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Betek modern tool systems

During the transformation period, in order to secure sufficient amounts of energy and to ensure that energy systems remain stable, it will still be necessary to produce energy based on raw materials such as coal, natural gas, and oil derivatives. Hence, mining techniques are being developed to increase productivity and improve safety by eliminating workstations that pose a risk to human health and life. This is ensured by fully automated mining systems. However, even the best-designed system is only as strong as its weakest link. In most mining machines, the cutting tool that has the most impact on performance are the tangential rotary bits (picks). Fully automated mining machine systems only make sense if the working units are designed with high-quality materials used in the production of bit holders, bit sleeves, and the bits themselves. This is something that EURO-TECH PLUS Sp. z o.o. has been working on together with Betek for years

Key words: *Betek GmbH & KG, EURO-TECH PLUS Sp. z o.o., tangential rotary bits (picks), sintered carbide, mining*

1. INTRODUCTION

Betek GmbH & KG. [1], the company represented in Poland by Euro-Tech Plus Sp. z o.o., is one of the leading manufacturers of modern mining tool systems, such as tangential rotary bits, bit holders, bit sleeves, sintered carbide inserts (points), as well as tools for mining, tunnelling, specialised construction, road construction, rail track construction, agriculture, crushing, etc. Production takes place on automated production lines based on internal resources of raw materials. The quality management system used is described in a quality management manual based on ISO 9001 and IATF 16949. This guarantees the highest quality and repeatability of products.

The mission of Euro-Tech Plus Sp. z o.o. is to design, manufacture, and supply high-performance and reliable tangential rotary bits in order to achieve the objectives set. Our aim is to make tools that will be used in easy and hard conditions, with soft and hard surfaces, in other words, a single universal range of bits.

2. TECHNICAL CHARACTERISTICS OF BETEK BITS (PICKS)

The manufacturer has indicated the elements that affect the performance, lifespan, and reliability of cutting tools in any and all conditions. In the case of tangential rotary bits (Fig. 1), these are:

- steel grade and heat treatment,
- workmanship tolerances of the details,
- the method of connecting the sintered carbide insert to the body,
- quality, size, and alignment of tungsten carbide grains,
- the diameter, shape and length of the sintered carbide insert.

For the production of tangential rotary bit body forging, Betek uses grade I steel 34MnCrB4+Ti, for which after heat treatment the body hardness is set at 46 HRC in a tolerance of ±3 HRC, and in special cases at the customer's request the hardness can be increased to 52 HRC. Such hardness of the body works very well with coarse-grained

sintered carbide inserts with a grain size of 4.5–6 μm measured using the linear method according to EN ISO 4499-2/2021-02 [3]. This makes it possible to extend the life of the bits in tougher conditions. Also, the use of intermediate sleeves with a hardness of 52 HRC and above in shanks allows the use of bits with an equal body hardness for the working (point) section and the shank section, which is preferred by our company. This eliminates the necessity to reduce the shank hardness of the bit body through the so-called tempering process. The different hardness values at the interface between the working (point) section and the shank section create a very large notch, which is the reason why the bits break. As a result, there is a need to mark the bits on the shank section, which remains in the holder after breaking. This is something unknown for Betek, and such problems have never occurred. This is probably due to the fact that the bits have a uniform hardness throughout the whole cross-section of the bit. This is very important for the life of the bit and the automation of the mining process.

An extremely important element in the design of the bit is the correct technique of connecting the sintered carbide insert to the body, as well as the composition of the brazing compound itself, which is produced in-house and constitutes a Betek trade secret. The connection made in this way fills one hundred per cent of the space between the insert and the body of the bit. This is fundamental to the durability of the bit and the absence of situations in which the insert falls out during a mining operation.

Fig. 1. Examples of the bits manufactured by Betek [2]

3. ERRORS AND DEFECTS OF BITS ENCOUNTERED IN MINES

Users of bits made by other manufacturers have informed Betek representatives of incidents they face in their daily work. These include the use of inferior steel grades, poorer quality body processing, inadequate heat treatment resulting in increased brittleness of the body, or a faulty method of connecting the point to the body of the bit (Figs. 2 and 3).

