
Attenuation of Noise Pollution Produced by Band Conveyors from the Mining Unit of Career Rosia Due to Climatic Conditions

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Abstract: *In this paper we intend to make a noise monitoring, produced by band conveyors, monitorization necessary for finding solutions to reduce noise. The main sources of noise pollution are: tracked excavators with rotor and band conveyors. For the urban areas and forested areas the tracked excavators with rotor is not a source of noise pollution. They represent a source of noise just inside the career, because of the way adjacent extraction steps, which is a natural barrier against the propagation of noise. The band conveyor T111 from the Mining Unit of Career Rosia, which is transporting excavated material represents a source of noise pollution for residents of the village of Rosia of Jiu due to he`s close location. Exposure to noise for long-term can cause adverse effects on health.*

Keywords: *Pollution, Noise control, Noise attenuation*

1. INTRODUCTION

Opening of the Mining Unit of Career Rosia began in April 1973, and it is the largest career in Romania and also from the South-Eastern Europe by volume of geological reserves of lignite. Mining Unit of Career Rosia has toughest hydrogeological conditions in Romania.

The Mining Unit of Career Rosia is making part of the coal basin of northwestern Oltenia managed by Trading Company Oltenia Energy Complex - SA, located in the interfluvium between the river Jilț and the river Jiu, regularized and developed on a third of the surface in the Jiu valley and the rest is in the hilly part.

Exploitation perimeter of the Mining Unit of Career Rosia is located on the territory of the administrative city Rovinari and administrative territories of the communes Farcasesti and Bălteni; is part of the mining basin Rovinari part of the mining area Motru-Jilț-Rovinari, located in northern Oltenia [1].

In Romania there is a tendency, which also manifests itself in the world: the increase in noise and vibration generation - whose sources appear with impetuous development of all branches of the economy and transportation.

In the lignite career from Oltenia, transport of the excavated material is made with band conveyors.

Band conveyors, from the point of view of transportation, belong to the category of transport system with continuous acting.

One of the main objectives of modernization of production capacities of mining coal basin of Oltenia is reduction of noise and dust emissions.

2. THEORETICAL CONSIDERATIONS

Noise pollution is an important component of environmental pollution, both by harmful character and he is present in all day-to-day activities of modern life. The noise pollution is a major problem for all economically developed countries or developing countries. Noise pollution is a continuous aggression,

determined by different noises made by machinery, industrial equipment or domestic, inside or outside buildings, noise favored by the placement and their constructive isolation [2].

One of the disturbing factors of the environment, that influence the environment in which it operates and human life is the noise which is associated and identified in generally by noise pollution.

Source of pollution, by noise, include:

- Use of motorized vehicles to transport workers, materials and equipment to and from career;
- Use of mobile machinery and stationary inside of careers, they typically include the tracked excavators with rotor, cross-pit spreader and band conveyors [3].

Potential noise receptors typically include mine workers, people outside the open pit limits.

Choice of methods to combat noise is conditioned to the combined between noise sources, the propagation medium (path) of acoustic energy and receivers. In the noise control methods should be incorporated parts of this system, it distinguished: methods of noise control at source, methods of the control of noise on pathways and methods to combat noise at the receiver [4].

When crossing propagation environment, the acoustic waves lose some of the energy originally contained due to the following physical causes: internal friction of environmental particles which particles enters in oscillation (viscosity), thermal conductivity of the environment, radiation heat and energy of intermolecular exchange.

Attenuation due to viscosity is expressed by a coefficient dependent on the characteristics of the environment but and the frequency of the sound.

$$A_{\theta} = \frac{4\pi^2}{\lambda^2} \cdot \frac{2}{3} \cdot \frac{\eta}{Z_s} \quad (1)$$

Where:

λ - Wave length of the given sound

η – Dynamic viscosity of the environment

$Z_s = \rho \cdot c$ – specific impedance of environment.

In case of band conveyors sound wavelengths remain unchanged; which varies is the characteristics of the environment due to temperature variations.

