

Noise Levels of Sand and Stone Quarry at Kota Belud Sabah

Norfadillahusna Yakup, Carolyn Payus*

Faculty of Science and Natural Resources, Universiti Malaysia Sabah, Jalan UMS, 88400 Kota Kinabalu, Sabah, MALAYSIA.

*Corresponding author. E-Mail:cpayus@gmail.com; Tel: +6088-320000 Ext: 5852; Fax: +6088-435324.

ABSTRACT: Noise is unwanted sound that leads to major annoyance to the human ear. Uncontrolled emission of noise in sand and stone industry causing the increase of noise pollution amongst the workers and local people who live near the quarry. Overexposure of noise may raise the problem ranged from annoyance to hearing impairment. The study has been conducted in sand and stone quarry at Kota Belud District. Seven sites have been chosen that is water pump, water injector, roller sand screen, main office, weighting office, stone quarry and residence. The result shows that all sites are exceeding permissible limit set by DOE (Department of Environment) and NIOSH (National Institute of Occupational, Safety and Health) except main office and weighting office.

KEYWORDS: Environmental Noise; Noise Pollution; Environment; Health Hazards; Sand & Stone Quarry

Received 12 July 2016 Revised 28 Feb 2017 Accepted 23 June 2017 Online 23 July 2017

© Transactions on Science and Technology 2017

INTRODUCTION

Sound is a vibration of an object that can be heard by humans and animals every day. When the sound level rises above acceptable limits by the human ear (Noor Rasfanjani, 2005) and unwanted by the individual, then it is known as noise (Farzana *et al.*, 2014). According to the Environmental Quality Act 1974, any direct or indirect changes to the physical, chemical, biological and radioactive release, removing or placing the waste to be harmful to health, safety, public welfare and life is called pollution. Noise pollution is also an unwanted noise that may affects human health (Naik *et al.*, 2007). Noise pollution in the quarry is one of the environmental problems that pose a risk to workers and residents around (Farzana *et al.*, 2014). Sand and gravel quarry is an industry that produces sand and rocks of various sizes for the construction of buildings, bridges, tunnels and roads. Such quarries usually located near the river because the river is a source of sand and rock. This industry is booming and has been built many in the town as well as small areas (Agusrianto, 2016). The rapid development of this industry without control of noise pollution may increase the exposure of noise pollution to people especially people who near or work in the quarry.

The study of the noise level in the sand and stone quarry still limited. However, in 2008, the newspaper Bernama had released news that the noise in the workplace is a major contributor to serious hearing problems to people of this country. Moreover, the study of public health institutions showed 424,000 people in this country are diagnosed with hearing problems caused by exposure of too much noise in the workplace such as sound equipment and machinery (Bernama, 2008). Exposure to loud noise continuously without protection causes various health problems to workers and the local population, especially Noise-Induced Hearing Loss (NIHL) (Bauer & Babich, 2007). NIHL happens when there's an increase in the threshold of hearing (threshold shift) which is hearing threshold is increased to 10 dB and above in 2000, 3000, and 4000 Hz in one of ear or both (hearing impairment). There are two types of NIHL that is temporary hearing loss and permanent hearing loss (Gyamfi *et al.*, 2016). Apart from NIHL, there are problems occur as a result of exposure to loud noise such as an increase in the number of accidents at work, sickness, loss of productivity, communication disorders, sleep disorders, lack of concentration, irritability, less efficient, headache,

increased blood pressure, nerve damage and eventually lead to deafness (Gyamfi *et al.*, 2016; Naik *et al.*, 2007). The main source of noise in the sand and stone quarry is from vibrating filter. Vibrating filter operates at higher frequencies and operating without cover enhances the level of noise. Intermittent noise that comes from crushing machine is also one of the causes. Intermittent noise is also produced during unloading sand and stone operations. Furthermore, the conveyor belts also produce continuous noise, especially when the belt is not well maintained and cheap (Divya *et al.*, 2012; Naik *et al.*, 2007). Moreover, people nearby the quarry had complaint about the noise coming from it where the noise causes annoyance effect and sleep disturbance to some of them. Also, from the observation, worker in this quarry are not wearing any ear protection. Therefore, the possibility for workers and people nearby the quarry exposed and affected to certain level of noise is higher.

METHODOLOGY

Noise level monitoring is carried out in sand and stone quarry at Kota Belud District. Noise levels were monitored using Sound Level Meter model GM1351 and were monitored at A weightings. This equipment is designed to meet the measurement requirements of safety engineers, health, industrial safety offices and sound quality control in various environments including factories, offices, families and audio system. This equipment is designed according to the standards IEC 651 Type 2 and ANSI S1.4 Type 2. Measuring accuracy is until ± 1.5 dB. Noise level were recorded at seven places which six location inside quarry and one at residence near quarry. The distance of sound level meter were measured from sources is between 5 to 100 meters away and at a height of 1.4 meters above the ground.

