DISRUPTIONS ANALYSIS FOR EQUIPMENTS USED IN LIGNITE OPEN PITS

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Abstract: The study on time and capacity of using technological systems of complex profile is a high importance problem implying different approach levels and views. The paper handles the character of running interruptions for the machinery from lignite open pits in Romania, using a method based on statistic analysis.

Keywords: quarry, lignite, bucket-wheel excavator, belt conveyer

1. INTRODUCTION

Since open pit exploitations in Romania started quite recently, the opportunity of choosing the most modern exploitation system and equipment was influenced by the experience from other open pits worldwide.

The basic characteristics of open pits nowadays are:

- using efficient exploitation modern methods;
- complex mechanization of production by using appropriate high capacity machinery;
- the possibility of judicious work planning and organization.

The continuous exploitation systems are most used in lignite open pits, the technologic process stages being developed in normal sequence, the component machines being correlated on the excavation – transportation – dumping – storage capacity. For these continuous activity exploitation systems there can be found bucket wheel excavators, high capacity belt conveyors, dumping machines and storage machinery.

The technologic process for a deposit exploitation consists in three main operations: extraction, transport and storage (fig. 1).

The technologic process stages develop in normal sequence, the machinery being correlated on the excavation capacities, suitable for the deposit conditions.

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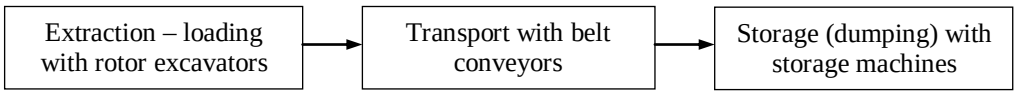

Fig. 1. The technologic process for lignite extraction, transport and storage

The open pit extraction technology (fig. 2) mainly took into consideration the utilization of high efficiency machinery, mainly:

- rotor excavators type EsRc-1400 30/7·630;
- distribution equipment type CBS 1200·60 and BRS 1600·60;
- T.M.C. belt conveyors with carpet width 1000-2000 mm;
- dump facilities type IH 6500·90 and IH 4400·170;
- dumping and distribution machines type MHD 4400·50;
- deposit and loading combines type Ks-S 5600/3800·40 and storage machines type As-G 6000·40

