STUDY OF THE WEAR OF COAL CUTTING WORKING PARTS IN VIEW TO INCREASE THEIR RELIABILITY

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Abstract: The paper deals with the results obtained with shearer bit and bucket wheel excavator teeh wear resistance study and research in order to increase their lifetime.

1. Shearer bit wear and lifetime

The rock cutting process by shearing using shearer-loaders (fig.1) is the main process in the coal harvesting technology through longwall mining. It is characterized by a special complexity, which results from variable structure and strength properties of rocks and, on the other hand, due to the large number of constructive and functional parameters of cutting tools and working parts of the longwall shearer loader. The main parameters which influence the performances of the shearsers, and globally the performances of coal mining process are the haulage speed and the specific energy consumption. This latest one is strongly influenced by the wear of cutting tools (bits) mounted on cutting drums.

The main synthetic indicator, which reflects the bit’s quality from their wear resistance point of view, is the specific bit’s consumption, expressed in pieces/unit of measurement of resulted mining product quantity.

In the paper are presented the results of some in situ determination of realized bit’s consumption at two mining plants from Jiu Valley (E.M. Valea de Brazi and E.M. Lupeni) for the CMR – 4 bits case, which equipped ANDERSON AM – 500, KS-3M and KWB – 3RDU shearsers. From these data analysis, it can find that exist a large dispersion of specific consumptions in bits per 1000 t produced, respectively of daily medium consumption for the same shearer and the same kind of bit.

There were made observations in time about bit’s behavior in exploitation, for determination their durability, their wear resistance and the main causes of their out from use.
The CMR-4 bits are from radial type, in hard construction and they have two distinctive parts: the body and the tail. The bit’s body is like a wedge orientated forward. The peak is ended through a sharp cemented carbide tip.

The main effect of wear is defined through the clearance angle reduction until 0°. The different forms of wear manifestation which find at CMR-4 bits are showed in figure no. 2.

The kind of wear depends on the position of the bit on the shearer’s drum. After loosing the carbide pick, the wear is rapidly advancing in the bit’s body.

The observations were made directly on 112 bits, assembled in the same period, for which were settled the bit’s consumption on wear types.

Analyzing the data obtained and processed, it can find:
- A large difference of specific consumption on 1000 t, respectively the daily medium consumptions for the same shearer and the same type of bit;
- The medium value of specific consumption at those eight faces is 17,61 pieces/1000 t respectively a daily medium consumption is 4,58 pieces/day;
- The medium value of consumption for the same type of bits (CMR - 4) is 18,44 pieces/1000 t, respectively 4,77 pieces/day.

From those exposed above, it can conclusion that the shearer bit’s reliability isn’t guarantee by their constructive quality, the specific consumption values having a pronounce dispensations for the modern types of bits, from import. From this reason is required the theoretical and experimental study, on stands of wear requires of shearer bits.

The reliability parameters, in Weibull model case, it can determine through analytics and graphics methods.

The parameters determination of Weibull model with help of probabilities net Allan-Plait makes part from graphs methods of the reliability parameters. This probabilities net has on abscise the considered variable (the function time until the failure appearance), and on ordonates the appearance probability of failure in percents. It can be noticed that the values are comparable with those obtained at moment’s method.

Based on obtained data about the shearer bits exploitation requires, using Weibull model has determined the reliability indicators for the bits used at the eight faces. Using the calculation relation of reliability, Weibull model, has determined the reliability variation in report with time is presented in figure 3, as follows: A– for CMR – 4 bit, A face; B– for CMR – 4 bit, B face; C– for 3R4 – 80 bit, C face; D– for CMR – 4 bit, D; E– for CMR – 4 bit, E face; F – for CMR – 4 bit, F face; G– for CMR – 4 bit, G face; H– for CMR – 4 bit, H face.
2. Increasing life time and quality of teeth for bucket wheel excavators in lignite mines

This section deals with the problem of adapting the type and shape of the excavator bucket in Romanian open pits, as a function of the physical and mechanical characteristics of the excavated rocks and the technology used, with special respect to the wear and lifetime aspects.

The characteristics that influence the excavation process are: coal and rock properties; bucket wheel, bucket and teeth design.

The main physical and mechanical characteristics of the rocks in Romanian lignite fields have been determined at early times by laboratory analyses on the samples (cores) taken from geological prospecting drillings, but at present samples are taken in all existing faces to determine the most important parameters: compression resistance, tensile strength, faulting, breaking behavior, adherence, abrasiveness.

Abrasiveness is an essential parameter in determining the wear of the teeth and can be determined as a numerical value, by many known of abrasiveness tests.

Taking into consideration the shape of the bucket along with the arrangement and direction of the teeth, as well as breaking behavior of the material, the crushing range for each bucket can be inferred, and thus the distribution of the extracted material at a given moment.

The areas, in which the material is crushed, except cutting with teeth, are known as crushing range.

The unsuitable positioning and arrangement of the teeth on the bucket lead to both a rapid wear of those and to an increase of the volume of material, which can result in an increase of the share of required power in the wheel and in the pivoting mechanism.

All these elements led to the development of asymmetrical polygonal buckets (see fig 5), with which most of the modernized excavators are equipped.

The analysis of the behavior of the buckets recommends the use of asymmetrical polygonal buckets for low, "under bench" excavation.

The study of the wear of teeth fixed on the buckets shows that it is significantly influenced by the nature of the excavated material, as well as by their arrangement on the bucket.

The frequency of contacts of each point on the surface can be determined by analyzing the breaking of the cuttings in each position of the bucket wheel inside the excavated block.
The cutting process of the material depends on the hardness and faulting of the material of the face, and can be considered in the transversal section plane along the cutting arch at the angle of tear of material.

3. Conclusions

There were determined the main types of wear and their statistical distribution of those. It was determined the specific bit’s consumption.

It can draw a conclusion that economical efficiency analyze of bits utilization in mines, must have in view the specific bit’s consumption and, so the costs on which they introduced in output’s costs.

The reliability indicators knowledge permit taking some increase measures of reliability, respectively of their function period without disturbance through elimination the causes that lead to failure appearance and a better planning of repairing activities.

Adapting the geometry of the cutting parts, function of the geological and mining conditions, is absolutely necessary. Only after a thorough analysis of the geological and mining conditions can the shape and geometry of the bucket, as well the arrangement of the teeth be established.

References

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