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Noise Pollution Risk Assessment in Cement Factory of Larestan Using William Fine Method

Eghbal Sekhavati[1], Maria Mohammadizadeh[2]*, Iraj Mohammadfam[3], Ali Faghihi Zarandi[4]

[1]Larestan School of medical Sciences, Larestan, Iran.
[2]Department of Environmental Management, Collogue of Natural Resources, Islamic Azad University, Bandar Abbas Branch, Bandar Abbas, Iran
[3] Professional Health Group, faculty member in Medical Sciences University of Hamedan, Iran
[4]Professional Health Group, Health Faculty, Medical Sciences University of Kerman, Kerman, Iran

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ABSTRACT

Background: Current research was carried with the aim of possible risks recognition, classification and decrease of risk level to protect workers that have exposure to noise pollution.
Materials and Methods: after investigation the processes of this factory and providing sound map, by using William fine method, each region were scored by connoisseur experts, then the regions were classified in order to level of risk and all areas were determined as high, median and low risks
.**Research Findings:** Based on William Fine method, raw materials mill, cement and stucco mill, crusher, kiln, raw materials silo and kiln feeding, side motor of water pump and pre-heater, were the first seven high risk region and other 7 regions including cement silos and bulk loading, air slide, loading house, duster set, compressor room, create cooler, mixture hall were placed in median risk level parts.
Discussion and Conclusion: According to results, all mentioned regions need to management attention and control. Raw material mill with 109.8 db were dangerous section of the factory. Control solutions like workers' training, doing correction actions, following risk control directions and using Personal Protective Equipments (PPE), were suggested for decrease or elimination of risks.
KEYWORDS: Risk assessment, William Fine Method, Cement factory, Noise pollution

1. INTRODUCTION

Today one of the most important indices for investigating the status of an organization is number and severity of events occurred in this organization. Incidence of different events in processes that lead to human and environmental tragedies, made experts take advantage of probable approaches including bioenvironmental risk evaluation (6).

These technological advances have resulted in many dangers for humans and serious damages and hurts have been incurred on their property and life. (8)

Noise pollution in cement industry have been proposed for long ago and personnel of production and maintenance units of this factory have faced with its pressures and consequences which have led to physical and psychological dangers in long time. And hearing loss due to work in some units of cement production has often observed in working personnel. (3)

In the past, investigation of events causes was done after events happening and irreparable hurts and deficiency of a system or a process was determined but today event stimulating and critical points can be characterized before occurrence because of existence of different methods for risk evaluation and taking necessary actions for prevention and control of these events. (14)

Evaluation of danger is done with qualitative and quantitative methods. Centers and factors of existing danger can be identified by quantitative methods of evaluation and elimination or control of them are provided by taking preventing and control solutions. First step in management and evaluation process of dangers is identification of dangers and their effects. In this direction there are different techniques each of which does this duty with special

Corresponding author: Maria Mohammadizadeh, Department of Environmental Management, Collogue of Natural Resources, Islamic Azad University, Bandar Abbas Branch, Bandar Abbas, Iran

capabilities and limitations of their own. Among these techniques we can refer to preliminary hazard analysis[1] (PHA), failure modes and their effect analysis[2] (FMEA), fault tree analysis[3] (FTA) and also William Fine method[4]. (2)

One of the common methods to evaluate in which security experts trust is William Fine method that is based on calculation and evaluation of risk. (12)

William Fine method is an organized and systematic technique of hazard evaluation in identifying potential dangers and estimation of danger level to manage hazard and decrease it to an acceptable level. This method helps managers speed up getting specific aims explicitly with prioritizing their control programs of dangers and events and determining necessity and control planning .(9,10,15)

The method is an analytical one and tries to identify and rank existing potential dangers as much as possible in a range that evaluation is done and also causes and related effects (16).

In industrial environments, there are different harmful factors including physical factors. One of these physical factors is noise which is coordinate of industrial community and provides important issues of health and security inside and outside of workshops that must be considered for timely prevention of dangers that may be raised. (4)

In the case of noises produced in factories, main problem is not workers' object and sadness but the problem is its adverse effect on nerve and soul, heart and arteries system and especially hearing system. Noise control in industry and hearing protection plan is carried out to prevent workers' hearing loss that are continuously in contact with noise in work place (7).