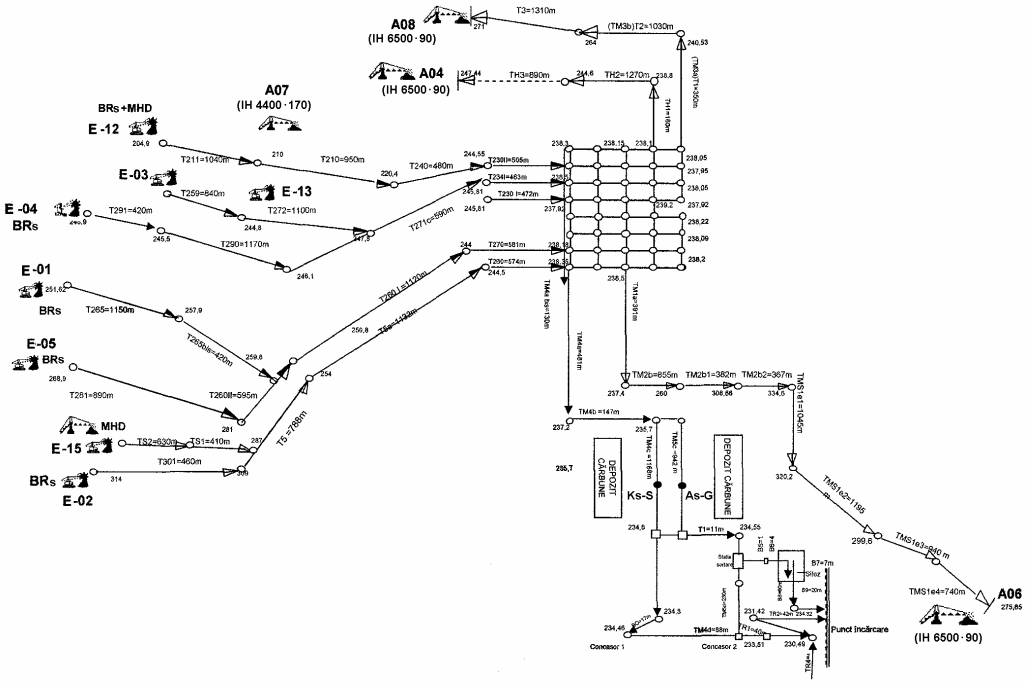

Fig. 2. Lignite open pits technological flow

In the lignite open pits from Oltenia, the layers are 1-8 meters thick, with 3°-7° slope and show barren intercalation with variable thickness.

2. MAIN ISSUES IN HANDLING THE EXTRACTION SYSTEM

The planned interruptions for technologic works (technologic interruptions) and maintenance and repairing works (non-technologic interruptions) represent the

main issues in handling the extraction system.

The evolution of planned interruptions for technologic works is shown in figure 3.

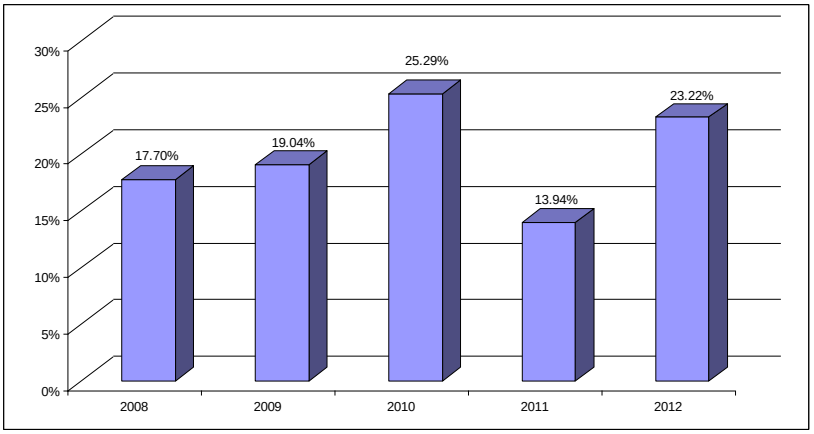

Fig. 3. The share of technologic interruptions in total interruptions

The interruptions for basic technologic processes, transversal displacements, conveyor belt crosses, bucket reverses, work front alterations represent a small part of the entire technologic interruptions.

The biggest part of the technologic interruptions is given by other causes like weather or floods.

Transversal displacements and front / dump conveyor extension works are important for the technologic lines operations, but preliminary works are often done improperly, for example:

- transversal displacement platforms and conveyor alignments;
- belt routes section holding;
- section alignment, centering and equidistancing;
- replacing and straightening crooked rails;
- straps and clings.

The above listed lead to improper transversal displacements, resulting in excavators operating on low hourly capacity, increasing the number of random interruptions.

Regarding the maintenance and repairing works, we noticed the following issues, leading to established term overdue:

- the human and technical values of the dedicated providers has decreased continuously;
- performing maintenance and repairing works due to random events (mining works, technical accidents) which forces the provider to do works without proper material preparation, without enough work force and even without auxiliary equipment;

- malfunctions in ensuring the materials due to financial jams;
- lack of reliability for the landmarks and subassemblies of the equipment;
- absence of measuring and control devices for establishing the wearing degree of the mechanisms and parts.

The planned stops for maintenance and repairing works are shown in figure 4.

