ESTIMATION OF DIAMOND WHEELS EFFICIENCY ON THE BASIS OF DETERMINATION OF THE BOND RELATIVE WEAR RATE

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Design of new high-efficiency bonds for diamond grinding wheels is related with selection of an optimal criterion providing maximal efficiency. It is necessary under design of new bonds to provide optimal value of the bond relative wear rate V_{rel} by change of the wear-proof fillings contents in the bond and the diamond grits toughness**,** and by choice of the grinding conditions. Under change of the grinding condition within the experimental limits the grinding ratio G increases as the bond relative wear rate V_{rel} is increased.

KEY WORDS: grinding, diamond wheel, bond, grit, grinding ratio

1. INTRODUCTION

A generalized criterion for design of new bonds for high-performance diamond grinding wheels, optimal value of which provides maximal grinding ratio, has been proposed. The criterion represents the bond relative wear rate, which is determined as the difference between the bond wear rate in a zone ahead of diamond grits and the diamond grits wear rate. One has been stated, that it is necessary under design of new bond to provide optimal value of the bond relative wear rate by change of the wear-proof filling contents in the bond and of the diamond grits toughness, and also by choice of the grinding condition.

Design of new high-efficiency bonds for diamond grinding wheels is related with selection of an optimal criterion providing maximal efficiency. It is necessary also to determine the factors allowing the change this criterion. However, the published data as to a complex criterion for estimation of the wheels efficiency, relating the wear of the bond and diamond grits, are absent.

2. METHODS AND RESULTS OF EXPERIMENTS

The bond relative wear rate V_{rel} as a generalized criterion of the diamond wheels efficiency estimation is proposed here. It is determined as $V_{rel} = V_b - V_{dg}$, where V_b is the bond wear rate in a zone ahead of diamond grits, and V_{dg} - the diamond grits wear rate (Fig. 1).

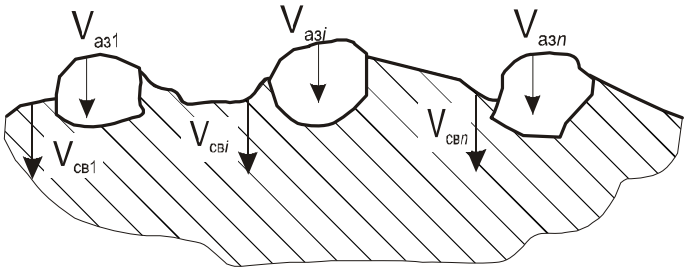

Fig. 1. Wear scheme of the diamond grinding wheel.
($V_b = V_{св}$, $V_{dg} = V_{аз}$)

Given scheme of the wheel wear is based on the fact that the bond wear rate ahead the diamond grit differs from that of the grit wear (Fig. 1). The chip groove ahead the diamond grit is formed under abrasive effect of groove coming off over the grit's front surface [1].

The follow technique was used for the bond relative wear rate V_{rel} measurement. At first, the levels of diamond grit apices (wear area) and of chip groove bottom ahead of the diamond grit were fixed with the help of microscope. Then, the flaring value of diamond grit over the bond ahead of the grit (the chip groove value) was determined with use of the indicator with the scale mark charge 0.001 mm. The bond relative wear rate V_{rel} was determined by the formula:

$$V_{rel} = \frac{(h_2) - (h_1)}{\tau}$$

where h_1 - the flaring value of diamond grit over the bond before the grinding, mkm; h_2 - that after the grinding, mkm; τ - the grinding time, s.

The bond relative wear rate was determined as the average one for 10 diamond grits.

One has been stated, that at the bond relative wear rate $V_{rel} < 0$ the diamond wheel works in the cutting capacity loss condition. When the wear of diamond grits reaches the bond level, the cutting capacity loss occurs. To restore the cutting capacity, it is necessary to remove the bond ahead of the grits. When $V_{rel} > 0$, the diamond wheel works in the self-sharpening condition in the process of grinding.

