POSSIBILITIES FOR INCREASING THE RELIABILITY OF THE SUBASSEMBLIES OF THE KSW-460NE TYPE SHEARER

DANIEL-DUMITRU BRÎNZAN[1], VLAD ALEXANDRU FLOREA[2]

Abstract: Various spare parts and subassemblies, through their specific consumption, cause high production costs leading therefore to a lower overall profitability. An example is the captive guidance of the KSW-460NE type shearer, the overall duration of normal operation of which does not exceed 2 months.

The paper presents the results of the use of laminated composite materials for metal surfaces of abrasive wear of the captive guidance of the KSW-460NE type shearer. Production experiments of the captive guidance have proven the viability of the technological solution for the improvement of their wear resistance made in the presence of fatigue cracks in rocks with non-homogenous content and variable mechanical properties.

Keywords: reliability, technological equipments, abrasive wear, composite materials

1. INTRODUCTION

The physical phenomenon of material wear implies experimental research to allow the determination of possible laws regarding the influence of technological parameters, factors concerning the material as well as the operation.

In practice, the need for creating and adapting the materials composing the machines and technological devices to the meet the extreme wear conditions, especially abrasive wear comes into question more often. [1], [2]. The complexity of the stress the equipments of the longwall are kept under in coal mines determined by the physical-mechanical properties of coal and of the interlayers of sterile implies the use of adequate machineries with an increased reliability.

In order to increase productivity and consequently the efficiency of mines, the most important problem is therefore making the subassemblies of the technological equipments, found in the longwall mines, more reliable. The operation period, namely

[1] *Eng.PhD Student, E.M. Lupeni*
[2] *Eng.PhD, Lecturer at University of Petrosani, floreavladalexandru@yahoo.com*

their continuous operation, is influenced by the conditions in which they operate, respectively shocks and vibrations which appear during the coal cutting process, coal which may present tough interlayers. A detailed analysis of the parameters characterising the cutting, support and conveyer transport processes (for scrapper conveyers) as well as of the specific underground environment conditions (moisture, gas emissions) imply therefore the need to realise and use materials with specific properties, usually antagonistic, for the manufacture of the subassemblies of technological equipments found in longwall mines.

2. SOLUTIONS FOR INCREASING THE RELIABILITY OF THE SUBASSEMBLIES OF THE KSE-460NE TYPE SHEARER

The main physical - mechanical characteristics the materials for the manufacture of subassemblies of the mining equipment should have are the following:

- Mechanical resistance (toughness associated with increased tenacity);
- Resistance to increased temperatures;
- Resistance to mechanical and thermal shocks;
- Abrasion resistance.

If spark resistance (antispark) is added to the physical-mechanical properties then the problem receives an increased degree of complexity.

Such a number of properties is not available but for composite materials or for those coated with a structural and consequently functional gradient.

Such materials, designed in order to meet a number of properties are defined as functional gradient materials.

Although being aware of their existence for several years, functional gradient materials started being defined as such, mainly due to the need of a thorough classification of composite materials. A subgroup, has separated from the group of composite materials, where the accent is laid not only on the differences of chemical composition of the phases which compose the material or on the means these phases appear in the structure (dusts, long or short fibres, etc.), but also on the how the construction of the material meets a series of functional requirements. Moreover, this kind of materials are also abbreviated FGM (Functional Gradient Materials).

FGMs are multilayered material obtained through different techniques, while thickness of the layers may vary. Therefore, structural and / or compositional gradient materials of the same system may offer a series of spectacular solutions to different specific problems.

For example, a gradient of properties [2] in order to increase the toughness from the surface towards the core of a part, together with the decrease of the resistance characteristics becomes really interesting as a functional solution in solving the complex stress the respective part is kept under.

Mainly composite or structural gradient materials were obtained using surface means and technologies.

Although some of the layers may be obtained with a progressive variation of the composition, for example Ti(C, N) layers by changing the C:N ratio, the layers of hard alloys and cermets contain bi-dimensional interfaces such as the one in the top layer as well as the hard alloy.

