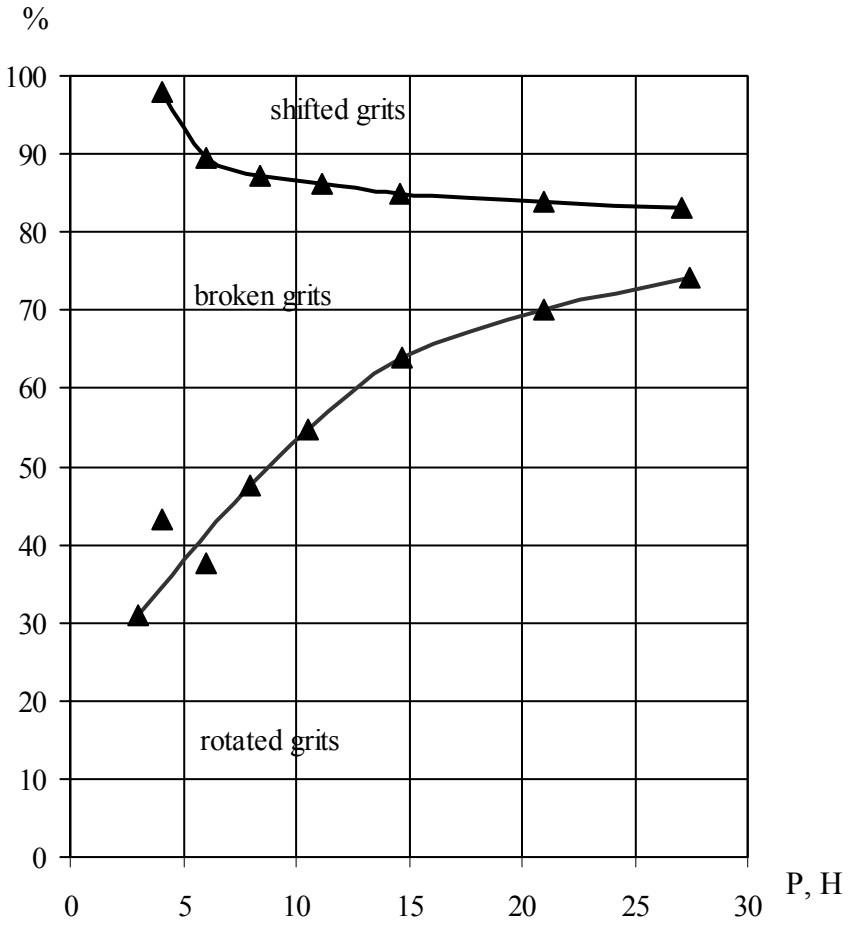


Fig. 2. Relationships of the basic destruction models of the resin bond diamond wheel for different diamond grits toughness P under grinding of cemented carbide: 1 – shifted grits; 2 – broken grits; 3 – rotated grits.

Fig. 3 shows the dependence of the relationship of basic destruction models of the metal bond diamond wheels, working in the cutting capacity loss condition, after treatment of 200 g glass. The cutting capacity loss occurs in that case at the diamond grits wear up to the bond level. After that the wheel was subjected to abrasive effect for the cutting capacity restoring. It follows from the experimental data, that, for example, at the abrasive toughness 20 N the number of rotated grits amounts 54% from total grits number, nonparticipating in the process of cutting; the number of broken grits is about 33%, and that of shifted grits – 13%. The metal bond diamond wheels are produced, in general, with use of abrasives with toughness of the order of 15÷30 N. Analysis of the dependencies, obtained for given toughness range, has shown, that the destruction of the metal bond wheels occurs mainly as a result of the grits local rotations in the bond, the number of which amounts 50÷55% of total number of destructions. At that the numbers of broken and shifted grits amount 30÷40% and 10÷15%, respectively. Thus, it is most efficiently to decrease the number of locally rotated grits for prevention of the destruction of the metal bond diamond wheels, working in the cutting capacity loss condition in the process of cutting.