RESULT AND DISCUSSION

Different measurements were taken from various areas of quarry and the results were summarized in the figure 1. As a result of the measurements performed at the quarry, the highest noise level is from stone quarry with average 91.8 ± 0.4 dBA, followed by roller sand screen with average 90.8 ± 0.3 dBA. Water pump is producing noise at 87.4 ± 0.3 dBA and water injectors is producing noise at 86.7 ± 1.4 dBA. Furthermore, the noise levels measured at both weighting office and residence are 67.3 ± 4.2 dBA and 66.9 ± 1.9 dBA respectively. The lowest level of noise was recorded at main office that is 63.5 ± 3.6 dBA. The noise level in stone quarry can be depend on few factors such as operation, truck traffic, topography, ground cover around the site and climate condition. Stone quarry site have highest level of noise due to crushing stone activities where the extracted rock were transferred to primary crusher and screening facilities, resulting in the desired product sizes. The noise producing from stone crusher is some continuously and some intermittent. Intermittent noise can be come from crusher during the time of breaking the stone and also from loading and unloading operation. Meanwhile, continuously noise produce come from vibratory screens which operates at higher frequency and producing abnormally high noise level without enclosure. Truck traffic such as lorry, tractors and excavators also give rise to noise level. According to Behrooz Lar *et al.* (2012), sound pressure level of tractors is ranged between 91 dBA to 93 dBA which exceeded National Institute for Occupational Safety and Health (NIOSH) allowable 85 dBA criteria. It caused driver and other workers exposed more to noise pollution. Besides that, topography and ground cover around the site play an important role in noise emission. The location of stone quarry at higher places and surround by little land cover makes the noise emission higher compared to other sites. Roller sand screen site also located at place where no such barriers causing it producing higher noise level after stone quarry. Furthermore, climate condition such as temperature inversion and wind gradient also may increase noise levels by 5 to 10 dB and increase

as much as 20 dB in extreme condition. It happens when sound-wave propagation path is focusing at a single point (EPA, 2000).

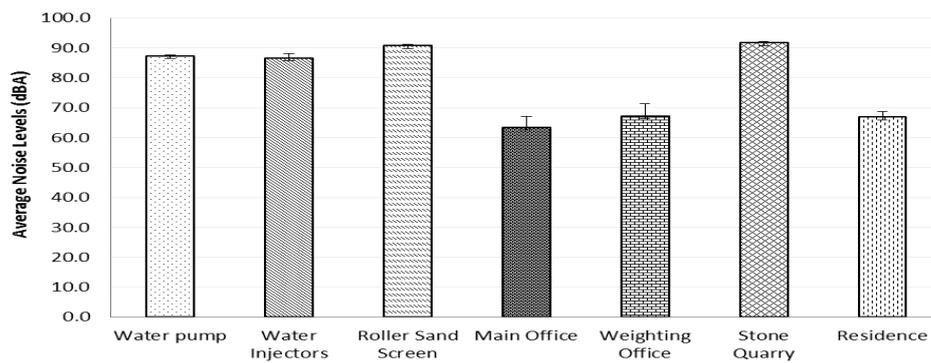


Figure 1: Noise level at seven site of sand and stone quarry.

Figure 2 shows the contour map of noise level in sand and stone quarry at Kota Belud Sabah. According to standard set by European Occupational Safety and Health (EU-OSHA), the degree of noise sensitivity in every decibel is different and the level of noise lower than 60 dBA is considered safe. However, the readings of noise level in this quarry are higher than 60 dBA. Therefore, the areas on the map below are divided into three different degree of sensitivity which is irritating, harmful and damaging. The noise level which from 60 to 70 dBA may cause irritate to people in term of annoyance and noise stress. Based on the map (Figure 2), the sites that may experience some level of stress and annoyance are main office, weighting office and residence area. The water pump and water injectors sites may experience harmful effects as the resulting noise can be achieve between 70 to 90 dBA. The continuous exposure to these high levels of noise can cause cardiovascular effects, sleep disturbance and in worse scenario may cause hearing loss and tinnitus. Noise-Induce Hearing Loss (NIHL) is result from long term exposure. Some people have some sign regarding this effect such as straining to hear, constantly asking for the word to be repeated, difficult in communication by phone, misunderstanding and ringing or buzzing in the ear (tinnitus). The continuous exposure to noise which higher than 90 dBA may cause damage to ear structure and eventually leading to hearing loss permanently. Bohne & Harding (1999) says that the person who exposed to excessive noise on a daily basis may affect the ear-inner damage such as degeneration of hair cells, progressive degeneration of supporting cells and afferent nerve fibers.

