International Journal of Science and Technology Research Archive

ISSN: 0799-6632 (Online)

Journal homepage: https://sciresjournals.com/ijstra/

(RESEARCH ARTICLE)

Check for updates

The noise pollution and heat stress in different parts of Rabak Cement Factory, White Nile State, Sudan

Mazahir Elhadi Abdallah Mohammed Ali [1,*], Bashir Mohamed Elhassan [2] and Abdelaal Ali Hammad Ali [3]

[1] *Department of Public Health, Applied Medical Sciences, University of King Khalid, KSA.*
[2] *Faculty of Civil Engineering, University of Khartoum, Sudan.*
[3] *RAE Company for Environmental Services, Al-Jafr, KSA.*

International Journal of Science and Technology Research Archive, 2022, 02(02), 016–021

Publication history: Received on 24 February 2022; revised on 09 April 2022; accepted on 11 April 2022

Article DOI: https://doi.org/10.53771/ijstra.2022.2.2.0032

Abstract

Cement industry caused environmental impacts at all stages of the process in the area; include emissions of airborne pollution in the form of dust, gases, noise and vibration. This study is conducted to evaluate the noise pollution and heat stress in different parts of Rabak Cement Factory. The study involved the exposed and unexposed groups. The noise levels were measured by the aid of an occupational health specialist who was familiar with the measuring device instructions and the study protocol. On the other hand, structured questionnaires were used to assess the workers' response to noise pollution in all sections of the factory. Environmental temperature was measured as close as feasible to the work area where the workers are exposed. The measurements were taken from two locations in the factory; the chemical laboratory and kiln in order to determine the heat stress. Some instruments were used to calculating heat stress parameters. Highest noise level was found in compressors 105.33 dB, conveyor belts 101.66 dB, raw materials mills 98.33dB and workshops 97.00 dB. The levels exceeded the maximum permitted noise level described by WHO. There is high temperature in work environment over standard level which may lead to heat stress. For these findings, the company should create a formal noise and heat stress management program.

Keywords: Noise; Pollution; Heat Stress; Cement Factory

1. Introduction

The impacts of cement industry are countless and it even did not spare humans from its deteriorating impacts and have adversely impacted the health of workers. Dust is not only deteriorating air quality, but also degrading human health, and resulting in global warming, ozone depletion, acid rain, biodiversity loss, reduced crop productivity…etc [1]. Exposure to cement pollution has been linked to a number of different health outcomes, starting from modest transient changes in the respiratory tract and impaired pulmonary function, passing to restricted activity or reduced performance, emergency room visits, hospital admissions and death [2].

Noise is a type of air pollution in the form of waves. The British encyclopedia defines noise as “the unwanted sound” whereas the American encyclopedia defines the term as “the undesired sound” [3]. Noise causes inconvenience, stress and possibly deafness it accompanies general productivity and manufacturing processes, the severity of noise can vary depending on the nature and quality of those processes. Regulations limiting noise exposure to industrial workers have been instituted in different countries [4]. Noise in the work environment is the major cause of concern for safety and health of the factory workers. Exposure duration of 40 hours per week of equivalent noise level of 85 dB is considered to be a safe and noise level above this limit is bound to cause noise induced hearing loss the most common effects among

*Corresponding author: Mazahir Elhadi Abdallah Mohammed Ali
Assist. Prof., Public Health Dept, Applied Medical Sciences, University of King Khalid, KSA.

the physiological ones [5]. Data management elements are critical to ensure that workers are being protected where noise levels are unable to be reduced below the OSHA required levels [6].

High heat stress disturbs the thermal equilibrium of the body, and consequently produces many adverse physiological reactions in man. It is important to evaluate the degree of heat stress imposed on the human body by a certain environment in order to determine whether it is within the safe limits or is harmful. Many indices have been designed for the effective evaluation of heat stress conditions which are used in occupational situations [7].

