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EVALUATION OF MAGLOVEC QUARRY BY APPLICATION OF VISUALIZATION TECHNIQUES TO EMISSIONS OF NOISE FOR DEVELOPING ANTI-NOISE MEASURES

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ABSTRACT: *Excessive noise and vibrations are one of the important factors threatening the environment. That is why an effort to eliminate noise as much as possible cut down its values to a minimum and create ecologically-friendly working environment, free from both disturbing and harmful effects of noise on human health should be one of the paramount tasks and goal of each and every society. This paper presents the technique of noise visualization used in measuring noise, designing and evaluating the effectiveness of the anti-noise measures for SDT aggregate screen in heavy industry operation – aggregate screens in the Maglovec quarry of IS LOM s.r.o. company carried out using the acoustic camera. Measurements taken with the acoustic camera were subsequently visualized and used for identification of noise sources.*
KEYWORDS: *visualization, acoustic camera, anti-noise measures*

INTRODUCTION

The Slanske hills forming part of East Slovakian neovolcanites belong to important regions of the Western Carpathian Mountains as a potential source of construction aggregate. In the region of the Slanske hills and their surroundings there are eight exclusive deposits of unrestricted minerals. The Vysna Sebastova (IS-LOM s.r.o Maglovec) quarry is also found there. Natural crushed aggregate from the Maglovec quarry is used for production of concrete, mortar, compacted asphalt layers of pavements, mastic asphalt, binder courses of pavements, stabilized aggregate base courses of roads, asphalt mixtures, railway ballast as well as for winter gritting of roads, summer maintenance of roads.

The mining of building stone is mostly carried out by quarry method in benched quarries using large-scale blast operations (bench blasting) with additional secondary small scale shooting and blasting. Various types of machinery are employed in surface mining, such as excavators, shovels, bulldozers, drills and transport vehicles. Processing, by itself, includes crushing in crushers and further screening into fractions using stationary lines or mobile equipment as well as other technological machinery and equipment.

All these demanding and challenging processes produce unwanted by-products such as excessive noise and vibrations which, directly or indirectly, affect the environment and eventually people who are imminently interested in the exploitation process. In the recent years a comprehensive reconstruction of the production line for production using "dry method" was carried out. The reason was not only to enlarge the assortment and improve working environment, but also to enhance protection of the environment and the surrounding countryside.

Prevention measures can be taken in order to protect health at work by organizing the daily flow of work, e.g. safety breaks, operation of exhaust systems, providing sufficient amount of effective personal protective wear and equipment at work, carrying out regular medical checks, etc.

One of the options how to adequately control the exposure of workers to noise at acceptable levels at extremely exposed workplaces is application of modern information technology in designing anti-noise safety measures.

The paper was developed as a result of cooperation between the industrial sector and the university and presents the use of the state-of-art software applications to find a solution related to technical and technological problems arising under real conditions.

METHODS FOR SOLUTION OF THE PROBLEM

The following procedure was used to solve the noise problem:

- *Measurement of noise using a classic sound level meter to determine the level of acoustic pressure of the technological elements before and after implementation of the anti-noise measures.*
- *Measurement of noise using the acoustic camera before and after implementation of the anti-noise measures.*

- *Analysis of these measurements, identification of the most critical sources of noise and critical frequencies of the emitted noise.*
- *Identification of the sources of noise to reduce emissions of noise and establish suitable solution techniques.*
- *Ideological proposal of an anti-noise cover plate for SDT screen.*
- *Evaluation of the effectiveness of the anti-noise cover plate of SDT screen.*

PROPOSAL OF ANTI-NOISE MEASURE

Fig. 2 shows SDT screen used in the quarry to separate individual fractions of the aggregate. The size of fractions is proportional to the size of the applied screen meshes. The screen operates on the principle of vibration of its active part where screen meshes cause emission of high levels of acoustic pressure. Since it is not possible to absolutely eliminate the presence of people from the technological operation where the screen is situated, it is necessary to solve the acoustic situation in the vicinity of the screen. Ideological proposal of an anti-noise cover plate for SDT screen. Figure 3 shows the ideological proposal of the screen anti-noise cover plate

