Int. J. Econ. Environ. Geol. Vol. 10 (1) 01-04, 2019
Journal home page: www.econ-environ-geol.org

Open Access
ISSN: 2223-957X

Mapping of Noise Propagation in Quarries for Environmental Perspective

Ibrahim Çınar[1], Cem Şensöğüt[2*]

[1] Konya Technical University, Mining Engineering Department, Konya, Turkey
[2*] Kütahya Dumlupinar University, Mining Engineering Department, Kütahya, Turkey

*Email: cem.sensogut@dpu.edu.tr

Received: *8 March, 2019* ***Accepted:*** *26 March, 2019*

Abstract: In this study noise measurements were made in a quarry belonging to a private, company located in the boundaries of Karaomerler village, Konya (Turkey). Noise levels were measured at 42 points, in the operation field and equivalent noise levels were determined and the results were mapped using NetCad program. With the help of the obtained noise maps, it is recommended to take preventive measures, where necessary. Proper reading of maps is crucial for effective and sufficient measures in terms of occupational health and safety measures have to be taken.

Keywords: Noise propagation, equivalent noise level, occupational safety.

Introduction

Noise in the mining sector is an important problem in relation to safety at work. Additionally, it is significantly effective on human health. It has physical and mental side effects on the employees as well as psychological and social side effects.

The most dangerous consequence of exposure to noise is undoubtedly permanent hearing loss. When this is the case, the only treatment is unfortunately to use a hearing aid. Audiometric tests should be regularly conducted at least every 6 months for persons working in noisy environments of mining workplaces in order to reduce and prevent noise-related hearing loss. In addition, all noise propagating from any sources should be measured and recorded for preparing noise maps according to the measurement results. Measurements should be repeated at certain periods and maps should be updated according to the results (Mutlu et al., 2017).

In a recent work, it is found that when noise measurements are evaluated from 67 operating machines of different types and models used in mining sites, the lowest noise exposure is mainly in standby cycle and the highest noise exposure generally occurs when performing basic functions of mine vehicles (Erdem et al., 2017).

However, when noise management action plan is made, it is necessary to establish a clear resource to plan noise reduction measures. Noise mapping is a handy tool that gives us such a potential and is an effective way to assess and manage noise in design and operational stages (Lilic et al., 2017).

Noise and dust emission management during the planning of mining operations is a complex procedure due to large number of parameters related to particulate matter emissions and distribution as well as noise emissions. Best practice in noise and dust management requires the application of models to assess suspension particle distribution and noise propagation. Thus noise maps, computer modeling software and modeling of dust distribution and noise propagation have been used successfully (Lilic et al., 2018).

The noise levels of three major mining sites – mineral processing facilities, open pit mining operations and underground mining operations - were investigated. According to the statistical analyses using the available noise levels for mining sites and Minitab® 14 statistical software, it was found that the coal preparation plants had higher noise levels. Other noise generating units are listed as underground coal mines and open cast coal mines. To reduce noise, noisy machines can be maintained or replaced and acoustic insulation can be used. Assessment of the noise levels of mining sites will ensure that the risk of noise-related hearing loss among workers is controlled (Onder and Onder, 2018).

The exposure limit values for the daily 8-hour work period are 85, 85 and 90 dB(A) for ACGIH (American Conference of Governmental Industrial Hygienists), NIOSH (National Institute for Occupational Safety and Health) and OSHA (Occupational Safety and Health Administration), respectively, according to some different standards used in the world (McCommon and Sorensen, 1996).

In accordance with the Noise Regulation which was published in the Official Gazette dated 23 December 2003 and numbered 25325 in Turkey, the exposure limit value for the 8-hour daily working time is 87 dB (A) (MLLS, 2003).

Noise mapping is used to identify existing noise levels, classify noise sensitive or noise producing regions, set criteria, and introduce noise reduction planning. Having available noise data is of great importance both in terms of development control and strategic planning in land use. It also forms the basis for transportation planning, preparation of action plans and taking

insulation measures at the premises. Noise mapping can also be used to track changes (Ascigil, 2009).