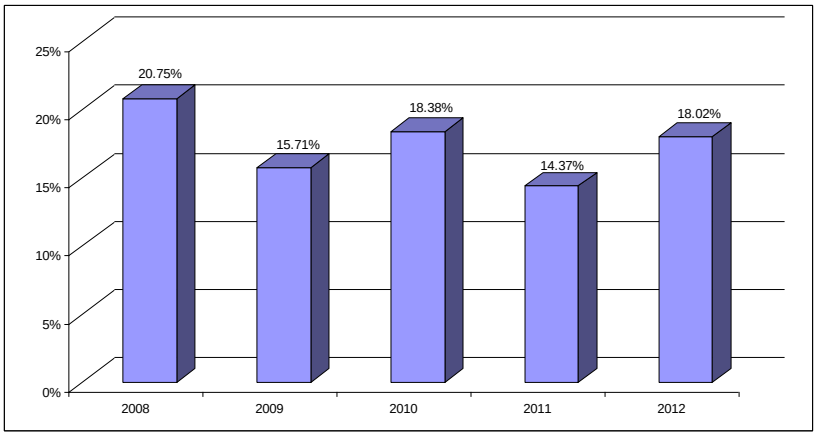

Fig. 4. The share of maintenance and repairing works among all interruptions

From figure 4 we notice that the time for maintenance and repairing works has decreased though, due to multiple reasons, mainly:

- following the repairing introduction conditions, regarding the operation hours and the performed production, stipulated by the improved normatives;
- following the correlation standards between the repairing costs and the revenue achievements.

Random interruptions are another cause why the machines do not work at full capacity. The shares of these interruptions are shown in figure 5.

During 2008-2012, in lignite open pits, the main interruption causes were:

- mechanical interruptions, with a share of 6.14% (fig. 6);
- electrical interruptions, with a share of 6% (fig. 7);
- vulcanization interruptions, with a share of 25.96% (fig. 8);

Among mechanical interruptions, the biggest share is given by excavator mechanical interruptions, as shown in figure 9.

During 2008-2012, the shares of various mechanical interruptions among excavator mechanical interruptions are shown in figure 10.

The following malfunctions stand out:

- bucket wheel reducing action unit malfunctions;
- mechanical malfunctions for excavator conveyors;
- marching system supports, spurs, rolls breakings;
- excavator buckets, teeth, handles breakings;

