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Survey and Analysis of Noise Pollution in the Bidboland Gas Refinery

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ABSTRACT: We investigated the issue of noise pollution in the Bidboland gas refinery by noise measurement and surveys. The Bidboland gas refinery has several process units. The sound pressure levels were measured at several places, such as units of 200, 300, 400, 500, boiler, powerhouse area, cooling towers pumps, and maintenance area, and the corresponding noise maps were produced by using sound plan software. We identified the sources of noise pollution. We first measured the mean A-weighted sound pressure level in each study unit and analyzed the obtained data in Microsoft Excel. The noisiest units were identified and some suggestions were offered to reduce the sound exposure level. It was specifically noted through the surveys that the noise levels detected in all tested industries was much above 80 dBA limit specified by regulations. In lieu, various measures to control the noise pollution were contemplated and discussed.

Keywords: bidboland refinery, measurement, noise maps, sound pressure level.

INTRODUCTION

One of the most important indices for investigating the status of an organization is through the number and severity of events occurring in that particular organization. Incidences of different events in processes that lead to human and environmental tragedies has led experts to take advantage of probable approaches including bioenvironmental risk evaluation (Ghal *et al*., 2012).

The word “noise” is derived from the Latin word “nausea” implying “unwanted sound” or “a sound that is loud, unpleasant, or unexpected.” Noise originates from human activities, especially activities such as urbanization and those associated with transportation and industrial works (Melnik, 1979). Noise is one of the physical environmental factors that affect our health in the present time (Jones and Hothersall, 1980). It is generally defined as unpleasant sounds that disturb the human

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being physically and physiologically as well as cause environmental pollution by destroying environmental properties (Narendra and Davar, 2004).

Noise pollution is a major problem and the major complaint among workers within the industrial sector. It is estimated that most of the industries in Iran suffer from problems induced by noise generation (Pourabdiyan *et al*., 2009). Major power plant-generated noise sources for a biomass-fired power plant, for instance, could include steam generators, steam turbine generators, fuel-handling equipment, air compressors, air separators, cooling towers, and rooftop ventilation fans. Fans in the plant without speed controls can produce "tonal" noise, which is sound centered on the narrow frequency band. Tonal noise has been shown to affect people more than other types of noises, especially at lower overall noise levels, and it may therefore require special silencer mechanisms (NIOSH, 1998). Exposure duration of 40 h/week of equivalent noise level of 85 dBA is considered to be safe, and noise level above this limit is bound to cause noise-induced temporary or permanent hearing loss (Rick, 2004). Gas refinery is one of the major areas that play a significant role in the economy of a country. Experimental sound pressure level (SPL) with the calculated SPL by proposed formula and related the exposed SPL to the horsepower and the life time of the source (Sharma *et al*., 1998). Comparison of the experimental sound pressure level (SPL) with the calculated SPL through a proposed formula revealed the correlation of the exposed SPL to the horsepower and the life-time of the source (Eleftheriou, 2002). In addition, some research has been performed on the measurement of noise level in gas refineries and cement factories to analyze the hearing damage to labors as well as to provide some noise control suggestions for reducing the bad effects of noise exposure (Asdrubali and Baldinelli, 2003; S.I., 2005). Vast research has been performed to recognize the noise-generation parameters (Melamed *et al*., 2001). With the aim of noise generation parameters recognition, a vast research has been done (Makarewicz, 2012). some researchers have been done on measuring the noise level in cement plants, analyzing the hearing damage to labors and providing some noise control suggestions to reduce the damaging effects of noise exposure (Canfeng *et al*. 2012; GhotbiRavandi, *et al*., 2012; Ahmadi Orkomi *et al*., 2013; Noorpoor and Ahmadi Orkomi, 2014). Production machineries in gas refinery emit offensive noises. From the design perspective, to investigate the sensitivity of emitted noise to physical parameters, the influence was conducted in the Bidboland gas refinery to demonstrate the biggest noise-emission sources by using a sound plan software. In other studies, geographic information systems (GIS) was used to conclude that noise maps are useful for evaluating noise levels (Tsai *et al*., 2009).