Figure 2. View of SDT screen

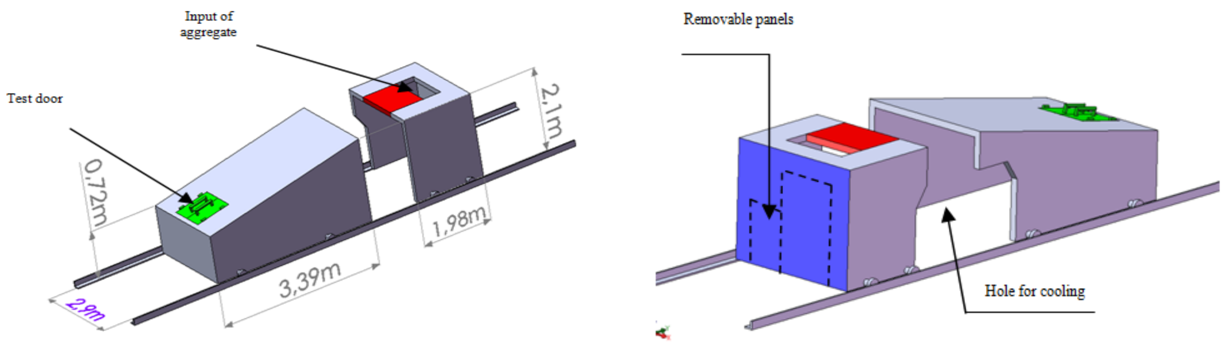

Figure 3. Ideological proposal of of the cover plate

PROPOSAL OF MATERIAL FOR THE ANTI-NOISE COVER

When designing the anti-noise cover plate for SDT screen, we took into account both the results of the measurements taken on the material with the trade name „Ekomolitan PUR" supplied by the manufacturer and our own measurements of noise absorption coefficient. Disposal of old cars generates a lot of types of waste. One of them is polyurethane foam that is one of the components car seats are made of. This material in combination with recycled seat covers and a liquid hardenable polymer-based binder produces material that exhibits favourable insulation and acoustic properties. Physical properties of "Ekomolitan PUR" material supplied by the manufacturer are given in Table 1.

Table 1. Physical properties of „ekomolitan pur" material

Characteristics	Declared value or class	Number of Test Protocol and Laboratory
Thermal resistance (50 mm thick)	1,16 m^2.K/W	40-08-0190
Thermal conductivity (50 mm thick)	0,0453 W/m.K	Technický a skúšobný ústav stavebný, n.o. Bratislava
Apparent (bulk) density	192,6 kg/m^3	
Compressive strength perpendicular to the plane of the board	≥ 50 kPa	Building Testing and Research Institute
Shear strength	51,3 kPa	Accredited laboratory
Shear modulus	203,4 kPa	004/S-045
Long term water absorption by immersion	32,40%	
Weighted Sound Absorption Coefficient.	(20 mm) - 0,35 MH	A12-1/08, A12-2/08
	(40 mm) - 0,65 MH	A12-3/08, A12-4/08
Impact sound insulation of a ceiling construction (STN EN ISO 140-6)	KPUR 150	Applied Precision, s.r.o., Bratislava
	$L_{n,w}(C_1)$ = 58(-1) dB	Accredited laboratory 175/S-167
Impact sound reduction index (STN EN ISO 717-2)	KPUR 150	AO SK 51
	ΔL_w = 19 dB	
Normalized impact sound level index	KPUR 150	
	$\Delta L_{a,r,w}$ = 59 dB	
Airborne sound insulation index	R_w = 57 dB	-
Sound absorption coefficient	DL_α = 10 dB	-