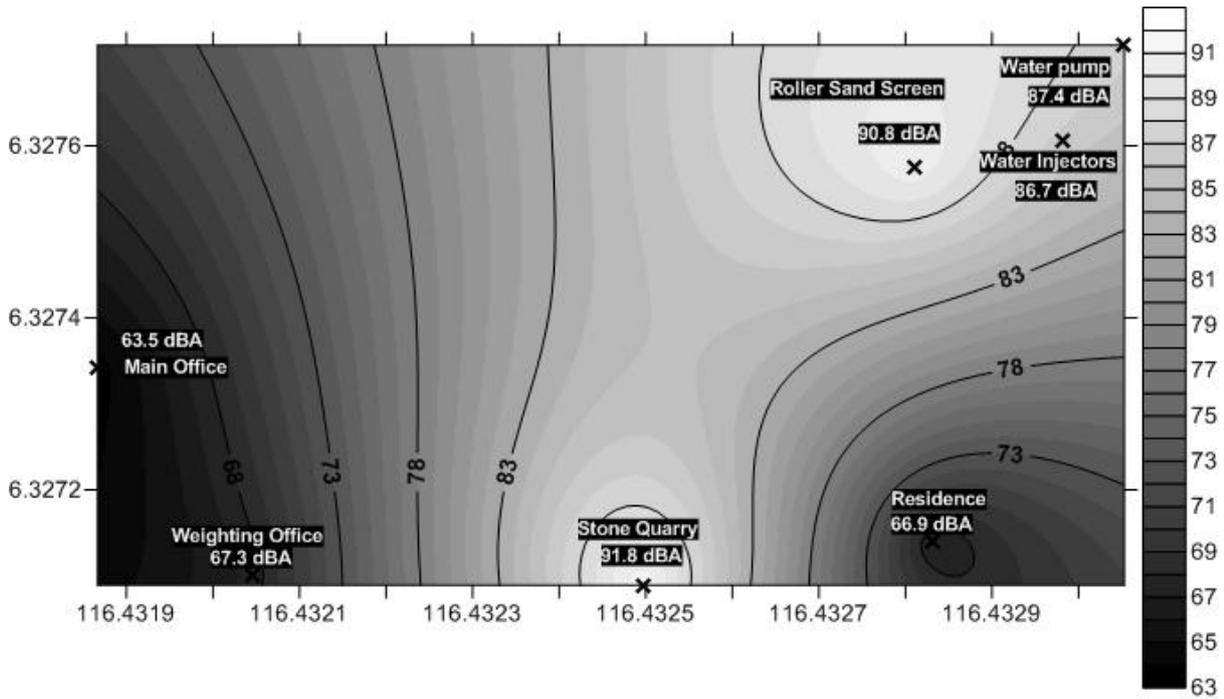


Figure 2: Noise contour map of sand and stone quarry at Kota Belud, Sabah.

There are several standard and law that being used to determine the limitation of noise level in industry. Table 1 shows the maximum permissible sound level in receiving area. Kota Belud District is located at suburban area. Therefore, the suitable noise level limit for resident area is 55 dBA at day and 45 dBA at night. For Industrial zone, the suitable noise level limit is 70 dB at day and 60 dB at night. Apart from that, NIOSH (National Institute Occupational Safety and Health) has recommended exposure limit of occupational noise is 85 dBA for an 8-hour shift, 40-hour work week. Therefore, from the result, all site in industrial areas are exceeded the limit except main office and weighting office which below 85 dBA. The worker who operates machines is more exposed to noise compare to worker who works in the office as their working indoor condition limiting the noise from emits inside the office. In addition, residence site also exceeded the permissible limit that set by DOE (Department of Environment). The main office and weighting office is having the lower risk of the impact as their location is a bit a far from the machines and trucks. Residence area has exceeded the limit because the location is very near to the quarry which is less than 100 m away.