Fig. 2 shows the grinding ratio G vs. the bond relative wear rate V_{rel} under grinding of the cemented carbide (6% Co) by the wheel 1A1 type 100×6×3×32 mm with grits size 106/90 and 100% concentration on different resin bonds. Experiments were made at the wheel peripheral speed 25 m/s, feed rate 2500 mm/min, and depth of cut 0.04 mm with use of the coolant fluid on the water base. One has been stated, that with reference to the wheels, working in the self-sharpening condition in the process of grinding, an optimal value of the bond relative wear V_{rel} exists. This optimal value corresponds to maximal grinding ratio

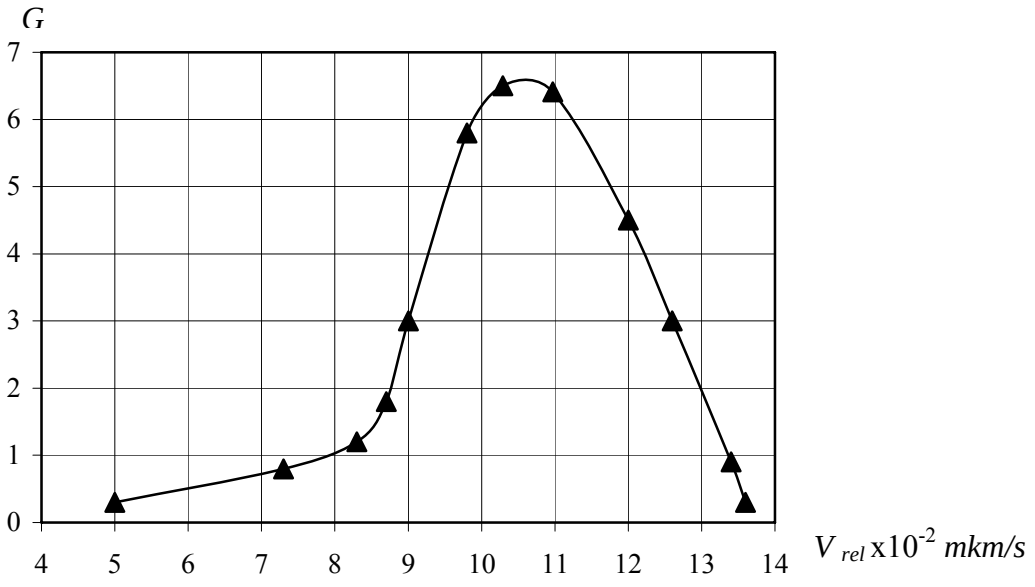

Fig. 2. The grinding ratio G vs. the bond relative wear rate V_{rel} under grinding by different resin bond wheels.

The bond relative wear rate V_{rel} lowering may occur because of the bond wear rate V_{b} decrease due to the wear-proof filling materials addition into the bond or due to the grit wear rate V_{gr} increase when the less tough abrasive is used.

However, the factors listed above may change the bond relative wear rate backwards also. Thus, it is necessary under design of new bond for diamond grinding wheel to provide optimal value of the bond relative wear rate V_{rel} by change both the wear-proof fillers contents in the bond and the diamond grits toughness.

Fig. 3 shows the grinding ratio G as a function of V_{rel} at grinding under different cutting conditions. The grinding of the cemented carbide (6% Co) by the resin bond wheel 1A1 type 100×6×3×32 mm with grits size 106/90 and 100% concentration was performed in the experiments at the wheel peripheral speeds (25-35) m/s, feed rates (1250-3750) mm/min, and depths of cut (0.02-0.06) mm with use of the coolant fluid on the water base. It has been stated, that under the grinding conditions referred above the grinding ratio G increases with the bond relative wear rate V_{rel} increase.