Wet bulb globe temperature (WBGT) index accounts for air velocity, temperature, humidity, and radiant heat and is a useful index of the environmental contribution to heat stress. WBGT is a function of dry bulb temperature, natural wet bulb temperature, and black globe temperature. The WBGT monitors were placed around each of the four bottles forming machines, in the break room, and outside, and were allowed to equilibrate for a minimum of 15 minutes before being read [8].

In Rabak city residential area neighborhoods close to cement plant are constantly exposed to cement manufacturing noise and heat. The objective of this study was: to assessment of noise and heat stress negative impacts in work environment.

2. Material and methods

2.1 Study area

Rabak cement factory which is located in Rabak city which is the capital of the White Nile State. It is located in the south of Sudan in the eastern bank of the White Nile River, approximately 260 km south of Khartoum and 15 km south east Kosti town. The climate of the study area is tropical, characterized by hot and dry most of the year. The temperature ranged between 8 in December to 46^{0}C in April and May. The relative humidity ranged between 28-75%.

2.2 Study population

The study involved the exposed (134 individuals) group which included cement workers and populations living in areas of about 1.5 km around the cement factory. The other not exposed (134 individuals) group lived about 5.0 km far from the factory.

2.3 Measurement noise level in work environment

The noise levels were measured by the aid of an occupational health specialist who was familiar with the measuring device instructions and the study protocol. All measurements were done during morning working hours between 8:00 am to 4:00 pm in which the maximum number of workers was working, and all of the noise producing equipment was operating. The noise measurement was done in various sections of cement processing and non-production sections. In each section at least 3 measurements were done and the mean for each section was determined. A digital mini sound level meter (Model: CENTER 329) scale was used to measure the noise at a worker's ear level and expressed in dB. On the other hand, structured questionnaires were used to assess the workers' response to noise pollution in all sections of the factory.

2.4 Measurements of temperature in work environment

Environmental temperature was measured as close as feasible to the work area where the workers are exposed. The measurements were taken from two locations in the factory; the chemical laboratory and kiln in order to determine the heat stress. Some instruments were used to measure air temperature (using dry bulb thermometer), air movement (using Katathermometer), air humidity (using Wet bulb thermometer) and radian heat (using globe thermometer), according to the method described by NIOSH [9] and [4]. The equations of Louis [10] were used for calculating heat stress.

2.5 Data analysis

Statistical analysis was carried out with SPSS version 21. Comparison of demographic data among exposed and unexposed groups was calculated using means, standard deviation and the standard error of variables was calculated.

3. Results

Concerning the period of stay in the exposed group, the age of 11-20 years (25.4%) and 21-30 years (24.6%) were the more frequent intervals, whereas in the unexposed group the age of 21-30 years (33.6%); 31-40 years (25.4%) and 11-20 years (23.9%) were the more frequent individuals (Table, 1).

Table 1 Distribution of exposed and unexposed subjects according to the duration of stay in the study area

Period of stay (year)	Exposed Group		Unexposed Group	
	Frequency	Percent	Frequency	Percent
5-10	20	14.9	20	14.9
11-20	34	25.4	32	23.9
21-30	33	24.6	45	33.6
31-40	23	17.2	34	25.4
41-50	16	11.9	1	0.7
> 50	8	6.0	2	1.5
Total	134	100.0	134	100.0

The majority of workers (57.5%) complained about the high level of noise in the work environment as shown in Table (2).

Table 2 Feel by high noise in work environment in Rabak cement factory

Noise in work environment	Frequency	Percent
Yes	77	57.5
No	57	42.5
Total	134	100.0

About 50% of cement workers responded that they experienced an inability to communicate and feelings of discomfort, thus these were considered as the major impacts of noise in work environment followed by (42.5%) who said that the noise affected their ears as shown in Table (3).

Table 3 Impact of noise on health of workers in Rabak cement factory

Impact of noise on health	Frequency	Percent
Effect on ear health	10	7.5
Inability to communicate and feelings of discomfort	67	50.0
Don't Know	57	42.5
Total	134	100.0

24% of workers' respondents that high noise in work place caused the presence of auditory diseases. The result also indicates that there was a statistical significant difference between the auditory disease, infection and the presence of high nuisance in the work environment ($p < 0.05$) as shown in Table (4).