Fig. 2. Bits after one day of working from an unknown competitor

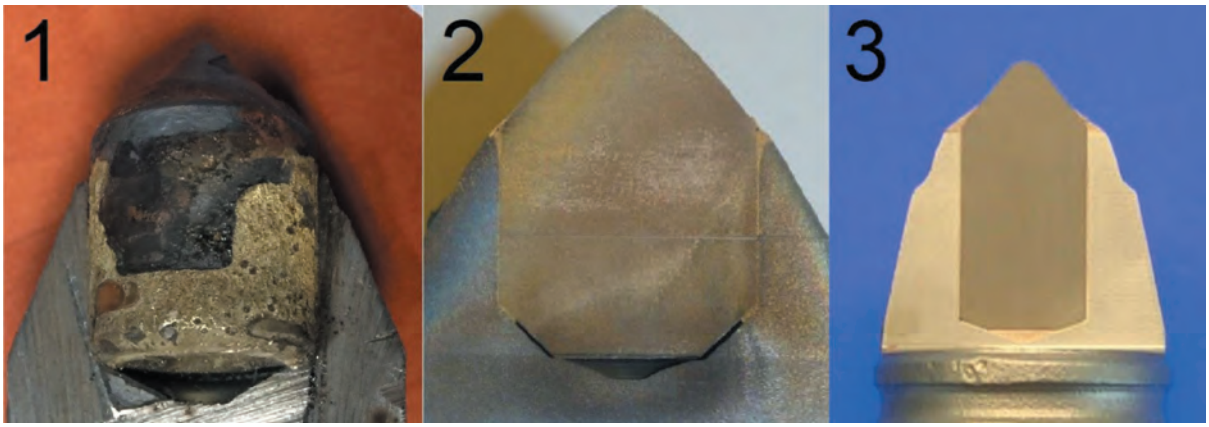

Fig. 3. Incorrect filling with solder from an unknown competitor (items 1 and 2) and an example of complete filling with solder from Betek (item 3)

Another element that makes mining ineffective is the wrong choice of sintered carbide insert. Contrary to the general belief that the larger the diameter of the insert the better, this is not confirmed in practice. The experience to date and the tests carried out show that the use of a smaller diameter insert improves the penetration of intact soil and increases the efficiency of mining. The use of a larger insert diameter in the presence of harder rocks and rocks with a higher silica content causes the body of the bit to wear faster than the point, which leads to exposure of the insert and its chipping or even for it to fall out (Fig. 4).

Also, the belief that the greater the length of the blade, the longer the bit will survive is inherently wrong and sometimes results from the cases described above. One may ask the following question: If the machine manufacturer recommends replacing the bits when the height of its working (point) section is worn down by 12 to 15 mm, due to the geometry and mechanics of the mining operation, why use an insert that is, say, 35 or 38 mm long? Even if this bit survives longer and a new bit longer by 15 mm is inserted in the adjacent holder, which bit will wear out faster? Does it make sense? The answer is obvious. Increasing the length of the insert is not economically justifiable due to the significant share of the cost of the insert in the cost of manufacturing the bit. Betka's statistical research showed that for 1,000

worn-out bits with a 35 mm sintered carbide insert, as many as 95% of the worn-out bits still had an 8 mm insert, measured as the height of the cylindrical part (without the cone) completely unworn. This indicates that it had been overbuilt unnecessarily, only increasing the cost of the tool.

Fig. 4. Incorrect sizing of the sintered carbide insert to the hardness of the body and mining conditions

4. HOW TO INCREASE THE LIFESPAN OF YOUR BITS?

Betek owns a unique patented technology called BeCoat, which consists of coating the working part of the bit below the insert with a layer of tungsten powder in a NiCr matrix with a hardness similar to that of the insert itself, significantly increasing the wear resistance of the body (Fig. 5). The use of this type of bits significantly (sometimes triply) extends tool life when mining highly abrasive rock.

In general, any increase in the service life of cutting tools has an impact on improving the efficiency of the entire mining system by reducing the frequency of tool replacement.

Fig. 5. Examples of Betek bits with a protective layer in the working (point) section [2]

5. SUMMARY

The system of purchasing mining tools should not be overlooked here. Mining plants are mostly state-owned companies, where purchasing rules are based on the Public Procurement Act. Experience shows that this system is not ideal and does not promote the creation of good products but rather those that are only cheap to buy. The difficulty of establishing quickly measurable parameters for mining tools does not allow the use of appropriate evaluation criteria to balance price differences. The criteria used so far to promote the size of the sintered carbide insert (diameter and weight) in the light of the above considerations do not reflect its suitability, durability, and quality in relation to price. The only way to do this is to perform trials and test the life of the bits. Poor quality bits have often been and remain the cause of the early wear of the working units, requiring them to be dismantled and taken to the surface for repair and reconditioning, something which is very expensive.

According to data from private firms that carry out works for mining companies which procure tools under single-source procurement procedure, the purchase of such tools at a slightly higher price (approx. 4–6%) from the cheapest supplier reduces wear of the bits by 40–70%, and in more difficult conditions even several times. This is often confirmed in work with clients.

References

[1] Betek GmbH & KG: www.betek.de
[2] Euro-Tech Plus Sp. z o.o.: www.eurotechplus.pl
[3] EN ISO 4499-2/2021-02: *Cemented carbides – Metallographic evaluation of the microstructure – Part 2: Measurement of the grain size of tungsten carbides.*

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