Materials and Methods

The raw material in the working site is limestone and the period of the raw material production permit is 5 years. Allowed group is under II-A. License area is approximately 9 hectares (Fig. 1).

Fig. 1 Map showing the study area.

The production in quarry is realized by drilling-blasting method and the blasting works take place every 10 days. As a result of each blasting work, about 500 trucks full of material, which is 15,000 tons of material, are extracted and 2500 kg ANFO is used for this process. Blasting operations are carried out under the supervision of a Mining Engineer and the Gendarmerie. After blasting, the material that is loosened is transported to crusher by trucks.

The GENERAL DSM8922 (WEB1, 2018) noise meter developed for health and quality control determination in different environment was used for noise level measurements (Table 1). Obtained equivalent noise levels and the coordinates of measurement points are given in Table 2.

Table 1. Noise Measurement Device Specifications [9].

Min./max. record keeping feature	
Manual or automatic range	
Fast or slow response time	
Background noise absorber	
3-1 / 2-digit LCD display with bar graph	
RS-232 interface and Windows software	
IEC651, ANSI S1.4 standards	Sensor: 0.25" intensive microphone
Range: 30-130 dB(A)	Power: "9-volt" battery (DC 9V out)
Frequency range: 31.5 Hz-8 KHz	LCD screen size: 2.5" x 1.65"
Standard deviation: ±1.5 dB(A)	Device size: 11" x 3" x 1.5"
Resolution: 0.1 dB(A)	Weight: 292 gr. (10,3 oz.)

Table 2. Equivalent noise levels and the coordinates of the measurement points in stone quarry.

POINT NO	Coordinates		Noise levels
	y	x	dB(A)
1	475619,66	4218142,01	69,06
2	475637,92	4218160,53	68,18
3	475665,03	4218185,93	64,39
4	475710,65	4218203,50	69,82
5	475721,70	4218224,27	73,26
6	475727,17	4218245,18	72,65
7	475710,13	4218261,93	73,92
8	475695,58	4218252,91	75,50
9	475677,00	4218265,26	72,82
10	475667,00	4218278,83	78,65
11	475686,60	4218290,40	80,39
12	475671,00	4218304,40	81,98
13	475697,70	4218381,39	73,54
14	475681,79	4218336,61	72,54
15	475696,20	4218358,00	71,28
16	475710,55	4218362,93	65,55
17	475719,90	4218382,76	54,71
18	475720,60	4218383,12	59,23
19	475721,90	4218405,59	56,07
20	475694,00	4218380,00	75,90
21	475690,00	4218423,00	57,45
22	475666,00	4218420,00	61,84
23	475652,00	4218373,00	82,64
24	475632,00	4218370,00	75,14
25	475637,00	4218364,00	83,27
26	475623,00	4218347,00	91,35
27	475629,00	4218391,00	71,44
28	475626,00	4218384,00	72,16
29	475614,00	4218326,00	75,18
30	475607,00	4218318,00	74,24
31	475569,00	4218320,00	64,65
32	475580,00	4218288,00	61,73
33	475599,00	4218268,00	72,16
34	475594,00	4218241,00	66,12
35	475615,00	4218230,00	68,28
36	475613,00	4218228,00	63,15
37	475621,00	4218200,00	59,14
38	475633,00	4218211,00	54,52
39	475628,00	4218241,00	57,57
40	475628,00	4218268,00	73,75
41	475629,00	4218285,00	79,90
42	475646,00	4218316,00	87,66

The noise is different from other pollutants and its management is very difficult. Because noise does not leave residues and the effects on human beings do not show up in a short time. Since the sound evaluated in the concept of environmental noise can be acoustically examined, the noise levels that can affect human life can be determined. In other words, the concept of noise that is intangible and related to personality is attempted to be managed by being embodied by acoustic basic values. The noise, which can be expressed by physical and basic values, can be examined using computer simulations and its propagation and character can be put forward (Ece., 2015).