Today determination of event stimulating and critical points and taking action to prevent happening and control of accidents can be possible before happening of an accident because there are different methods for evaluating risk (13).

Complete protection of workers is subject of hearing protection program and successful programs in this respect protect workers against danger of hearing loss and employers against heavy paying for damages. Performing such actions is possible only with measuring and analysis of obtained data and if these measurements are accurate, systematic and based on existing standards, analysis of obtained data will be certain and we have taken effective steps for reaching industrial prevention and control results of noise. (11)

Cement is one of the important and strategic goods of Iran and among most important structural materials for building including light and heavy and in all production processes from exploiting substance to shattering, mixing, drying and . . . there are dangers that must be determined and planned (5).

Cement factory of Larestan have continuous effort in establishment and keeping this system by applying expert personnel along with its production. For this purpose in this phase refinement of environment and security and health pollutions of this factory havebegan as one of the required parameters in getting standards for its action.

Identification and evaluation of probable dangers due to pollution effect related to noise of different resources in cement industry on workers and at last ranking regions having noise risk to keeping human capital and increasing factory yield and also decrease of damages and harms due to noise pollution are necessary (1).

Current research was performed with aim of identifying probable dangers, danger rate estimation, control and decrease of hazard level and keeping health of personnel, equipment, capital and environment affected by cement factory in Larestan.

2. MATERIALS AND METHODS

To investigate noise pollution status in industrial unit necessary measurements must be done and required sound maps must be drawn. To achieve this purpose, proper methods in cement factory of Larestan were chosen and determined by texts study, visiting required units, documents investigation and also knowledge about standard methods accepted by Environment Organization. In the research noise evaluation was done using environmental measurement and evaluation. For this purpose, at first actions and processes of the factory were investigated. Then the region was divided into plaid zones with same dimensions by providing zone plan of noise with respect to studied region area and in center of each zone, noise measurement was made. Noise measurement using Sound level meter model DL7103 was carried out. After determining noise balance extent severity in each zone, permitted and not permitted sounds were divided based on environment standard. Then probability of happening and probable consequences of facing with noise were scored by connoisseur experts based on William Fine's risk evaluation method

[1]Primary Hazard Analysis (PHA)
[1]Failure Mode and Effect Analysis (FMEA)
[3]Fault Tree Analysis (FTA)
[4]William Fine

of effect severity and with respect to obtained results, risk evaluation and classification of polluting regions were done and all regions were classified into high, median and low risk regions.

Application Purpose: William Fine method is decision about necessity and acceptability of manager's attention and also necessity of performing dangers control plans as fast as possible. Foundation of this method based on calculation and evaluation of risk score is as following:

$$R = C \times E \times P$$

R: risk score P: happening possibility
E: encountering rat C: consequence severity

Table (1): Consequences Severity Criterion of Events

Consequences Severity Criterion of Events C	
Rate	Event Classification
100	Catastrophic, differentdeaths, very long time stop of action
50	Several cases of death
25	Death
15	Super severe wounds as amputation, lifetime inability
5	Disabling injuries
1	Less severe injuries or damages

Table (2): Encountering Rate

Encountering Rate (E)	
Rate	Classification
10	Continuously (several times in a day)
6	Repeatedly (about once in a day)
3	Sometimes (once in a week or a month)
2	Unusually (once in a month or a year)
1	Seldom (it may happen during life of an organization)
0. 5	Its occurring probability is too low (it seems impossible)

Table (3): Occurring Probability

Occurring Probability (P)	
Rate	Classification
10	Complete consequences of the event: In the case of event, danger occurrence is expected and possible.
6	It may completely possible; it is not unusual. Its probability is 50- 50.
3	It will be an accident and unusual.
0.5	After several years encountering has not happened but sometimes it may happen.
1	It is practically impossible (It has never happened)

Table (4): Risk Score and Necessary Actions Summary

Risk Score and Necessary Actions Summary (R)	
Rate	Necessary Actions
200- 1500	Immediate need to corrective actions and these actions must be not stopped until danger decreases.
90- 199	It needs faster attention and investigation as much as possible.
0- 89	Danger must be omitted without any delay but situation is not emergency.