Sound attenuation due to thermal conductivity is expressed by the corresponding coefficient of attenuation (expression given by Herzfeld and Rice).

$$A_T = \frac{4\pi^2}{\lambda^2} \cdot \frac{c_T}{2Z_s} \cdot \frac{\gamma-1}{\gamma C_V} \quad (2)$$

Where, in addition to the variables in the expression (1) appear:

C_T – coefficient of thermal conductivity of air

γ - adiabatic coefficient

C_V – specific heat at constant volume of environment

Acoustic wave attenuation is achieved by increasing energy level of the gas molecules by putting them in motion of vibration. This variation of the energy depends on the number of degrees of freedom of the molecules, so energy loss increases from monatomic to the polyatomic molecules. Like global effect of sound attenuation in air, Beranek gives the following formula for the additional attenuation:

$$A_S = 7,4 \left(\frac{f_{m,r}^2}{\Phi} \right) \cdot 10^{-8} \text{ [dB]} \quad (3)$$

Where:

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f_m – is the geometric average of the frequency band in which the sound is emitted (Hz)

r – the distance of point of registration to the source (m)

Φ – the relative humidity of the environment (%) [5].

This attenuation is added to the produced attenuation according to the distance from the receiver to the source of sound.

3. RESULTS AND DISCUSSION

Noises produced by machinery and mining installations are often uncomfortable for environment. Sources of noise in Mining Unit of Career Rosia equipped with technology in continuous flow can be:

- driving motor and drive of the rotor excavators, cross-pit spreader and tractor in motion;
- engines of bulldozers,
- loaders and dumpers which acting in career
- band conveyors [6].



Fig1. Machinery used in Mining Unit of Career Rosia

Due to the type of construction and operation of band conveyors, we have a source of structural noise - rolling noise. Rolling noise is the result of roughness or irregularities from the contact of the rolling surfaces. Spectral composition of rolling noise is broadband. Roller bearings used in the construction of band conveyors are the elements with periodic motion that make appear tonal components.

The band conveyors T111 is a source of noise pollution in the Mining Unit of Career Rosia that is located to a distance of 15-20 m from the first house in the village Rosia of Jiu. In order to find solutions to combat noise pollution produced by the band conveyors we conducted noise monitoring for a period of 30 days.

In order to monitor noise we used digital measuring device 4 in 1 PVE-222.

The digital measuring device 4 in 1 with multiple functions for the environment has been designed to combine the measurement of the sound level, light, humidity and temperature.

Measurements were performed at different periods of day ranging ambient temperature and the humidity.

