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# EQUIPMENT MAINTANANCE – FACTOR OF PROFESSIONAL NOISE EXPOSURE REDUCTION

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**Abstract**. *Noise is a technological metabolism by-product, representing one of the most important discomfort factors for personnel that work in energetic coal extracting and preparation processes. Being aware of the general risks specific to energetic coal extracting and preparation activities, generated by exposure to noise, helps quantifying the effects upon workers, such as: blanking, auditory fatigue, sonorous trauma, partial loss of hearing, professional deafness. Prolonged exposure to high intensity noise may lead, in time, to professional deafness. Unlike auditory fatigue, which is a transitory and reversible phenomenon, noise-induced deafness noise caused deafness is characterized by definitive and irreversible loss of hearing. The number of people exposed to noise is continuously rising because of the increasing work speed of the equipment and power and increased mechanization. The current paper analyzes the evolution of the main sources of noise specific to energetic coal extracting and preparation processes, depending on maintenance and refurbishment.*

**Key words***: noise, ear protection, occupational diseases*

## 1. INTRODUCTION

Development has led to increased power and work speed of equipment used in the production processes, leading to a diversified and increased number of noise sources and hence increased number of people exposed.

Noise is one of the most important industrial emissions that generate occupational hazards by becoming a harmful factor, occurring from equipment damage and / or malfunction. [1,3]

Noise has a noxious influence on human body, this influence being firstly felt by the hearing organ. Systematic prolonged action of intense noise may represent a cause for decreases in the auditory capacity and, in severe cases, cause of total hearing loss.

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In the mining and coal preparation activity developed in the Jiu Valley, the presence of risks generated by noise cannot be ignored, because it affects the health and safety of workers.

Strategically, the issue of exposure to noise is unitarily approached at European level, according to European practices, by progressive implementation of regulations and techniques used by EU member states regarding the monitoring of noise emission levels in workplaces. [2]

To improve working conditions, specific guidelines for physical noxae (noise, vibration, electromagnetic radiation, etc.) were developed, providing minimum requirements that guarantee an optimal level of protection for workers. The purpose of these Directives is to reduce the number of occupational disease occurrence. Occupational deafness and hyperacusis influence all the activities of affected people by creating discomfort both in private life and workplace. Occupational deafness and hyperacusis affect more and more workers, leading to increasing costs for the healthcare system because these diseases are irreversible.

## 2. THE PURPOSE OF NOISE DETERMINATIONS

The technological processes of energetic coal extraction and preparation use noise generating machinery and equipment.

Main noise sources may be found in the following processes:

- horizontal and vertical mining mass transportation,
- water discharge
- compressed air production,
- crushing mining mass,
- preparation and separation of coal from the rock mass,
- tailings transportation to dumps, etc.

In order to improve occupational health and safety conditions and achieve the objective noise exposure reduction, some general principles should be considered, regarding:

- occupational risks prevention;
- protecting the health and safety of workers,
- elimination of accidents and professional diseases hazards [3, 4]

## 3. THE PARTICULARITIES OF NOISE DETERMINATIONS IN THE MINING INDUSTRY

The noises emitted during technological processes of energetic coal extraction and preparation are continuous (present when generating pneumatic energy, discharging groundwater, during mining mass preparation) or intermittent (when drilling, blasting, transporting minerals and tailings).

The particularities of extraction and preparation activities are:

- Impairing the ability of exposed workers to perceive noises made by underground mining pressure, eruptions of gases and fines particles etc.
- Masking warning acoustic signals (e.g. the conveyor's on / off signal, funicular start/ stop signal, etc.)

Noise levels produced by the equipment and facilities used in extraction and preparation of energetic coal comprise all types of noise including impulse noise that also produce effects on humans.

Noises in the process of extraction and preparation of energetic coal are among the ones with most numerous effects on the human body. Depending on the level of noise intensity and exposure time, there are several types of harmful effects on workers, namely:

- the masking effect,
- hearing tiredness,
- acoustic trauma,
- acute hyperacusis,
- accupational deafness.

In the processes of energetic coal extraction and preparation, the most appropriate methods for noise control at existing sources consist of active and passive protection measures.

The purpose of noise reduction is to achieve optimum acoustic comfort without affecting the production capacity at an affordable price.

## 4. THE EQUIPMENT USED

For noise noxae determinations, we used Bruel & Kjaer type 2250 integrated sound meter, Bruel & Kjaer type 4231 calibrators and the BZ 5503 determinations software. For ensuring the quality of results, sound meters and calibrators are inspected in accordance with the effective legislation.

In order to determine the A- weighted sound exposure and /or the level of equivalent continuous A- weighted sound pressure, the measurement of sound pressure was performed with the microphone placed in the position(s) usually occupied by the worker's head.