Table (5): Ranking of Danger Level in William Fine Method

Rank	Actions	Risk Level
200 <	Immediate corrections for danger control are necessary or it is necessary to stop single being studied action.	High (H)
90- 199	Situation is emergency or required actions must be taken in nearest time.	Unusual (M)
89 >	Dangerous potential factor is under supervision and control.	Usual (L)

Findings:

After noise measurement in different areas of the factory, regions with unallowable noise were found after final evaluation of measurement stations (Table 6). Then the results obtained from poll and scoring of experts in William Fine method, danger ranking of being studied industrial units was in high and median level (Table 7). Because of stations variety in each region, points mean was considered as noise rate representative in that section of the factory.

Table (6): Regions Having Illegal Noise Above 75 db Based on Noise Standard in Iran (Iran Environment Protection Organization 1993)

Row	Workshop Name	Noise level
1	Kiln	99.1
2	Side motor of water pump	96.5
3	Raw materials silo and kiln feeding	97.1
4	Raw materials mill	109.8
5	Crusher	103.2
6	Cement and stucco mill	107.4
7	Create cooler	82.3
8	Duster set	83.3
9	Cement and bulk loading silos	93.8
10	Loading house	89.1
11	Mixture hall	82.1
12	Compressor room	82.5
13	Air slide	83.6
14	Pre heater	93.9

Table (7): Division Table of Dangers

Noise Polluting Source	Risk Level	Rank	Mean	Actions
Raw material mill	High	1	721.1865	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
Cement and stucco mill	High	2	681.7344	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
Crusher	High	3	668.2638	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
Kiln	High	4	554.6678	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
Raw material silo and kiln feeding	High	5	524.7155	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
Side motor of water pump	High	6	303.8625	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
pre heater	High	7	205.436	Immediate correction for danger control is necessary or stopping of single being studied action is needed.
Cement and bulk loading silos	median	8	188.6288	The situation is emergencyor in nearest time required practices must be taken.
Air slide	median	9	183.7875	The situation is emergency or in nearest time required practices must be taken.
Loading house	median	10	178.068	The situation is emergency or in nearest time required practices must be taken.
Duster set	median	11	174.02	The situation is emergency or in nearest time required practices must be taken.
Compressor room	median	12	165.7058	The situation is emergency or in nearest time required practices must be taken.
Create cooler	median	13	158.661	The situation is emergency or in nearest time required practices must be taken.
Mixture hall	median	14	131.461	The situation is emergency or in nearest time required practices must be taken.

The regions having unallowable noise were determined after studying the results obtained from noise measurements in cement factory of Larestan. According to this, among 14 measured regions, raw material mill, cement and stucco mill, crusher, kiln, raw materials silo and kiln feeding, side motor of water pump and pre heater had highest sound pressure balance among other regions with pressure balances 109.8, 107.4, 103.2, 99.1 , 97.1, 96.5, 93.9 db respectively. Evaluation made by using William Fine method showed that highest noise level related to raw material mill section with sound pressure level 109.8 db and approximate mean score 722 and minimum sound pressure level was for mixture hall with sound pressure level 82.1 db and approximate mean score 132; This subject supported consistency with regions risk priority in William Fine method based on experts' opinion and results obtained from regions measurement (Diagram 5). Also it can be concluded that according to suggestion proposed in William Fine method, section of raw material mill needs immediate corrections for danger risk. To control and decrease noise in this factory it is suggested that most attention of manager will be for this section in future. Since all equipment of the factory is new in erosion, it seems that high noise cause of regions with high and median risk level in importance

degree is function nature of equipment. It is worth mentioning that in noise risk evaluation of studied section in William Fine method; all sections having unacceptable noise were evaluated. In other words, all noise risks were placed in high and median risk levels. So to eliminate or decrease risk level of all 14 regions it is necessary to use proper control solutions as workers' training, doing advised corrective practices, following risk control instructions and using individual protection devices to make a secure range with further certainty.