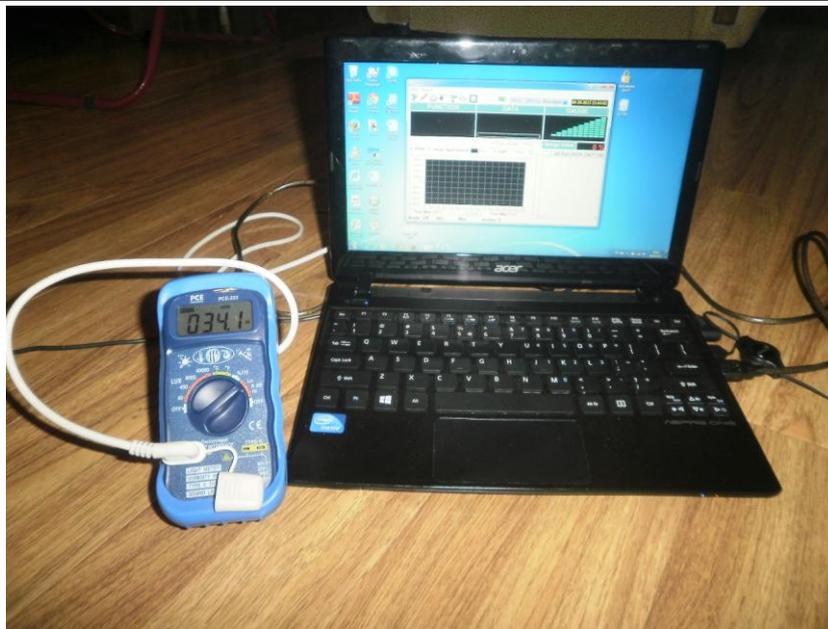


Fig2. The digital measuring device 4 in 1

The noise values were recorded at minimum temperature of 8.5°C near to the band conveyor and at 9 m from it, graphs are shown in the figure 3.

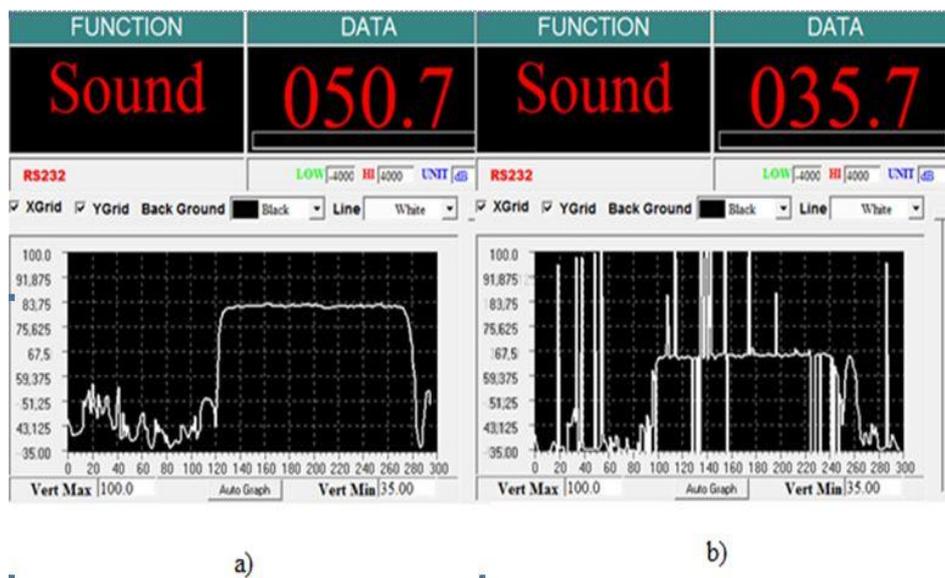


Fig3. Values recorded at temperature of 8.5°C a) near the band conveyor and b) at 9 m of band conveyor

For maximum temperature of 17.2°C noise values near of the band conveyor and at 9 m from it, and the graphs are shown in the figure 4.

Measurements were performed in accordance with STAS existing, during the day, and were calculated using the relation:

$$L_{equivalent} = L_{max} - \frac{1}{3} (L_{max} - L_{min}) \tag{4}$$

According to the equation (1), (2) and (3) change in sound attenuation depends on the temperature and humidity of the environment of propagation of the sound.

Humidity variation during the monitoring period was between 58.5% and 63.5%, which leads according with relation (3) to noise attenuation between 0.55 dB and 0.59 dB.

To study effect of temperature on the attenuation of noise from the band conveyor T 111, where selected days with the lowest temperatures (temperatures between 7 and 8 Celsius degrees) and days with the highest temperatures (temperatures between 17 and 18 Celsius degrees).