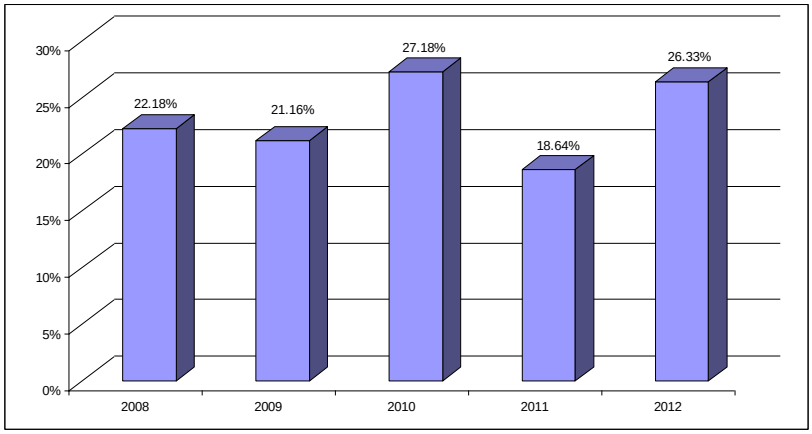

Fig. 5. Share of random interruptions among all interruptions

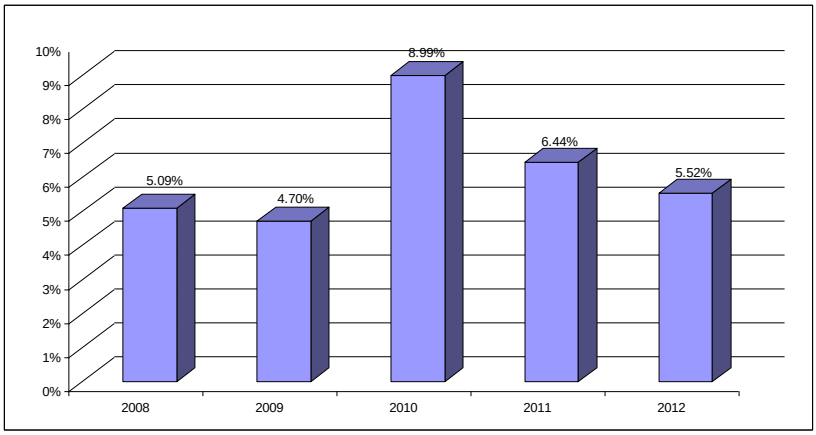

Fig. 6. Share of mechanical interruptions among random interruptions

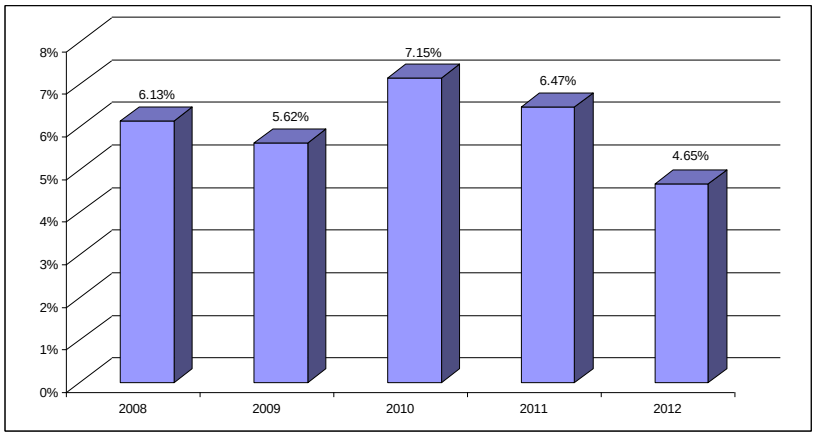

Fig. 7. Share of electrical interruptions among random interruptions

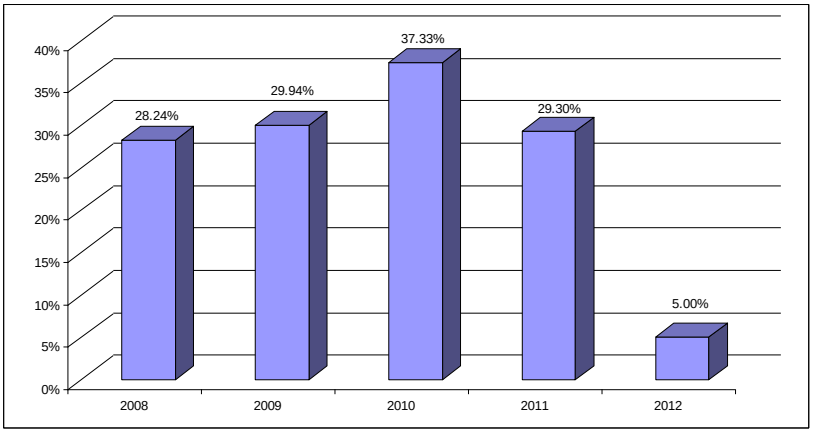

Fig. 8. Share of vulcanization interruptions among random interruptions

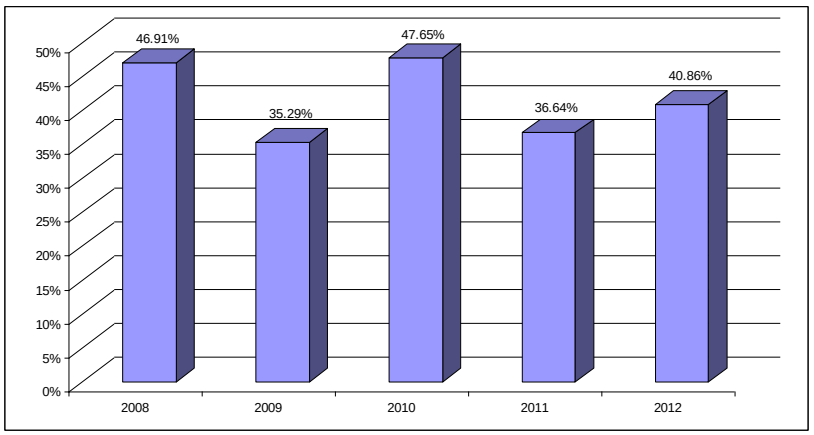

Fig. 9. Share of excavator interruptions among mechanical interruptions

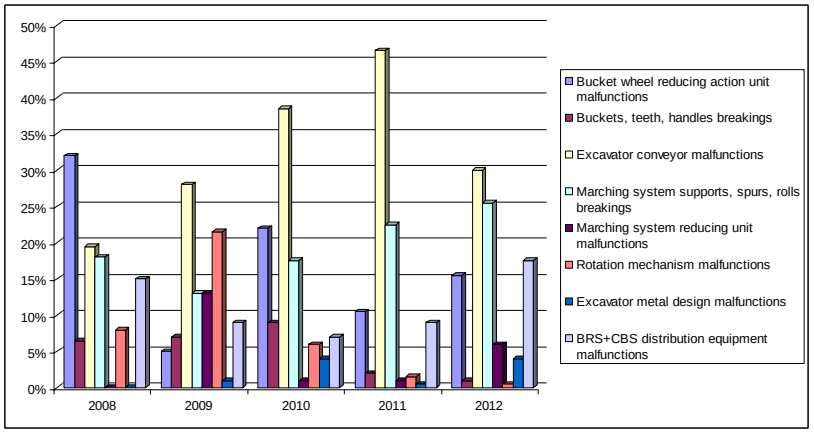

Fig. 10. Shares of various mechanical interruptions among excavator mechanical interruptions

Bucket wheel reducing action unit malfunctions consisted in:

- sprocket bearings jams;
- greasing system deficiencies related to oil level, pipe clogging;
- malfunctions of the greasing pumps;
- malfunctions of the greasing operation control devices.

The malfunctions of the machine conveyors are caused by damages of the bearing reels (action, return), by depressing the reducing units from the action reels spindles, by jamming and damaging the bearings from the sprockets to the reducing units. Bearing malfunctions are given by the damaging of the sealing system (labyrinths, locks), by the bearing wear and damage, by the loosening, damaging and even breaking the conical nuts which fasten the bearings on the reels spindles.

The marching system malfunctions consist in:

- improper functioning of the central greasing installation, which leads to diffusing of the nuts from the running rolls trains;
- support breakings;
- tracks stucking and uncoupling due to improper conditions given by operating on work stairs, which leads to marching mechanism overburden, increasing the damage of force and intermediary reducing units from the marching system.

Random interruptions given by other causes have the second share in average, the main causes being:

