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ABOUT SOME TECHNOLOGICAL PERFORMANCES OF DIAMOND CIRCULAR BLADES FOR CUTTING ROCK MATERIALS

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ABSTRACT

Here is considered the market situation of diamond circular blades in our country and on the bases of the analyses is suggested to produce them only on the bases of the physical and mechanical characteristics of the rock materials. About the production of diamond circular blades is commented the case of using synthetic diamond produced according to the requirements of the standards of FEPA and USA. The indicators for production of circular diamond blades in conformity with the type of the rock materials are dealt with in detail.

THE PROBLEM OF CHOOSING CIRCULAR DIAMOND BLADES

It is well known that a big assortment of diamond circular blades for cutting different materials, produced by foreign and Bulgarian companies, has been offered recently at our market. In most cases the diamond circular blades, which companies offer are so-called diamond circular blades for common purposes: cutting concrete, asphalt, ceramics, terracotta and different types of rock materials. Obviously, these instruments cannot satisfy the specific technological requirements for rational sawing of different rock materials. Moreover, these saw blades are with various qualities prices, which in most cases are determined by the market situation and to less extend by the technical and technological parameters of the instruments. In such cases, it is not rational to use diamond circular blades, which are not consistent with exploitation conditions of work and especially with the type and physical and mechanical properties of the rock material. Under the conditions of market economy the high competition between companies, producing diamond circular blades, forces them to take commission for single pieces which are consistent with a particular user's requirements. In this way, in order to do one correct commission for making diamond circular blades, which satisfy the user's requirements to the highest degree, it is necessary to avail of definite information, which is scrutinized below.

The production of diamond circular blades is connected with two kinds of factors: limiting and eligible.

The limiting factors mainly are connected with the kind, physical and mechanical properties and granule composition of the diamond material, which the producers of diamond circular blades supply from producers of diamond materials.

The eligible factors are defined by the user depending on the physical and mechanical properties of the sawing rock materials and other operating conditions and requirements.

Limiting factors of the technological characteristics of circular diamond blades

Specification of circular diamond blades. This is one of the basic factors, which determine the working capacity and technical resource of circular diamond blades. At present circular diamond blades for sawing rock materials are made exclusively from synthetic diamond. This stuff is made with programmable physical and mechanical qualities and granule characteristics. These parameters are defined by the technological parameters of diamond synthesis.

The synthesis being a company secret, the factories produce synthetic diamond with different indexes, but their materials correspond to the requirements of ГОСТ or of FEPA and USA. The production of the main manufacturers of synthetic diamond in the world corresponds to standards of FEPA and USA, so here are scrutinized only these materials. The synthetic diamonds are manufactured with various properties grouped as follows: SDA, SDA85, SDA100 and SDA100S.

The synthetic diamond SDA is typical for its very good strength index and controlled granule characteristics. This material is suitable for making segments for circular diamond blades for sawing rock materials with medial hardness such as marble and limestone.

The material SDA85 is designed for diamond tools for sawing rock materials with a wide range of hardness. It is accepted that this kind of diamond is suitable for sawing different non-metal materials.

The synthetic diamond SDA100 is more wear-resistant than the above mentioned. This sort contains a higher rate of diamond grains with raised hardness and this circumstance makes it suitable for tools sawing very hard rock materials such as granite and quartz. The tools with diamond segments made of SDA100 require higher engine power than those made of SDA and SDA85.

The synthetic diamond SDA100S is of exceptionally high quality and has the highest price. It is used for special needs as making segments for saw mills, which can saw very hard rock materials, as well as for drill heads.

It is very difficult to determine which sort of diamonds is most suitable for sawing rock materials with circular diamond blades. The basic criterion is realization of lower prime cost for a single sawing surface, which is determined by experimental research.