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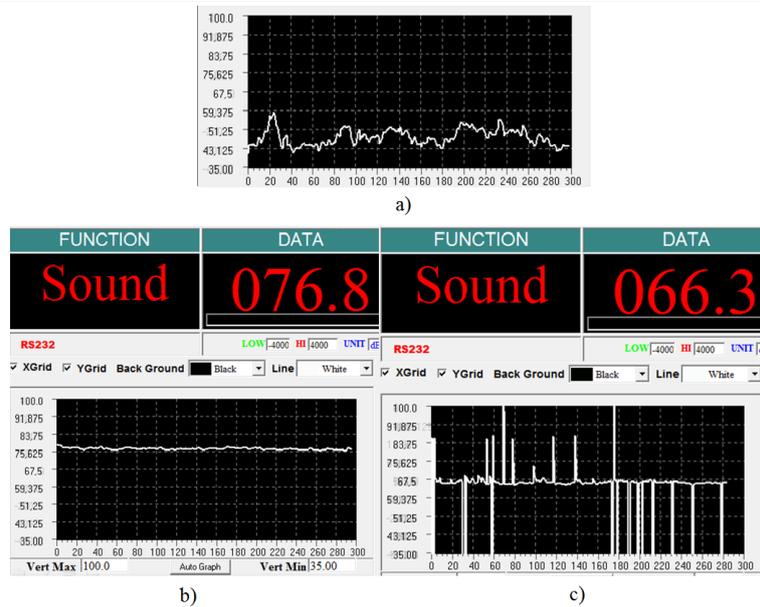


Fig4. Values recorded at a temperature of 17.2°C a) before starting work b) near the band conveyor and c) at 9 m from the band conveyor

Table 1 show the equivalent noise level and noise reduction at the temperatures between 17 and 18 Celsius degrees, and in Table 2 are shown noise level and noise reduction at the temperatures between 7 and 8 Celsius degrees.

Table1. Noise Level and Noise Reduction at the Temperatures between 17 and 18 Celsius Degrees

No.crt	Distance from source	L_{echiv} measurements	L_{echiv} background	Attenuation	Average attenuation
1	1	85,8	53,2	-	-
2	1	85,7		-	
3	1	85,9		-	
4	3	74,6		11,2	11,43
5	3	74,1		11,7	
6	3	74,4		11,4	
7	6	68,5		17,3	17,33
8	6	68,3		17,5	
9	6	68,6		17,2	
10	9	65,2		20,6	20,77
11	9	64,9		20,9	
12	9	65		20,8	

Analysing the results presented in the 2 tables, we observe the fact that at the same distance from the source we have different values depending on climate conditions.

Table2. Noise Level and Noise Reduction at the Temperatures between 7 and 8 Celsius Degrees

No.crt	Distance from source	L_{echiv} measurements	L_{echiv} background	Attenuation	Average attenuation
1	1	83,1	49,2	-	-
2	1	83		-	
3	1	83,2		-	
4	3	73,6		9,5	9,53
5	3	73,7		9,4	
6	3	73,4		9,7	
7	6	67,5		15,6	15,63
8	6	67,3		15,8	
9	6	67,6		15,5	
10	9	64,5		18,6	18,67
11	9	64,6		18,5	
12	9	64,2		18,9	

In these days difference of the humidity was very small, it was between 58.5% and 63.5%, and this was not having significantly impact on noise attenuation.

Temperature difference as shown in equations (1) and (2) has a significant impact on the results.

For the days with high temperature, the attenuation is reaching values of 20.9 dB at a distance of 9 m from the source while in cold days only 18.9 dB for the same distance.

4. CONCLUSIONS

Noise emission from band conveyors, passing through village Rosia of Jiu, transporting the material extracted, are producing perturbations in this area.

The value recommended to allowable noise limits, to limit functional urban areas considered as noise sources from adjacent areas (industrial premises) is 65 dB, and it is exceeded. The same is with acceptable limits of noise near protected buildings (houses, hotels, hostels, guest houses) which is 55 dB, the first house in the village of Rosia of Jiu is located just 15-20 m of band conveyor T111.

In result of the monitoring was found that noise limits are exceeding maximum allowable, this endangering the health of the habitants of the village Rosia of Jiu.

This study was conducted in order to establish methods of reducing the noise produced by band conveyors in the inhabited areas and near their placement. The sole measurements currently applied are just the measurements performed during the day.

Using the data record we can perform calculations for sizing the acoustic isolation and sound absorbing panels to reduce structural noise.

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