In this paper, the environmental noise pressure level was measured in several parts of study power plant.

MOTHODOLOGY

This study was conducted in the Bidboland gas refinery. The Bidboland gas refinery is one of the highest ranking gas purification set-up in Iran. Noise pollution from machinery in an industrial plant is not well-established as a contributor to environmental noise pollution. In our study, the measurements were performed during the work hours on Dec. 28. The actual noise levels were measured across different parts (Units 200, 300, 400, and 500, boiler, power plant area, cooling towers pumps, plant power area, and maintenance units) and the maximum and minimum values were determined. A sound level measuring instrument (TES 1353H Sound Level Meter) was used for estimating the values. The sound level meter was calibrated prior to measurement, and the calibration was checked once again after taking all measurements. The measurements results were recorded by holding the instrument at a height of 1.5 m from the ground in a frequency network. These measurements were performed in both local and general manners.

In the general method, each part was divided into squares, and the center of each square was set as the measuring station. For instance, measured coordinates in the cooling tower pumps are shown in Figure 1, and the measurement results are listed in Table 1. In case of the local method (maintenance part), the measurement was performed near the noise sources.

Furthermore, noise pollution in the maintenance unit was measured.

In Iran, the Noise Pollution (Regulation and Control) Rules 2000 have been framed under the Environment (Protection) Act of 1986, the guidelines for regulation and control of noise. The ambient levels of noise for different areas/zones specified in the rules are indicated in Table 2.

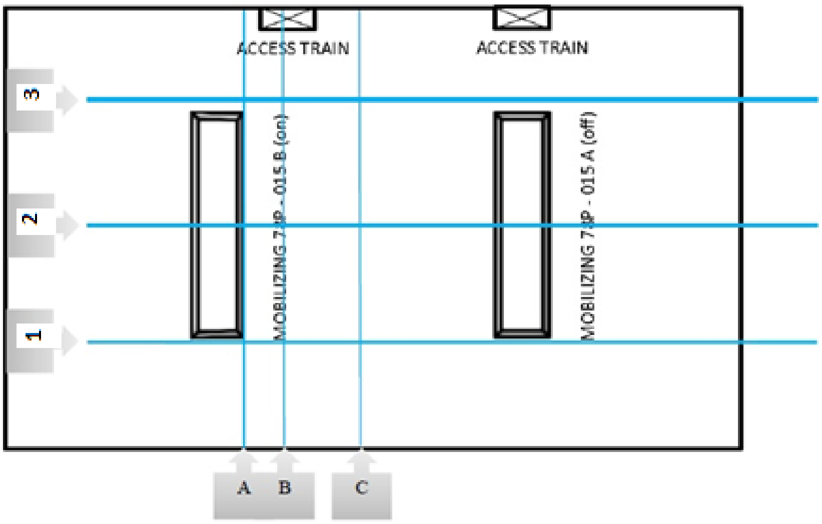

Fig. 1. Measured coordinate in the cooling tower pumps

Table 1. Sound pressure level in the measurement stations of the cooling tower pumps

	A	B	C
1	87	-	85.5
2	-	92.1	-
3	91.4	-	88

Table 2. Ambient noise standards (Environment Protection Act, 2002)

Area Code	Category of Area/Zone	Limits in dB*	
		Day Time	Night Time
(A)	Industrial Area	75	70
(B)	Commercial Area	65	55
(C)	Residential Area	55	45
(D)	Silence Zone	50	40

In order to determine the noise pollution across all sections of the study power plant, modeling was done. Noise maps were created by modeling for determining the critical resources and areas. Evaluation and determination of noise maps are illustrated in Figure 2. The noise map was created by using a sound plan software, including tools such as a plot, worksheet, data grid, and contour map. To create the noise map, all maps were first coordinated and then the resultant values with specific coordinates were entered into the simulation software. The preparation of noise map has been illustrated in the form of a flow chart in Figure 3. This flow chart illustrates the relationship between XYZ data files, grid files, contour maps, and wireframe maps.

