Assiut University Center for Environmental Studies-Egypt

The 9th Int. Conf. for Develop. and the Env . in the Arab world, April, 15-17, 2018

NOISE POLLUTION; ASSESSING AND CONTROL IN THE BEET SUGAR INDUSTRY

Mohamed Abuel- Kasem Mohamed[1], Mohamed Mahmoud Hafez[2]

Ragab Rabeiy[1], Essam AbdElFattah AboZeid El Nagreedy[2]

[1]Mining and Met. Eng. Dept. Faculty of Engineering. Assiut University, [2] Dakahlia Sugar and Refining Factories

ABSTRACT

Protecting the expertise workers in the Sugar production is essential for the sustainability and development of this strategic national industry. Noise pollution is a physical factor that may have negative effects on the employees. In this study, noise levels and control methods are studied in the Beet Sugar industry in the Dakhlia Plants. Inspection of the studied plants presented that Noise is emitting from several sources such as Beat lab reception, Beat washing and slicers, vacuum pump area, centrifugal mixer station, power station, boiler house among other. Sound Pressure Levels (SPL) of the sources are measured according to ISO recommendation, while noise exposure levels are carried out using equivalent noise level. The results proved that sound pressure level exceeded the national limits assigned by Egyptian Environmental Law No 4/1994. Maximum SPL was 110 dBA at boiler soot blower and the minimum value of SPL was 78 dBA. In the old Belqase sugar factory, it has been found that the maximum SPL reached to 112 dBA at boiler soot blower and the minimum value was 83 dBA in the air composer. Noise exposure also is assessed to protect the employees in the old and new Sugar plants. As the working shift is 12 hours in our investigated plant, a model is used to estimate the equivalent noise dose according to 8 hours exposure. The results presented that the workers in the old Sugar plant are suffering from the high emitted noise levels. Control measures are essential to reduce the noise especially from the old sugar plant.

Keywords: *Sugar Industry, Exposure Limits, Noise Sources, Noise Exposure*

1- INTRODUCTION

The sugar industry uses sugar cane and sugar beet to manufacture edible sugar. Sugar production from beet presents about 40% from the world sugar production. Beet sugar industry is considered as seasonal sugar production for 18 weeks a year. One of the operations during the processing of sugar beet is depending mainly on the quality of the beet. This process requires washing the beet using high pressure water jets in several washers before slicing and weighing. The noise control act of 1972 spells out federal plans to keep noise at tolerable levels. The federal laws are directed to emissions, but provide technical assistance to states establishing performance laws. The situation is also complicated by an overlapping of authority of the environmental protection agency and the occupational safety and health administration. As battle development over the acceptability of 85 or 90 dBA (decibel is a unit of sound pressure level based on

practical scale of 0-140 dBA) as the safe sound level for worker, it became evident that the U.S. Occupational Safety and Health Agency(OSHA) has direct responsibility for worker safety while EPA must protect the worker as a plant employee and also as a citizen. Madbuli el al. (2003) concluded that the problem of industrial noise had been aggravated by the use of high speed, high production machines in textile mills and other industries. The causal relationship between work place noise and hearing loss has been observed for centuries (Franks, 1988). Lately, there have been many trials for assessing the magnitude of the problem of noise exposure in manufacturing industries. The U.S. Occupational Safety and Health Agency (OSHA), in 1981, estimated that more than 6 million workers (active and retired) had noise exposure levels greater than 85 dBA in U.S.A (OSHA, 1981). However, Frank (1988) used data of two OSHA conducted U.S. industry-wide noise surveys estimated that some 4.7 mL were exposed in 1985 to average daily noise levels of 85 dBA or greater. Meanwhile, a National Occupational Hazard (NIOSH) Survey revealed that the top seven industries with the greatest percentage of workers exposed to 85 dBA or greater were lumber and wood, textiles, petroleum, utilities, metals, printing, and paper production industries (NIOSH-NOHS 1974, 1977 & 1978). Similar findings were reported by the two OSHA contracted noise surveys (Bolt et al., 1976; Booz et al., 1983). In U.K., noise pollution was reported in 1985 as the biggest hazard in factories, since 700 000 workers were being still exposed to noise levels exceeding the government's Recommended limit of 85 dBA (Pearce, 1985).