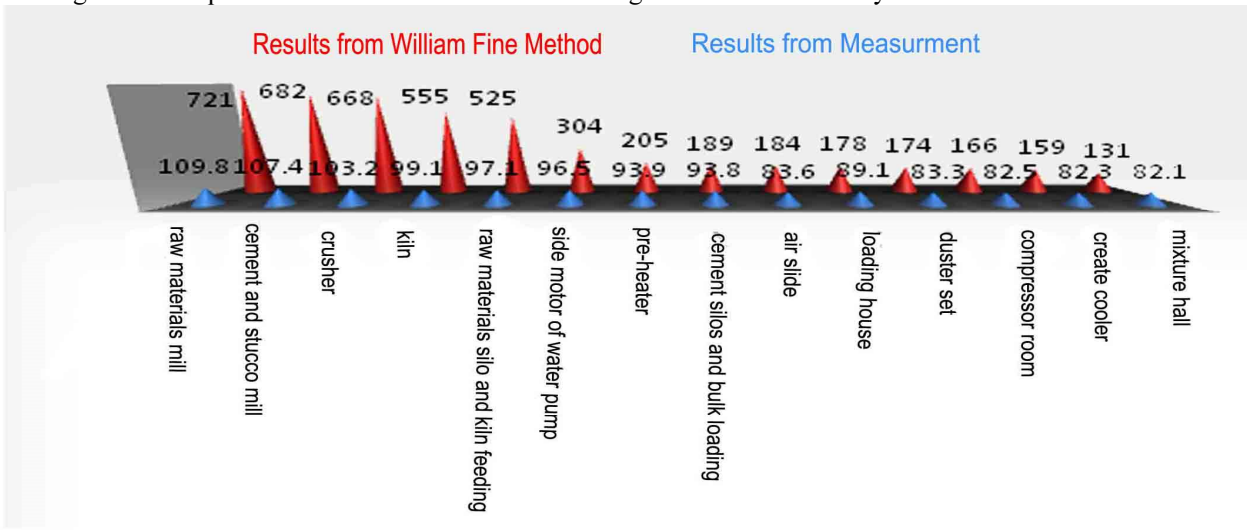

Diagram (5): Comparison of Measurements Results for Cement Factory of Larestan and Evaluation Results of Experts in William Fine Method

In a research done by Ghotbi Ravandi and et al (2010) under subject of professional encountering with noise in cement factory of Kerman, crusher, raw materials mill and iron ore, cement and stucco mill sections were respectively placed in first, second and third ranks in risk priority level. Since in present research mentioned sections had 1-3 orders in spite of priority shifts, it can be concluded that these sections in cement factories can be among important areas and need further control and managerial practices. (17)

In a research carried out by F.G. MNDEME and et al (2012) under title of noise level evaluation in workplaces in Tang cement factory, power plant, raw materials mill, cement mill and crusher were diagnosed as sections with more than standard noise and high risk and due to obtained results of priority and risk ranking results for these regions in this research, we can understand high importance of raw materials, cement mills and crusher sections. But based on results of the research pre heater section was evaluated as having high risk area that is opposite of noted research results. (18)

For obtained results, if a worker in a section encounters with banned noise, time of his encountering must decrease. Based on this, different organizations and countries follow different patterns. Accepted standard in Iran based on ACGIH and advice of Technical Professional Health Committee is sound pressure balance 85 db with 3db rule.[5] (17)

Table (8) Important Standards of Noise Encountering in Workplace Based on Standard of ACGIH and Technical Professional Health Committee

	Permitted Daily Encountering	Sound Pressure Balance dBA
Permitted Hours	**16**	**82**
	8	**85**
	4	**88**
	2	**91**
	1	**94**
	30	**97**
	15	**100**

[5] Rule 2 : 3 or 5 db

Permitted Minutes	**7/5**	**103**
	3/75	**106**
	1/88	**109**
	0/94	**112**

Considering table (8) it can be concluded that work hours of workers involved in raw materials mill, cement and stucco mill, crusher, raw materials silo and kiln feeding, side motor of water pump and pre heater sections decreased respectively to 1.75, 3.52, 7.47, 14.86, 30, 29.84,42.5, 60 minutes based on this rule.

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