Table 1. Maximum Permissible Sound Level (LAeq) (Source: Department of Environment, 2007)

Category	Noise level, L_{eq} dBA	
	Daytime	Night time
Noise sensitive area, low density residential, institutional (School, Hospital), worship areas	50	40
Suburban residential. Medium density areas, public spaces, parks, recreational areas	55	45
Urban residential, high density areas, designated mixed development areas (commercial)	60	50
Commercial business zones	65	55
Designated industrial zones	70	60

The exposure of noise higher than permissible limits could raise the problem from annoyance to hearing loss. Continuous exposed above permissible limit may lead to long-term effects on the human auditory system. The effects are including bursting of eardrum, permanent hearing loss, stress, fatigue, irritation, inefficiency and unproductive (Naik *et al.*, 2007). Therefore, the source of noise should be control to reduce noise emission. One of the effective control is by isolating the equipment by providing barriers or enclosure to the machines. Personal protective equipment should be provided such as earplugs, helmets and muffs to all workers who handling machines and trucks. Furthermore, education and awareness of noise exposure impacts should be done by the institution, social organization and the owner of quarry to educate and increase the awareness of noise pollution among the workers and local people. Other than that, working shift also can be adjusted so that the time exposed to the noise can be reduces. For example, as the permissible noise level for 8 working hours is 85 dBA. Therefore, the employees who work at place which is higher than 85 dBA should be given an opportunity to rotate their shift from noisy to quite working place. So, the time exposed to excessive noise can be minimised. Early prevention action is very important as it prevents people from having serious hearing problem and incurable.

CONCLUSION

It is apparently sand and stone quarry is complex and dangerous to overexposure if control measure not be taken. During our measurements it has been determined that the noise levels at the chosen site is exceeding the permissible limits except the main office and weighting office. This indicates that water pump, water injector, roller sand screen, and stone quarry can be a very high overexposure of loud noise to the worker. The noise should be reduced as it also affects the noise level at near housing area.

ACKNOWLEDGEMENTS

Grateful acknowledgements are made to Universiti Malaysia Sabah for the financial support in this study.

REFERENCES

- [1] Bauer, E. R. & Babich, D. R. (2007). Noise Assessment of Stone/Aggregate Mines: Six Case Studies. *Journal of Mining Engineering*, **59**(8), 55-13.
- [2] Bernama. (2008). *Peningkatan Masalah Hilang Pendengaran Akibat Kebisingan Tempat Kerja Membimbangkan*. (http://www.bernama.com/bernama/v3/bm/news_lite.php?id=347656). Accessed on 9 August 2016.
- [3] Divya, C. M., Sudarsanan, D. & Krishnan, R. (2012). *Environmental Issues in Stone Crushers*. (<https://businessimpactenvironment.wordpress.com/2012/01/08/environmental-issues-in-stone-crushers/>). Accessed on 11 August 2016.
- [4] EPA (Environmental Protection Agency). (2000). *NSW Industrial Noise Policy*. Sydney: Environment Protection Authority.
- [5] Farzana, S. Z., Nury, A. H., Biswas, B. & Das, A. (2007). A Study on Noise Pollution of Stone Crusher Machine at Jaflong, Sylhet. *Proceedings of 5th International Conference on Environmental Aspects of Bangladesh*. 11-12 September 2014, Dhaka, Bangladesh.
- [6] Gusrianto, P. (2016). Penggunaan Mesin Pemecah Batu (stone crusher) Menjadi Batu Koral Atau Batu Split di Dharmasraya. *Jurnal Nasional Ecopedon*, **3**(1), 72-76.
- [7] Naik, D. P., Ushamalini. & Somashekar, R. K. (2007). Noise Pollution in Stone Quarrying Industry –A case study in Bangalore District, Karnataka, India. *Journal of Industrial Pollution Control*, **23** (1), 43-48.
- [8] Noor Rasfanjani B. Ali. (2005). *Kajian Kesan Trafik Terhadap Pencemaran Hingar di Kawasan Sekolah di Skudai, Johor Bahru*. Disertasi Kejuruteraan Awam, Universiti Teknologi Malaysia.

- [9] Department of Environment. (2007). *Environmental Noise Limit and Control* (2nd edition). W.P Putrajaya. Department of Environmental Malaysia.
- [10] Brooks, P. J. (2007). *Industrial Noise Control*. (<https://ohsonline.com/Articles/2007/09/Industrial-Noise-Control.aspx?p=1>). Accessed on 11 August 2016.
- [11] Behroozi Lar, M., Payandeh, M., Bagheri, J. & Khodarahm Pour, Z. (2012). Comparison of Noise Level of Tractors With Cab and Without in Different Gears on Driver Ear and Bystander. *African Journal of Agricultural Research*, 7(7), 1150-1155.
- [12] Bohne, A. B. & Harding, G. W. (1999). *Noise- Induced Hearing Loss*. Dept. of Otolaryngology. St. Louis, MO: Washington University School of Medicine.