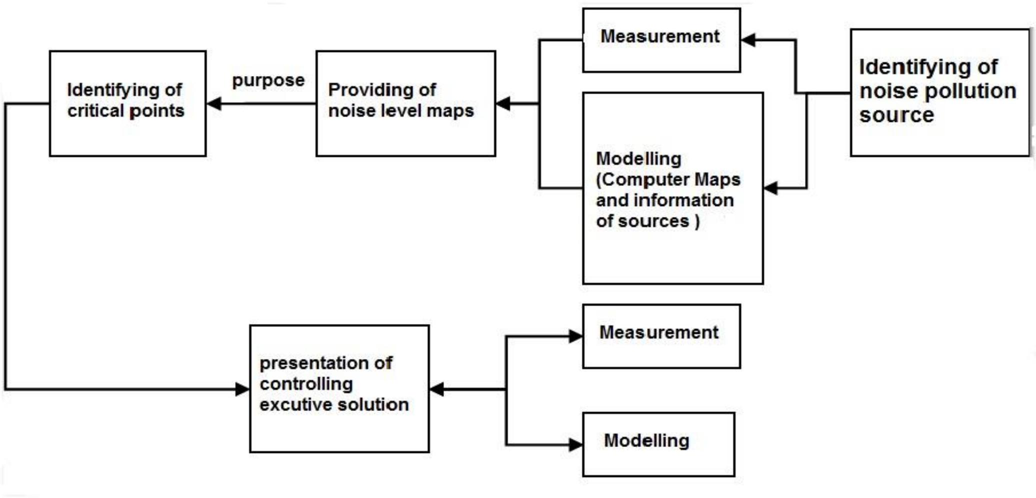

Fig. 2. Evaluation and determination of noise maps

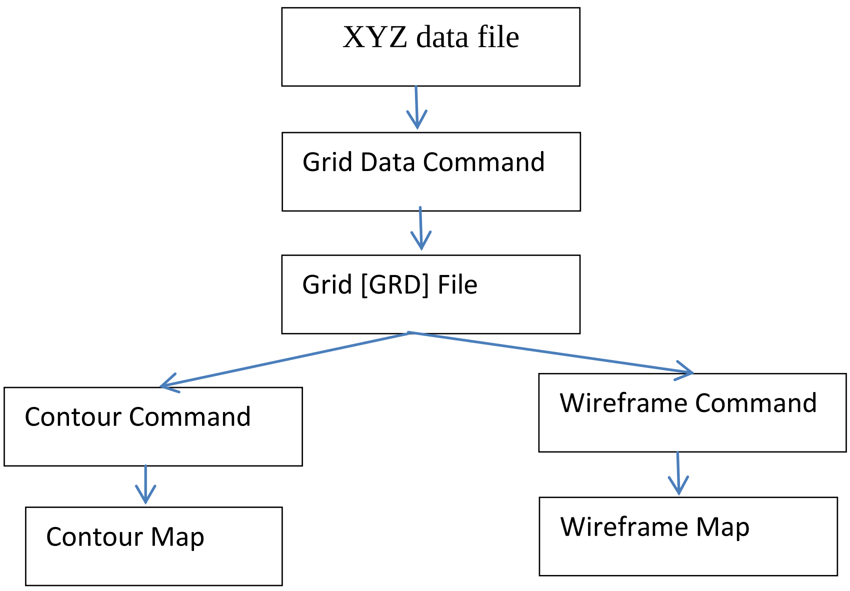

Fig. 3. Stages of noise map preparation

Sound maps were created for the 200, 300, 400, and 500 units, boiler, power plant area, cooling towers pump, and the refinery site. Unit 200 and cooling tower pumps showed the maximum and minimum noise pollution levels, respectively (Figs. 5 and 6).

RESULT AND DISCUSSION

During our measurements, the noise levels in all tested power plant sections showed noise level values of >75 dBA, which is greater than that specified in the Noise Control Regulation. As shown in Table 3, the highest noise level among the tested units was detected at the Unit 200 (112 dBA) and the least was recorded for the cooling tower pumps (92.2 dBA), although even that is 17.2 dB more than the corresponding standard value.