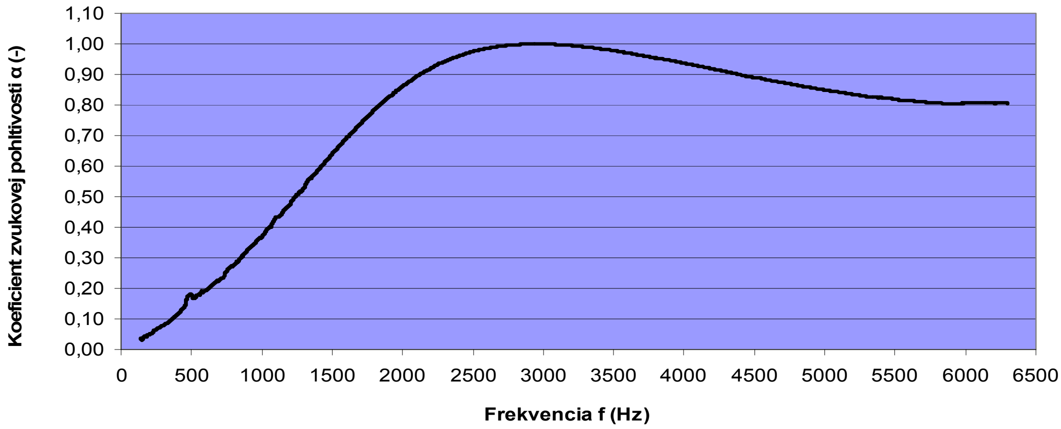

Figure 4.Sound absorption coefficient of „Ekomolitan PUR“ sample 20 mm thick

The result of the measurement of sound absorption coefficient of 20 mm thick and 60 mm in diameter „Ekomolitan PUR“ sample is given in Fig. 4.

RESULTS AND DISCUSSION OF MEASUREMENTS WITH AN ACOUSTIC CAMERA

Measurements with an acoustic camera were performed in positions under no-load conditions and also with supply of fraction up to 16 mm in size at the selected measuring levels off the screen. Measurements were carried out before and after taking anti-noise measures. Below are shown only selected measurements after taking anti-noise measures. Positioning of the acoustic camera and sound-level meter is shown in Fig. 5.

Figure 5. Positioning of the measurement site K2
MEASURING POSITION K2 – EQUIPMENT SCREEN (FRONT VIEW)

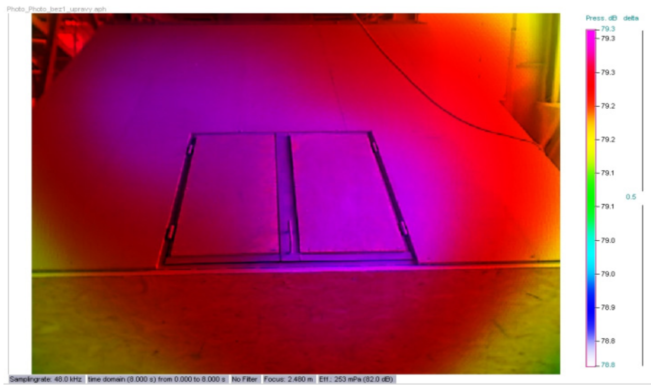

Figure 6. Visualization of the intensity of noise emission of the measured technology of SDT screen with a cover plate

Fig.6 shows the intensity of noise emission of the measured technology of SDT screen with a cover plate. Visualization of the noise sources is calculated from the whole measured frequency range (from 100 – 24 000 Hz) and during the whole period of measurement. In the acoustic image presented here it is obvious where the integrated centre of noise sources is located. Their more specific and detailed identification was performed by spectral analysis. The composition of the whole frequency spectrum is given in Fig.7 and a spectrogram in Fig. 8.