One of the multilayer plating advantages compared to the single layer one is that the stress is distributed and dissipated on a larger surface of the interface in a larger amount of material.

Various spare parts and subassemblies, through their increased specific consumption, cause high production costs leading therefore to a lower overall profitability. Conclusive examples are the rock dislocation tools (Figure 1) as well as a series of subassemblies belonging to the hauling equipment and to the shearers (Figure 2).

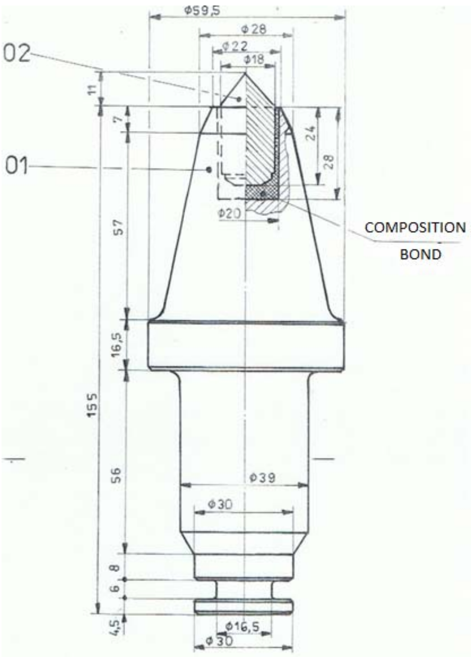

Fig. 1. Cutting tool for the KSW-460NE type shearer

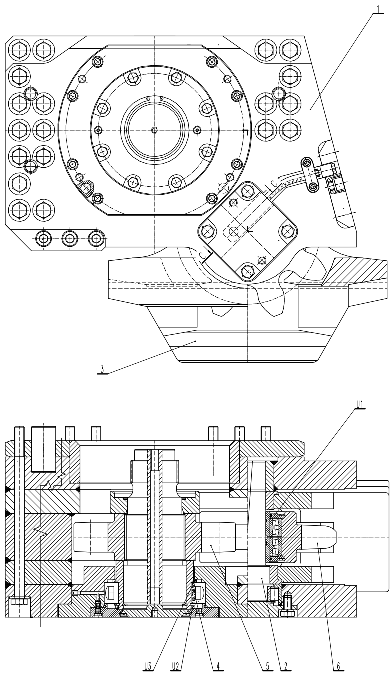

Fig. 2. Right (left) advance mechanism of the KSW-460NE type shearer:
1. Captive guidance; 2. Axle drive gear;
3, 4, 5, 6. Advance mechanism axle drive gear;
7. Axle drive gear

The reliability study of the subassemblies of the KSW-460NE type shearer (Table 1) and consequently of the possibilities on increasing t are based on the data obtained at Lupeni mine; the shearer has operated since 2007, with several interruptions, in longwall mines powered from the panel 2C, 1^{st} slice and panel 1C, 2^{nd}, 3^{rd} and 4^{th} slice from street no. 3 block IV.

The P2C longwall from Lupeni mine began its operation on the 1st of October 2007 having installed a TAGOR-18/37-POz/P type powered roof support (67 sections Polish manufacture), KSW-460NE Ø1800×800 type shearer and TAGOR 260/750 type conveyer (Table 1)

Table 1. **Centralizer for the reliability and maintenance indicators of the KSW-460NE type shearer components which presented several breakdowns**