Diamond material granule characteristics. It is well-known that the granule characteristics of ordinary grinder diamond tools are determined quantitatively by the standards of FEPA and the USA by the so-called 'mesh system', which is different from the metric system, used in some Eastern Europe countries, Russia and others. The producers of synthetic diamond of sorts SDA, SDA85, SDA100 and SDA100S supply material for sawing tools only by the USA standard ASTM with grain dimensions higher than 80 mesh i.e. fraction 60/80, 50/60, 40/50, 30/40 and 20/30 (the latter is with the biggest size). In this aspect the granule characteristics factor of diamond materials is limiting for the producers of circular diamond blades with which circumstance the consumer have to consider.

Circular diamond blade indexes determined by the type of rock material.

Diamond concentration. This is one of the most important indexes of circular diamond blades, which determines its sawing properties, output, technical resources and price.

The diamond concentration is called the percentage contents of diamond (by aggregation) in a unit of a diamond layer in the segment. This important index is determined by the USA standard accepted in 1922. For 100% concentration under condition it is accepted the contents of 7 ct (1 ct = 0,2 gr) diamond in a cubic inch. Transformed in metric system this measure is 0,88 g/mm^3. Providently the diamond compactness is 3,5 gr/cm^3, so the diamond content in 1cm^3 is:

$Vg = 0,88/3,52 = 0,25$ cm^3

Consequently, independently of the type of connecting substance, for 100 % concentration, the diamond pieces take 25 % of the whole diamond layer.

The diamond tools for common purposes are made with concentration from 12,5 % to 200 %. The diamond concentration in circular diamond blades is defined over technical and economical consideration and it is normally between 25 % and 50 %.

When choosing diamond concentration, it have to pay attention to many factors, the most important of which is keeping the diamond grain in the bind substance as long as possible, under the condition that it retains its sawing characteristics. This formulation can be explained with the following special cases: circular diamond blades with maximal and minimal diamond concentration.

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A circular diamond blade with high concentration has many diamond grains on the sawing surface and at sawing its percussion load is much lower in comparison with a circular diamond blade with low concentration. The probability of extracting grains in this situation is minimal. The result is that the sharp sawing edges get smooth, which decreases the productivity of the circular diamond blade.

A circular diamond blade with low concentration has a lower number of diamond grains on the surface of the segments, and the load upon the separate sawing grains is considerable. If it passes over the critical value, the grains will brake and extract from the connecting layer. The result is that the wearing out of the circular diamond blade increases and the sawing is not effective anymore.

Discussing the diamond concentration in circular diamond blades there must be taken into consideration the strength of tie, whose quantity is defined by the index strength of tie.

Strength of tie. The tie in diamond segments fixes the diamond grains and the aggregate substances in a sufficiently solid diamond layer. The segment ties in sawing rock materials are metal and consist of various compositions based on tin, copper, iron, cobalt and others. The basic parameter of metal ties, that determines its sawing ability and technical resource, is their strength which is defined with micro-strength measuring machine.

The problem of choosing compound elements and hardness of metal ties is rather complicated. It cannot have a simple solution because of the importance of the hardness and abrasive qualities of the rock material, which factors are independent from each other.

Basically, in practice the following rule is valid: in case of a hard metal tie, it achieve low productivity and high technical resource are achieved, and vice versa, in case of a soft tie – high productivity and low technical resource.

Extent of diamond grains. As it has been noted, rational size of diamond grains is limited and ranges from fractions 60/80 meshes to 20/30 meshes. The choice of diamond grains massiveness has to be based on the analysis of the factors loading up the working grains in sawing process. These are the peripheral speed of sawing and hardness of rock material. To choose diamond materials with the optimum granule characteristics the following rules have to be taken into consideration: Solid rock materials are sawn with circular diamond blades of low granule characteristics and small peripheral speed of sawing of 30 to 40 m/s, and converse, medial solid and soft rock materials are sawn with circular diamond blades with higher granule characteristics and higher peripheral speed from 45 to 55 m/s.

These are the basic factors, which determine the choice of circular diamond blades for sawing rock materials.