Noise mapping is the determination of how disturbed the workers are in a region with noise and the environmental noise they are exposed to. For this, noise maps are prepared which show the noise load arising from various noise sources (crusher, excavator, drilling machine, loader etc.). In noise maps it is

possible to show the load values averaged for full day, day and night. It is also determined by noise maps which show that employees are disturbed by certain sound values. The aim of noise mapping and the noise action planning is to distinguish and to take appropriate measures in the affected areas due to environmental noise.

With the formation of noise maps, following information can be reached (Cinar and Sensogut, 2009; Cinar and Sensogut, 2013; WEB2, 2018);

- Equal sound pressure level equilibrium curves (isophones),
- Sound pressure levels at the sides of buildings and structures,
- Number of workers exposed to certain levels of sound pressure and
- Size of areas subject to specific sound pressure levels.

With the results of formed noise maps, noise problems that may occur in the future will be avoided considerably by taking the noise factor into account. Noise maps ensure determination of the sites for which necessary control measures need to be taken. In this way, employees will be informed about the noise level from any noise source at any point.

Netcad program was used for the formation of noise maps. It is a CAD program capable of making map production, drawing zoning plan, making parcel mapping and preparing all kinds of drawings and reports of zoning applications, land consolidation, production of expropriation maps, sprinkling projects and geographic information systems (WEB3, 2018).

The isopone curves of the noise map of the study area are shown in Figure 2 and the noise map on the satellite image is shown in Figure 3.

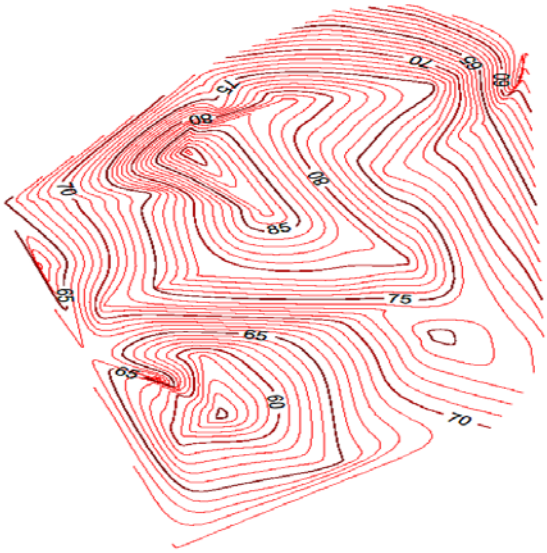

Fig. 2 Isopone curves of noise map.

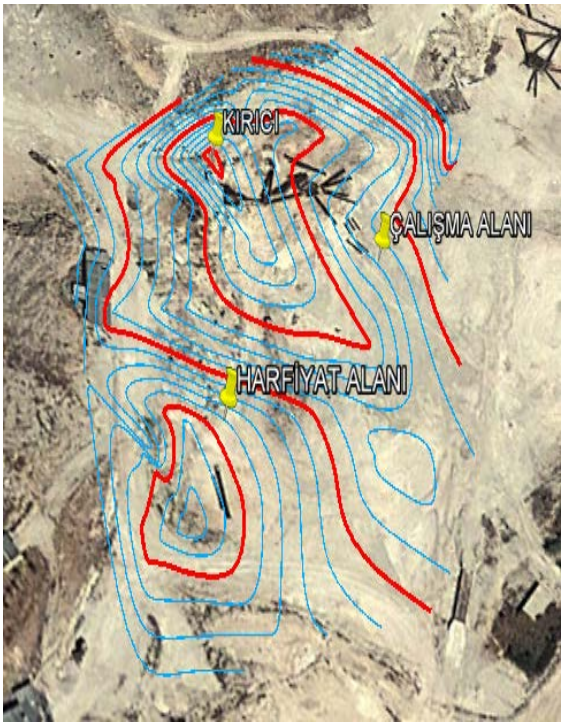

Fig. 3 Illustration of noise map on the satellite image.