Table 4 Correlation between high levels of noise in work environment and prevalence of auditory diseases in Rabak cement factory

Infected with auditory diseases	Feel by high noise in work environment				Total	
	Yes		No			
	No	%	No	%	No	%
Yes	19	76	6	24	25	18.7
No	58	53.2	51	46.8	109	81.3
Total	77	57.7	57	42.5	134	100

Chi-Square = 4.321, df = 1, p. value = 0.038

Only 23% of cement workers used personal protective equipment for protection from noise as shown in Table (5). This may lead to negative effects on health of workers.

Table 5 Use of personal protective equipment for protection from noise in Rabak cement factory

Use	Frequency	Percent
Yes	31	23.1
No	103	76.9
Total	134	100.0

Heat stress measurements in the production department in (chemical laboratory and kiln) the result showed that the temperature in the work environment was very high as shown in Table (6).

Table 6 Mean of reading temperature in work environment in Rabak cement factory

Locations	Tg ^{0}c	Tnwb ^{0}c	Ta ^{0}c	WBGT ^{0}c
Chemical laboratory	34	26	32	28.40
Kiln in the morning	36.5	27.5	34.5	31.85
Kiln in the afternoon	37.0	27	36.5	30.15
Kiln in the evening	37.6	29.5	37	31.15

WBGT= Wet Bulb Globe Temperature; T_{nwb}= Natural wet bulb temperature; T_g= globe temperature; T_a= dry blub (air) temperature

The study found that the WBGT were high when compared with the Sudanese permissible level of temperature in work environment shown in Table (7).

Table 7 Comparison between WBGT in work environment in Rabak cement factory and the standard

Locations	WBGT ^{0}c	Standard for moderate work
Chemical laboratory	28.40	26.6
Kiln in the morning	31.85	28.0
Kiln in the afternoon	30.15	29.4
Kiln in the evening	31.15	31.1

4. Discussion

The high noise pressure level is one of the characteristics of noise pollution in cement plant [11]. In this study noise level was measured at the compressors zone recorded (105.33 dB); this value is above the maximum permitted noise level of 85 dBA described by the WHO [12]. The minimum noise level was recorded in the offices (56.33 dB), because the offices were usually received most of safety services in the factory area. In addition, the results further demonstrated that workers in chemical laboratory and packing machines are less exposed to noise where the average noise values in these sections were equal or below 85dBA. The study indicated that with the exception of the offices, chemical laboratory and packing machine areas, all other locations received higher level of noise more than WHO standard level of noise. There is high risk of noise-induced hearing loss among workers that come from the noise exposure [13].

The results from the present study at Rabak cement factory on noise levels and workers' response to impacts of noise in the workplace are comparable to those reported in other previous study [14]carried out in the cement factories in Tanzania confirmed increasing prevalence of high noise levels in the workplaces of various factories. However, most of the responders 57.5% said they were feeling by high noise in their work environment. 57.6% of workers said the noise effects on their health, inability to communicate, effect on the ears, inability to communicate and feeling discomfort.

Many people believe that high level of industrial noise and traffic noise is one of the major reasons of high incidence of heart disease [15]. The study illustrated that there are health impacts of noise on workers in Rabak cement factory. However, 50.0% were unable to communicate and experienced feelings of discomfort and 7.5% were affected in their ears.

It is important to evaluate the degree of heat stress imposed on the human body by a certain environment in order to determine whether it is within the safe limits or is harmful and to ascertain the need for improvement by adopting suitable control measures [12]. The study found that the WBGT were high when compared with the Sudanese permissible level of temperature in the work environment. In a similar survey conducted on 400 workers in Slovenia, 96% perceived the temperature conditions as unsuitable, and 56% experienced headaches and fatigue [16].

5. Conclusion

High noise (above the maximum permitted noise level, 85 dBA described by WHO), was recorded in work environment. The higher levels of noise were found especially in the production sections whereas sections such as in chemical laboratory and offices had average noise values below 85 dBA. There was a positive correlation between the infection by auditory diseases and the presence of high nuisance in work environment. It has also been observed that majority of workers do not use personal protective equipment against noise while at work. However, few workers use protective equipment. There is high temperature in work environment over standard level which may lead to heat stress. For these findings, the company should create a formal noise and heat stress management program.