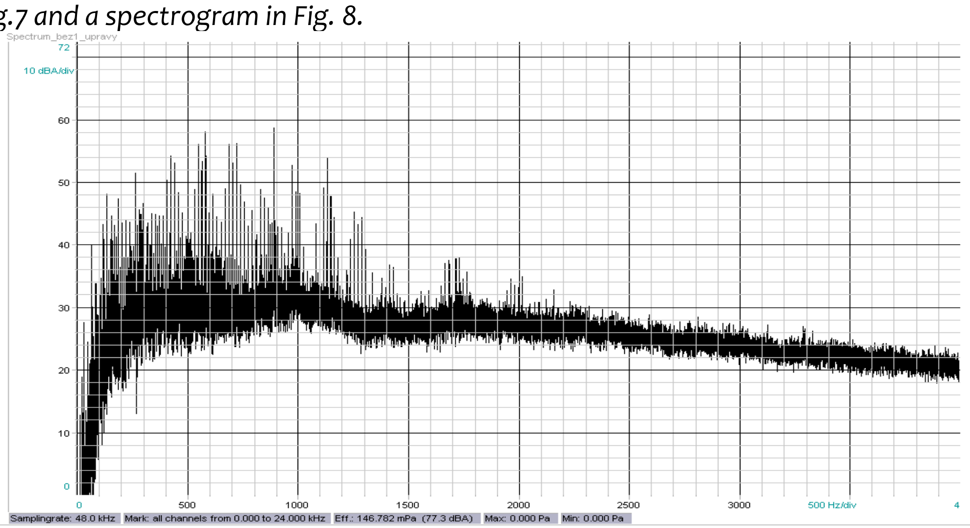

Figure 7. Frequency spectrum of the emitted noise recorded in the measuring point K2

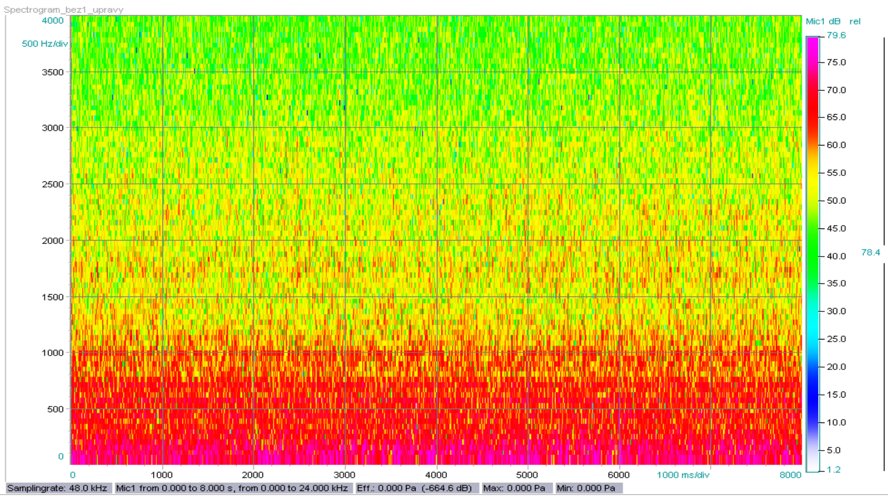

Figure 8. Spectrogram of the emitted noise recorded in the measuring point K2

Evaluation of the results of measurements with an acoustic camera. Values of the effective A sound level measured in individual positions are given in Table 2.

Table 2. Effective a sound level measured in individual positions

Mode of the screen at measuring	Measuring position	Before anti -nosie measures L_{eff} [dBA]	After anti -nosie measures L_{eff} [dBA]
Without supply of fraction (no-load condition)	K1	88,5	79,4
	K2	86,1	77,3
With supply of fraction up to 32 mm in size	K1	93,0	90,2
	K2	92,4	91,4
	K3	92,3	91,8

CONCLUSIONS

The software support applications used to reduce noise in industrial premises is a modern simulation tool that will enable students of the second and third level of higher education to understand the options how to deal with the problem of noise in real life.

Based on the measurements of noise acquired using a classical sound lever meter and acoustic camera before and after taking anti-noise measures, it is possible to conclude that we consider the anti-noise measures performed as effective. The measurements showed reduction of the noise level in the range of 3 to 5 dB. On the basis of the results obtained from measurements, we started to implement adjustment measures of the anti-noise cover plate in the area of drives and test opening. At present, these measures are being implemented.

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REFERENCES

[1.] Žiaran, S.: Ochrana človeka pred kmitaním a hlukom, Slovenská technická univerzita v Bratislave, 2007, ISBN 978-80-2799-0

[2.] Hatina a kol.: Encyklopedický súbor bezpečnosti a ochrany zdravia pri práci, Bratislava, 2007, Inštitút pre výskum práce a rodiny, ISBN 978-80-7138-124-2

[3.] Lumnitzer, E., Badida, M., Biľová, M.: Hodnotenie kvality prostredia, Elfa s.r.o. Košice, 2007, ISBN 978-80-8073-836-5

[4.] Janoušek, M.: Pravidlá dobrej praxe BOZP, Publikácia 12, Obmedzte hluk! Zásady BOZP pri práci v hluku, 2005, ISBN 80-968834-7-X

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