If a worker is present or needs to move near the place of measurement, then the microphone was positioned at about 0.10 m ± 0.01 m from the entrance to the ear canal, where it receives the highest level of A- weighted sound exposure and /or highest level of equivalent continuous A- weighted sound pressure [2,5]

An estimate of the measurement overall uncertainty was included when reporting the results, taking into account the influence of factors such as:

- Measuring equipment,
- Microphone's location.
- Number of measurements.
- Noise source time and space variation.

## 5. RESULTS

Table 1 shows the average results of measurements performed on noise generating equipment used in energetic coal mining and preparation activities carried out in Jiu Valley and their evolution in time, over a period of seven years. [2,3]

The evolution of noise depending on time, and also the tear, wear and changes occurring after maintenance and overhaul operations may be noticed.

Lack of major investments in new technologies is noticeable by the increased level of noise emitted by equipment in the monitoring period.

**Table 1** Experiment results

| Job / equipment name | P90 Pneumatic Drill | CA14 jackhammer | Scraper Conveyor TR 3 | TMB belt conveyor | Funicular mining unit | Crusher | Picking belt | Vibrating screen | Funicular preparation unit | Tailings Belt conveyor |
|---|---|---|---|---|---|---|---|---|---|---|
| Year | *Noise level dB(A)* | | | | | | | | | |
| 2007 | 101,6 | 109,1 | 93,9 | 88,4 | 88,1 | 91,5 | 92,2 | 97,3 | 87,9 | 89,5 |
| 2008 | 102,3 | 108,3 | 94,2 | 88,5 | 89,2 | 91,2 | 93,2 | 97,1 | 88,1 | 89,9 |
| 2009 | 102,5 | 107,2 | 94,1 | 88,9 | 89,8 | 96,9 | 96,3 | 98,1 | 88,2 | 91,8 |
| 2010 | 101,2 | 108,5 | 95,2 | 91,1 | 96,1 | 92,0 | 96,3 | 99,2 | 100,4 | 92,6 |
| 2011 | 104,3 | 108,4 | 95,6 | 91,6 | 88,5 | 90,3 | 98,2 | 99,1 | 90,9 | 100,5 |
| 2012 | 102,4 | 107,1 | 96,2 | 96,1 | 91,3 | 92,0 | 95,5 | 98,2 | 92,2 | 89,2 |
| 2013 | 103,6 | 108,5 | 95,2 | 95,2 | 92,5 | 93,2 | 100,3 | 101,7 | 95,1 | 89,4 |

Diagram no.1 shows the evolution in time of equipment that has been subjected to a regular maintenance program.

Due to the relatively low costs and low complexity, periodic maintenance of equipment like pneumatic drills, jackhammers, scraper conveyors, belt conveyors, crushers, can be performed by own mechanical workshops, which does not require an additional financial effort from the economic operators. Performing maintenance influences the levels of noise emissions; we noticed a relatively small variation in noise up to 4 dB(A) per analyzed period.

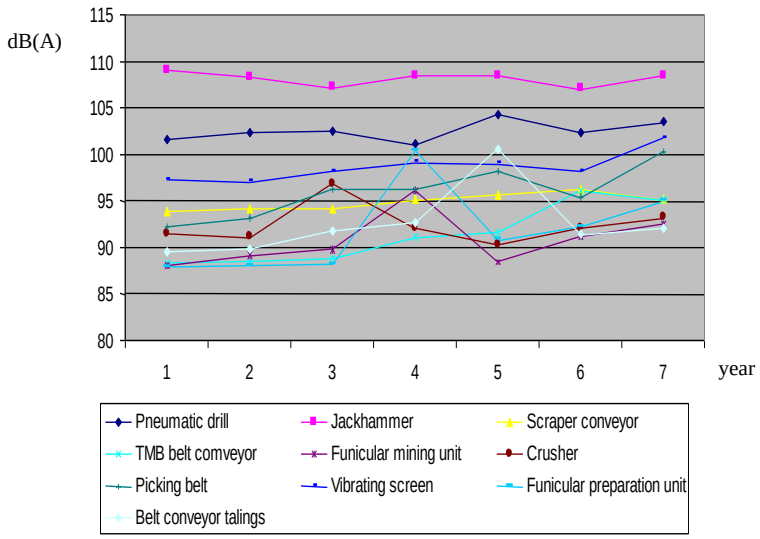


**Fig. 1** Evolution of equipment that has been subjected to a regular maintenance program

Diagram no.2 shows the time evolution of two machines, whose maintenance calls for allocation of large funds. Maintenance of these two devices takes a long cut-off time from the activity and granting of significant funds for economic operators.