Compliance with ethical standards

Acknowledgments

Thanks are due for Dr. Bashir Mohamed Elhassan, Dr. Amir Ali Bashir and Dr. Zainab Osman Saaeed, who providing the required technical support, in addition to the staff of the Lab. of Environment and Natural Resources Research Institute and Natural center for Research.

Disclosure of conflict of interest

The authors declare no conflicts of interest regarding the publication of this paper.

Statement of informed consent

The study was ethically cleared and endorsed by the Research Committee of the Institute for Environmental Studies, University of Khartoum. The cement factory manager also officially endorsed the study. All participants were informed about the aims of the study and his/her role as a participant, and then a verbal consent was taken. These formalities were done before launching the program of data collection.

References

[1] Pariyar SK, Das T, Ferdous T. Environment and health impact for brick kilns in Kathmandu valley. International Journal of Scientific & Technology Research. 2013; 2(5): 184-187.

[2] Zeleke Z, Moen B, Bratveit M. Cement dust exposure and acute lung function: A cross shift study. BMC Pulmonary Medicine. 2010; 10-1: 19.

[3] AlShowki A. Noise pollution its effects and sources, King Saud University, Department of Biology, Kingdom Saudi Arabia. 2010.

[4] Eleftheriou PC. Industrial noise and its effects on human hearing. Applied Acoustics. 2002; 63: 5–42.

[5] Neitzel R, Seixas N, Neitzel R. Noise exposure standards around the world. Department of Environmental and Occupational Health Sciences, University of Washington. 2004.

[6] OSHA. Protecting Workers from Heat Stress, Available at: https://www.osha.gov/sites/default/files/publications/osha3154.pdf.

[7] WHO, Occupational and Environmental Health Team. Guidelines for air quality. Geneva, Switzerland: WHO. https://apps.who.int/iris/handle/10665/66537. 2000.

[8] US NOAA, National Oceanic and Atmospheric Administration. *Climates of the States : a practical reference containing basic climatological data of the United States /* (Port Washington, N.Y. : Water Information Center, 1974.

[9] NIOSH, NIOSH criteria for a recommended standard: occupational exposure to heat and hot environments. By Jacklitsch B, Williams WJ, Musolin K, Coca A, Kim J-H, Turner N. Cincinnati, OH: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, DHHS (NIOSH) Publication 2016.

[10] Louis JD. Hand book of occupational safety and health. Publisher: John Wiley & Sons; 2nd edition. ISBN-10: 0471160172. 1999.

[11] NIOSH. Industrial Noise Control Manual (revised edition). National Institute for Occupational Safety and Health, US DHEW(NIOSH) Publication No. 79-117, Cincinnati, Ohi, 1978.

[12] WHO-Europe. Monitoring ambient air quality for health impact assessment WHO Regional Publications, European Series, No. 85 WHO Regional Office for Europe Copenhagen. 1999.

[13] Subramaniam M, Hassan MZ, Sadali MF, Ibrahim I, Daud MY, Aziz SA, Samsudin N, Sarip S. Evaluation and Analysis of Noise Pollution in the Manufacturing Industry. J. Phys. Conf. Ser., 1150(1): 012019. DOI: 10.1088/1742-6596/1150/1/012019. 2019

[14] Minja BM, Moshi NH, Riwa P. Noise induced hearing loss among industrial workers in Dar es Salaam. East African Medical Journal. 2003; 80(6): 298–302.

[15] Zhou H. Noise pollution in cement plant and the control measure, Cement Engineering. 2006; 4: 85.

[16] Pogacar T, Casanueva A, Kozjek K, Ciuha U, Mekjavic IB, Bogataj LK, ZalikaCrepinsek Z. The effect of hot days on occupational heat stress in the manufacturing industry: implications for workers' well-being and productivity. Int. J. Biometeorol. 2018; 62(7): 1251-1264.