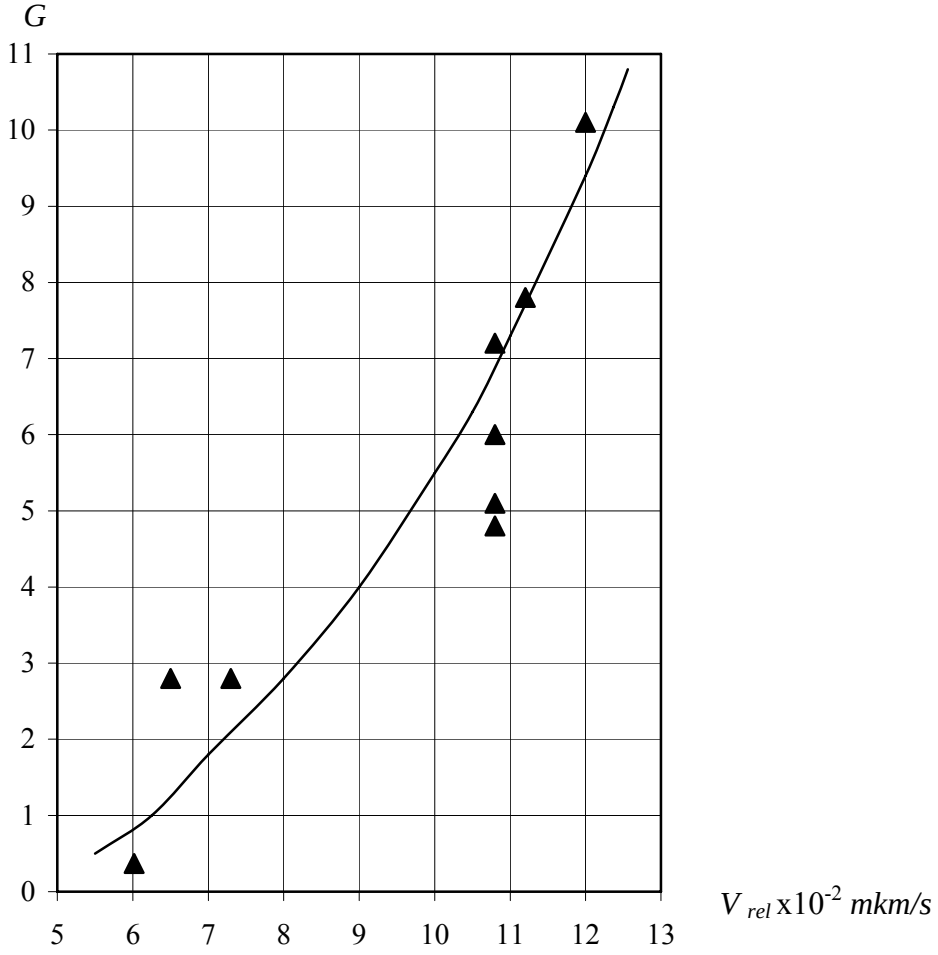

Fig. 3. The grinding ratio G vs. the bond relative wear rate V_{rel} depending on the cutting conditions.

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3. CONCLUSIONS

1. A generalized estimation of the diamond wheels efficiency, determined as the bond relative wear rate $V_{rel} = V_b - V_{dg}$, where V_b is the bond wear rate in a zone ahead of diamond grits, and V_{dg} - the diamond grits wear rate, has been proposed.

2. When the bond relative wear rate $V_{rel} < 0$, the diamond wheel works in the cutting capacity loss condition, and the cutting capacity restoring necessitates to remove the bond ahead the grits. When $V_{rel} > 0$, the diamond wheel works in the self-sharpening condition in the process of grinding.

3. It has been stated, that for the wheels, working in the self-sharpening condition, an optimal value of the bond relative wear rate V_{rel} exists, at which maximal cutting ratio G is achieved.

4. It is necessary under design of new bonds to provide optimal value of the bond relative wear rate V_{rel} by change of the wear-proof fillings contents in the bond and the diamond grits toughness**,** and by choice of the grinding conditions.

5. Under change of the grinding condition within the experimental limits the grinding ratio G increases as the bond relative wear rate V_{rel} is increased.

ESTIMATION OF DIAMOND WHEELS EFFICIENCY ON THE BASIS OF DETERMINATION OF THE BOND RELATIVE WEAR RATE

Summary:

A generalized estimation of the diamond wheels efficiency, determined as the bond relative wear rate $V_{rel} = V_b - V_{dg}$, where V_b is the bond wear rate in a zone ahead of diamond grits, and V_{dg} - the diamond grits wear rate, has been proposed.

When the bond relative wear rate $V_{rel} < 0$, the diamond wheel works in the cutting capacity loss condition, and the cutting capacity restoring necessitates to remove the bond ahead the grits. When $V_{rel} > 0$, the diamond wheel works in the self-sharpening condition in the process of grinding.

It has been stated, that for the wheels, working in the self-sharpening condition, an optimal value of the bond relative wear rate V_{rel} exists, at which maximal cutting ratio G is achieved.

It is necessary under design of new bonds to provide optimal value of the bond relative wear rate V_{rel} by change of the wear-proof fillings contents in the bond and the diamond grits toughness**,** and by choice of the grinding conditions.

Under change of the grinding condition within the experimental limits the grinding ratio G increases as the bond relative wear rate V_{rel} is increased.

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