No.	Component name	No of breakdowns	Breakdown frequency f_c	Repair time (min)	Repair time ratio p_r	MTR min	Repair rule	Reliability parameter	Operation between breakdowns (hours)
1.	Right Captive Guiding	6	0.1666	1920	0.1593	320	Exp	λ=0.00114 hours^{-1}	876
2.	Left Captive Guiding	7	0.1944	2520	0.2091	360	Exp	λ=0.001187 hours^{-1}	842
3.	Safety for right advance mechanism	3	0.833	160	0.0132	53.3	Exp	λ=0.00167 hours^{-1}	598
4.	Safety for left advance mechanism	4	0.1111	390	0.0323	97.5	Exp	λ=0.000683 hours^{-1}	1462.5
5.	Drive gear for left advance mechanism	6	0.1666	2400	0.1991	400	Exp	λ=0.001009	991
6.	Drive gear for right advance mechanism	3	0.0833	900	0.0746	300	Exp	λ=0.000505	1980
7.	Cutting organ	2	0.0555	780	0.0647	390	Exp	λ=0.000574	1740
8.	Hydraulic pump	1	0.0277	120	0.0099	120	Exp	λ=0.000192	5196
9.	Advance lip seal	1	0.0277	300	0.0248	300	Exp	λ=0.000174	5730
10.	Right beam satellite	1	0.0277	2400	0.1991	2400	Exp	λ=0.000896	1116
11.	Oil philtre	1	0.0277	60	0.0049	60	Exp	λ=0.000584	1710
12.	Shearer skid	1	0.0277	100	0.0082	100	Exp	λ=0.00019	5244
	TOTAL	26		12050					

The Pareto Diagram [3] in Figure 3 which highlights the breakdown frequency (fc) and the repair time ratio (pr) of the components of the KSW-460 N-E type shearer which presented several breakdowns was created with the use of the data presented in Table 1.

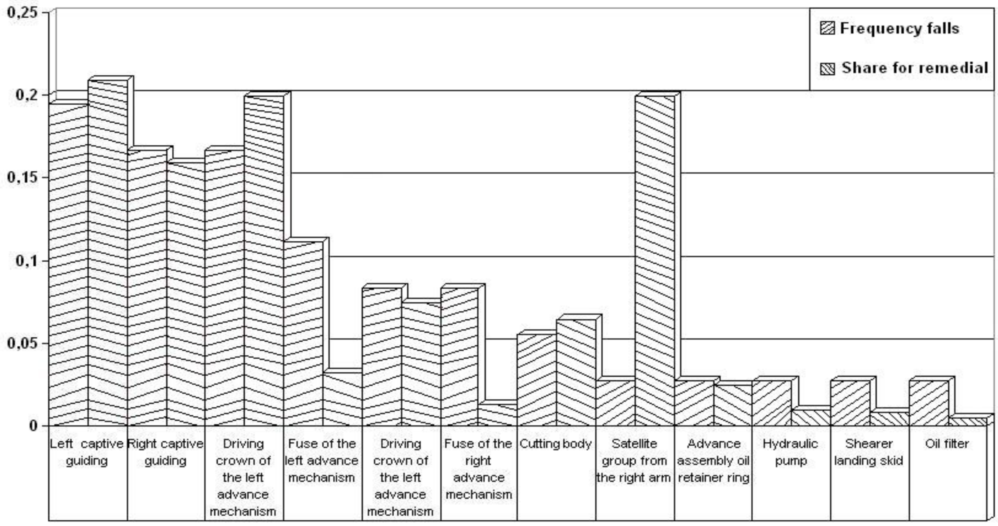

Fig. 3. Pareto Diagram for the components of the KSW-460NE type shearer

The left and right captive quiding present a 0.1944 respectively 0.1666 breakdown frequency, deciding therefore to test and experiment the recondition and increase of their operation period (Figure 3).

Fig. 3. Used and partially reconditioned guiding of the KSW-460 type shearer

The method of laying pure granules through welding is considered to be the best solution to realise layered composite metallic surfaces required for the execution of subassemblies with an increased abrasive wear resistance usable therefore in gas generated potentially explosive environments. The objective of the researches was to recondition different subassemblies of the technological machineries to be used in gas generated potentially explosive environments together with the increase of their operation period.

3. CONCLUSIONS

Practical trials of the layered composite materials, realised during the experiments carried out at Lupeni mine proved that the technological parameters having a decisive influence on the evolution of their wear is the granulation of the laid material and the value of the intensity of the current the equipment for carbide coating is set at.

The results of the experiments have emphasised the duplication of the operation time of the reconditioned guiding and the possibility of using different materials and methods without additional investments

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