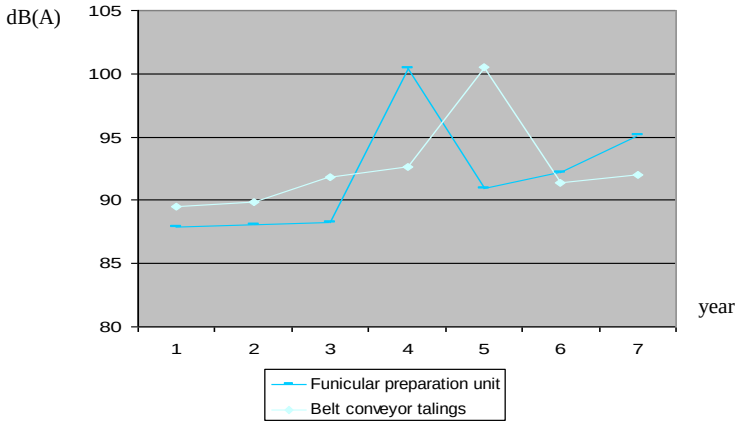


**Fig. 2** Time evolution of the two machines that maintenance require large repair funds

The repair works were not made with the same rigor because of the high cost of maintenance for the two devices, of the decreased production capacity, lack of funds for investment, restructuring of the mining filed; this led to higher levels of noise emissions generated by the wear of cable transportation system components.

One can notice that the funicular noise increases with wear within the period 2007-2010 when no repairs were made, and in 2011, after conducting major overhaul and maintenance operations (replacement of the traction cable, main actuator replacement, replacement of rollers, cups etc.). We have noticed a decrease in noise emission by about 10 dB(A) approximately returning to 2007 parameters.

The major overhaul of tailings belt conveyor (rollers replacement, belt, actuation stations) carried out in 2011 reduced noise by approx. 11 dB (A).

Taking into account energetic coal extraction and preparation processes, the effectiveness of a maintenance programs may be monitored by knowing the noise level evolution in time depending on equipment wear out. The effectiveness of maintenance programs should not be viewed only through the prism of economic efficiency, cost / productivity, but also in terms of safety and health at work. A well established and kept maintenance program reduces noise levels and /or maintains them within the parameters specified by the manufacturer.

Increased knowledge also allows retrofitting old equipment and lowering noise emissions that are affecting the health and safety of workers.

The analysis of specific noise sources in the processes of extraction and preparation of energetic coal showed that the optimal noise reduction solutions are:

- Upgrading / replacement of equipment with silenced new one;
- Carrying out maintenance processes in accordance with the manufacturer specifications for equipment;
- Installation of acoustic screens in the vicinity of noise source and replacement of control elements;
- Use of individual hearing protection;
- Limitation of exposure time.

## 6. CONCLUSIONS

From the above we subtracted the following conclusions:

- Maintenance activities have a major influence on noise levels, being able to contribute to the improvement of work conditions.
- The relatively low request for energetic coal leads to reduced allocation of funds for upgrading / buying quieter new equipment. Lack of funds for investment in the processes of extraction and preparation of energetic coal, high degree of physical and moral wear of equipment used, has led to the increased number of people exposed to hazardous noise levels that may affect safety and health.
- Contrary to financial difficulties in purchasing the appropriate equipment and facilities that generate acceptable levels of noise emissions, we have noticed a positive trend on the use of protective equipment, due to informing and raising awareness between workers.
- The lack of markings regarding noise emissions makes it difficult to assess the effectiveness of maintenance work in terms of workers exposure to noise. The effectiveness of these works can be determined only by measuring noise during a relatively long period of time or by comparison with similar equipment.
- Applying markings for acoustic power on equipment and informing the workers led to creating a safer working environment by reducing exposure to this noxae.

In order to verify the effectiveness of noise reducing methods, regardless of their nature (technical, organizational), we propose periodic audiograms of workers because hearing loss is an irreversible disease that affects the quality of both personal and professional life. [2].

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# ODRŽAVANJE OPREME - FAKTOR SMANJENJA PROFESIONALNE IZLOŽENOSTI BUCI

*Buka je nusproizvod tehnološkog metabolizma, i predstavlja jedan od najvažnijih faktora neprijatnosti za zaposlene u procesima iskopavanja i pripreme uglja. Svesnost da postoje opšti rizici vezani za izloženost buci koji nastaju pri određenim aktivnostima iskopavanja i pripreme uglja nam pomaže da ocenimo štetne posledice po radnike: zujanje, slušni zamor, zvučna trauma, delimični gubitak sluha, profesionalna gluvoća.Duže izlaganje visokim niovima buke vremenom može dovesti do profesionalne gluvoće. Za razliku od slušnog zamora, koji je prolazna i reverzibilna pojava, gluvoću prouzrokovanu bukom karakteriše konačni i nepovratni gubitak sluha. Broj ljudi izloženih buci kontinuirano raste zbog sve veće brzine i snage opreme i povećane mehanizacije.U radu je analizirana pojava glavnih izvora buke koji su specifični za procese iskopavanje i pripreme uglja, u zavisnosti od održavanja i remonta.*

Ključne reči: *buka, zaštita za uši, profesionalna oboljenja*