Comparison of our results with the standard values as per the Noise Control Regulation showed that none of the units met the corresponding standards. In case of the local method, as shown in Figure 4, Hammered showed more noise pollution (121 dBA), which is 46 dBA more than the standard value, while lapping horizontal showed the lowest noise pollution (80 dBA), which was 5 dBA more than the standard value.

Table 3. Results of sound pressure level measurement

Units	Max (dBA)	Min (dBA)
200	112	83
300	98	82
400	106	80
500	100	81
boiler	99	83
cooling towers pumps	92.2	85.5
Plant power area	96	86.6

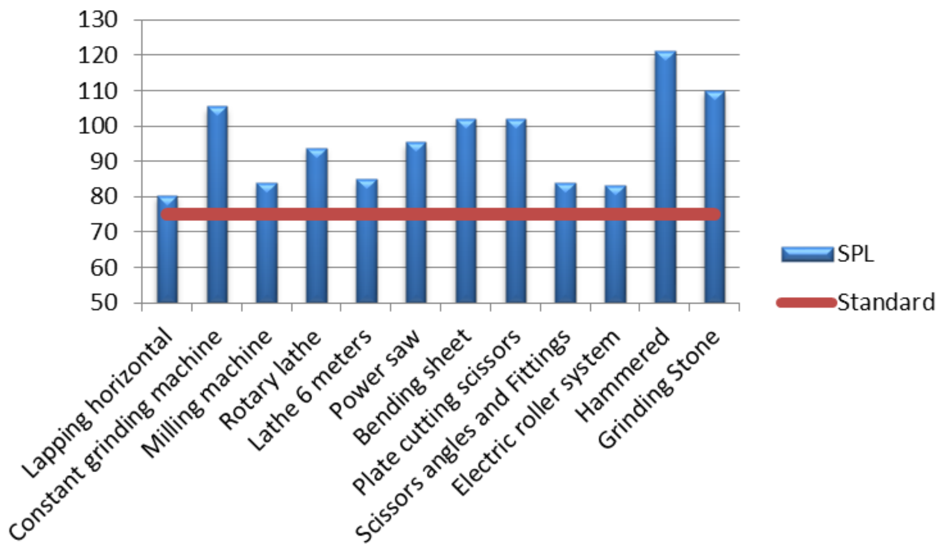

Fig. 4. Noise pollution in the maintenance unit

Dispersion of noise pollution in Unit 200 was more than that in the cooling tower pumps. As shown in Figure 5, SPL in Unit 200 was 86–98 dBA, while that in the cooling tower pumps was 82–90 dBA (Fig. 6).