- excavating and dumping machines being stuck due to not following the steps stipulated in the work monographs;
- transport circuits being stuck due to the improper technical state of the conveyors;
- lack of coal storage space, due to low demands;
- low dumping capacity.

During 2008-2012 the biggest share of random electrical interruptions on excavators was represented by command and signaling circuits interruptions, followed by malfunctions from the conveyor action engines from the dumping machines.

Most electrical malfunctions from the belt conveyors are found at the power equipment, electrical engines, liquid and metal rheostats, stator and rotor switches and also for 6 kV and 20 kV power supply cables breakdowns.

Another cause for electrical interruptions is the often breakdowns of the 6 kV electrical cables due to:

- improper positioning;
- protective sheath damaging by rubbing to the rubber carpet of the conveyors or by pressing from auxiliary equipment;
- aging.

3. CONCLUSIONS

The statistic approach is an efficient way to study the technologic systems used

in lignite open pits. The full solution of this problem implies a monitoring system and a data base where the software is connected to, so the speed factors to figure out in real time the capacity function of the system they operate by decision.

In conclusion, to achieve high hourly work capacities for all the machinery used in the lignite open pits, the following causes should be eliminated:

- improper operation of the excavation activities by providing work fronts (width, height) according to technical standards;
- not following the work technologies and not performing water administration works from work levels;
- not performing quality maintenance and repairing works and not replacing damaged elements;
- improper conditions of the belt conveyors;
- improper qualification of the working staff.

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