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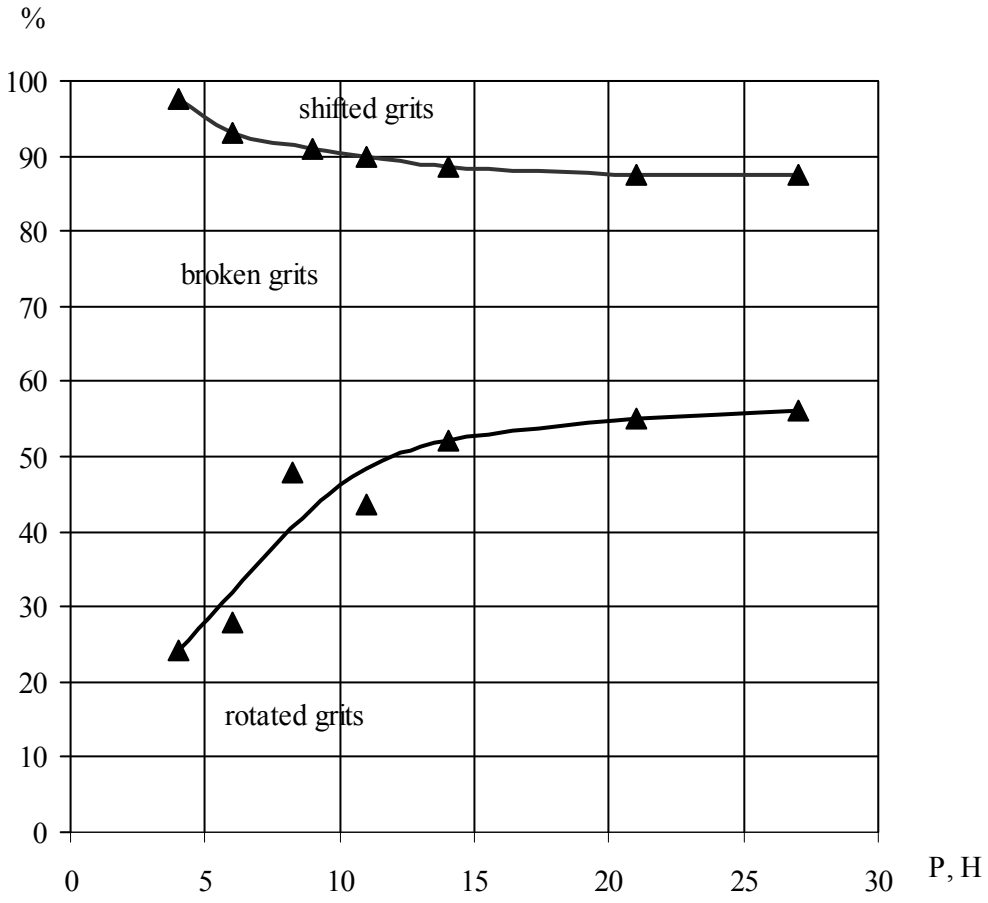

Fig. 3. Relationships of the basic destruction models of the metal bond diamond wheel for different diamond grits toughness P under grinding of glass: 1 – shifted grits; 2 – broken grits; 3 – rotated grits.

4. CONCLUSIONS

1. A classification of possible destruction models of the diamond grinding wheels, such as the local breaking, shifting and rotation of the diamond grits, taking place independently, in sequence or in one time, has been presented.

2. Destruction of the resin bond wheels, working in the self-sharpening condition in the process of cutting, occurs, in general, as a result of local rotations of the diamond grits in the bond, the number of which amounts 40÷65% of total grits number, nonparticipating in the process of cutting.

3. Destruction of the metal bond wheels, working in the cutting capacity loss condition in the process of cutting, occurs, in general, as a result of local rotations of the diamond grits in the bond, the number of which amounts 50÷55% of total grits number, nonparticipating in the process of cutting.

References:

[1] WARNECKE G., WIMMER J.. *Stock removal and wear in deep grinding high-performance ceramics. Industrial diamond review*, 1995, № 3, pp 126-132

ANALYSIS OF THE DIAMOND GRINDING WHEELS DESTRUCTION

Summary:

A classification of possible destruction models of the diamond grinding wheels, such as the local breaking, shifting and rotation of the diamond grits, taking place independently, in sequence or in one time, has been presented.

Destruction of the resin bond wheels, working in the self-sharpening condition in the process of cutting, occurs, in general, as a result of local rotations of the diamond grits in the bond, the number of which amounts 40÷65% of total grits number, nonparticipating in the process of cutting.

Destruction of the metal bond wheels, working in the cutting capacity loss condition in the process of cutting, occurs, in general, as a result of local rotations of the diamond grits in the bond, the number of which amounts 50÷55% of total grits number, nonparticipating in the process of cutting.

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