Results and Discussion

Combatting with noise can only be achieved as a result of the common belief and effort of the employer and the worker. Workers should strive to protect themselves from noise for their own health and must use protective equipment in this regard and comply with the rules set by the legislation. In this way, they reduce both the protection of their own health and responsibility of the employer from occupational disease.

The employer must also provide his/her workers with all the protective equipment necessary to combat noise. In order to emphasize the importance of fighting with noise in the workplace, necessary texts and pictures should be affixed and educational programs should be made. In this way, it is aimed to raise the awareness of the worker. That is to say, not just for rule, law or necessity, but for a real consciousness, the noise problem must be solved.

It has been observed that the instant measurement values in the site of quarry change depending on the operation of the machinery. The highest noise value was observed near the crusher.

As a result of the mapping process, the peak points of the noise curves are determined and it is disclosed that these points are noise sources. When the map was examined, it was seen that one of the two peak points was the bottom of the crusher while the other was the stock area, where the broken material was moved and stored. It is understood that this situation in the stock area is caused by noise, while trucks were hauling the broken material.

Acknowledgement

Support given to complete this work by the Scientific Research Funds of Konya Technical University and Kütahya Dumlupinar University are greatly acknowledged.

References

Ascigil, M. (2009). Preparation of highway noise maps: Istanbul Zincirlikuyu-Maslak transportation line case, MSc Thesis, Istanbul *Tec. Un., Ins. of Sci. & Tech.*, **(**263**)**, Turkish.

Cinar, I. Sensogut, C. (2009). Evaluation of environmental factors affecting noise propagation. *Environmental Monitoring and Assessment*, **153**,377-382.

Cinar, I., Sensogut, C. (2013). Evaluation of noise measurements performed in mining sites for environmental aspects, *Int. Journal of Environmental Research*, **7**(2), 383-386.

Ece, M. (2015). Investigation of different scenarios on traffic noise with noise mapping s as decision support assistant, Antalya case, PhD thesis, Suleyman Demirel Un., Ins. of Sci. & Tech., 171 pages, Turkish.

Erdem, B, Duran, Z, Dogan, T., Yuksel, H. (2017). Investigation of noise exposure of the mining machinery operators in open pit mines. *J. of Sci. Mining*, **56** (4), 148-165, Turkish.

Lilic N.M., Cvjetic A.S., Milisavljevic V.M., Pantelic U.R., Kolonja L.R. (2017). Environmental noise management in the area of opencast mines', *Tehnika-Rudarstvo, Geological I. Matalurgija*, **72** (1), 47-52.

Lilic, N. M., Cvjetic, A., Knezevic, D., Milisavljevic, V., Pantelic, U. (2018). Dust and noise environmental impact assessment and control in Serbian mining practice, Minerals, **8** (2), 34 pages.

McCammon, C., Sorensen, B. (1996). Health hazard evaluation report HETA 95-04062609, Matrix Auto Body, Englewood, Colorado, 27 pages.

MLSS, (2003). Minister of Labour and Social Security of Turkey, Noise Regulation, 25325 No Official Gazette.

Mutlu, M., Sari, M., Onder M., Onder, S. (2017). Predictability of noise-induced hearing loss in a stone quarry and crushing-screening plant by Fuzzy Logic Method, *Int. Sym. on Occupational Health and Safety in Mines*, 396-411, Adana/Turkey.

Onder, S., Onder, M. (2018). Statistical investigation of the noise levels in coal mining industry, *J. of Eng. & Arc. Fac. of Eskisehir Osmangazi* Un., **26** (1), 30-35.

WEB1, (2018). https://www.generaltools.com/digital-sound-meter-with-rs232-output, Date of access: 27.02.2018.

WEB2, (2018). http://gurultu.cevreorman.gov.tr/gurultu/ AnaSayfa/GurultuHaritalama.aspx?sflangtr Date of access: 27.02.2018.

WEB3, (2018). https://www.netcad.com.tr, Date of access: 27.02.2018.