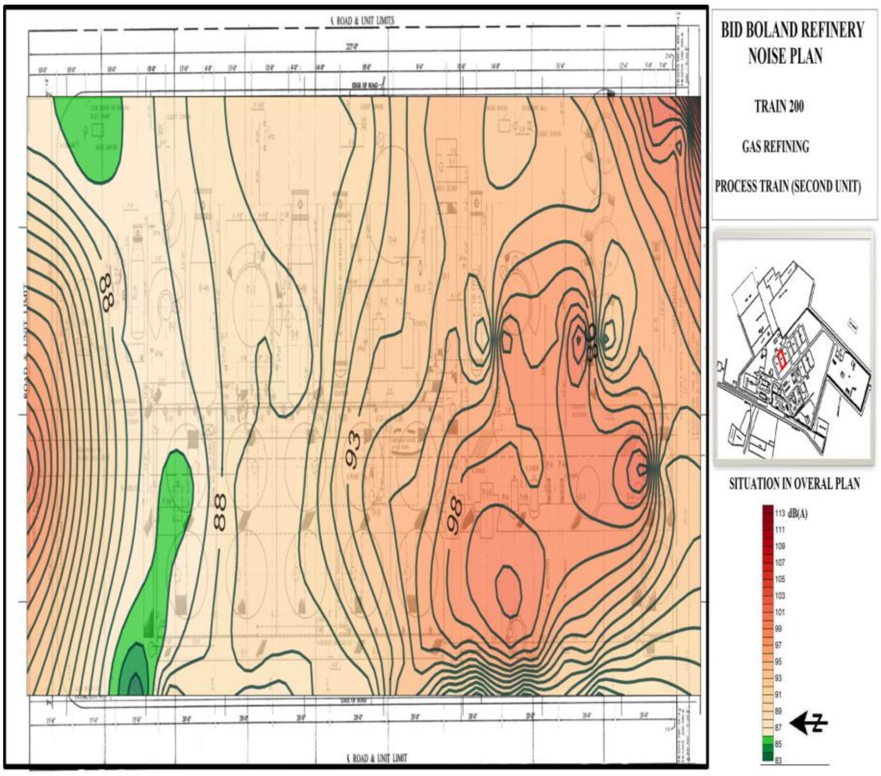

Fig. 5. Sound map in Unit 200

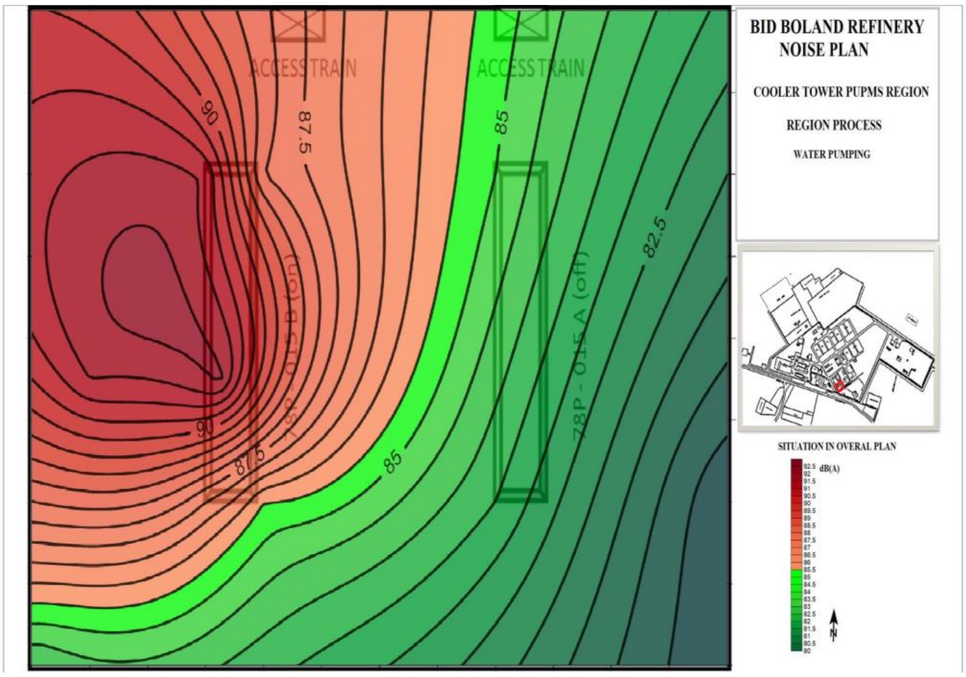

Fig. 6. Sound map in the cooling tower pumps

CONCLUSION

In this study, noise analysis was performed in the Bidboland gas refinery with the aim to aid power plant authorities adopt preventive measures as well as for developing future strategies to combat the menace of noise pollution via a scientific approach. The objective of this study was to ensure provision of a better environment for the employees in industrial units. We explored the sources of noise pollution and devised suggestions for controlling the excessive noise emission. Unit 200 was recorded to be the major source of noise pollution. The general acoustic measurement results showed that Unit 200 had a noise pollution level of 112 dB, which was the highest in the refinery, while both Unit 400 and the boiler showed the lowest noise pollution levels. Our results are in concordance with those of Xiaopeng and Lingqing, Yang and Wang (2008), Spitzer (2011), and Poorjabari Khameneh *et al*. (2009). These authors also reported that the environmental noise pressure level was higher than the set standard (75 dB) in both the refineries.

Several methods are available for application in controlling the level of noise pollution. For example, the design and technology of machine/equipment may reduce noise emission levels; the use of noise barriers may help control noise; and use of protection shield for sound receptors may help reduce noise emission, such as by insulating a building against noise.

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