This study aims to evaluate the noise pollution problems in sugar beet industry. Also, to establish noise pollution control methods. This study has been applied on Belqase Sugar Plants. The first factory has been holding in 1992 and the second factory has been installed in 2011.

2. MATERIALS AND METHODS

2.1. Site Description

Experimental work of this study is carried out in Belkas, AbuMady area. Sugar beet factories are located in this area at 1.5 m below sea level. The site of the factories is shown in Fig (1). The first factory has been holding in 1992 and the second factory has been holding in 2011.

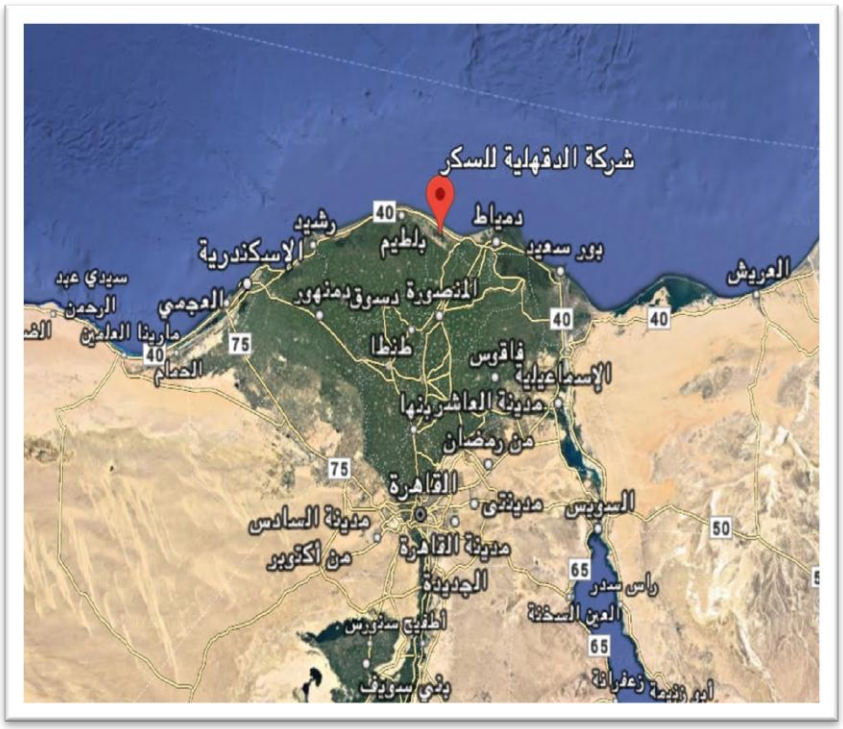

Fig (1) : **Site of the experimental work**

Fig (2) : **Layout for Dakhlia Sugar and Refining Plants**

Dakahlia sugar and refining company is one of the industrial castles in Africa and the Middle East for production of sugar beet and contributes about 13.65% of sugar production in Egypt. The Belkas Sugar Factories produce the white sugar as the main product and molasses used as animal feed. Dakahlia sugar and refining company produces white sugar according to Egyptian standard specifications (358/2005) and European standard as presented in table (1). In addition, Dakahlia Company produces also animal feed (Pulpbeltizing) and Molasses as byproduct with the specifications presented in table (1).

Table (1): Specifications of the white sugar, Pulpbeltizing, and Molasses

Sugar Specifications		Pulpbeltizing		Molasses	
Polarization	Min 99.9 %	Humidity	10%	Brix	82%
Humidity	Max 0.03%	Protein	7-9%	Purity	58.5%
Color in	Max 35 IU	Diameter	9-11 mm	Sugar	48%
Ash	0.015%	Sugar	Max 7%	pH	8.9
Color Type	1.5 unit	Humidity	10%	Brix	82%

.

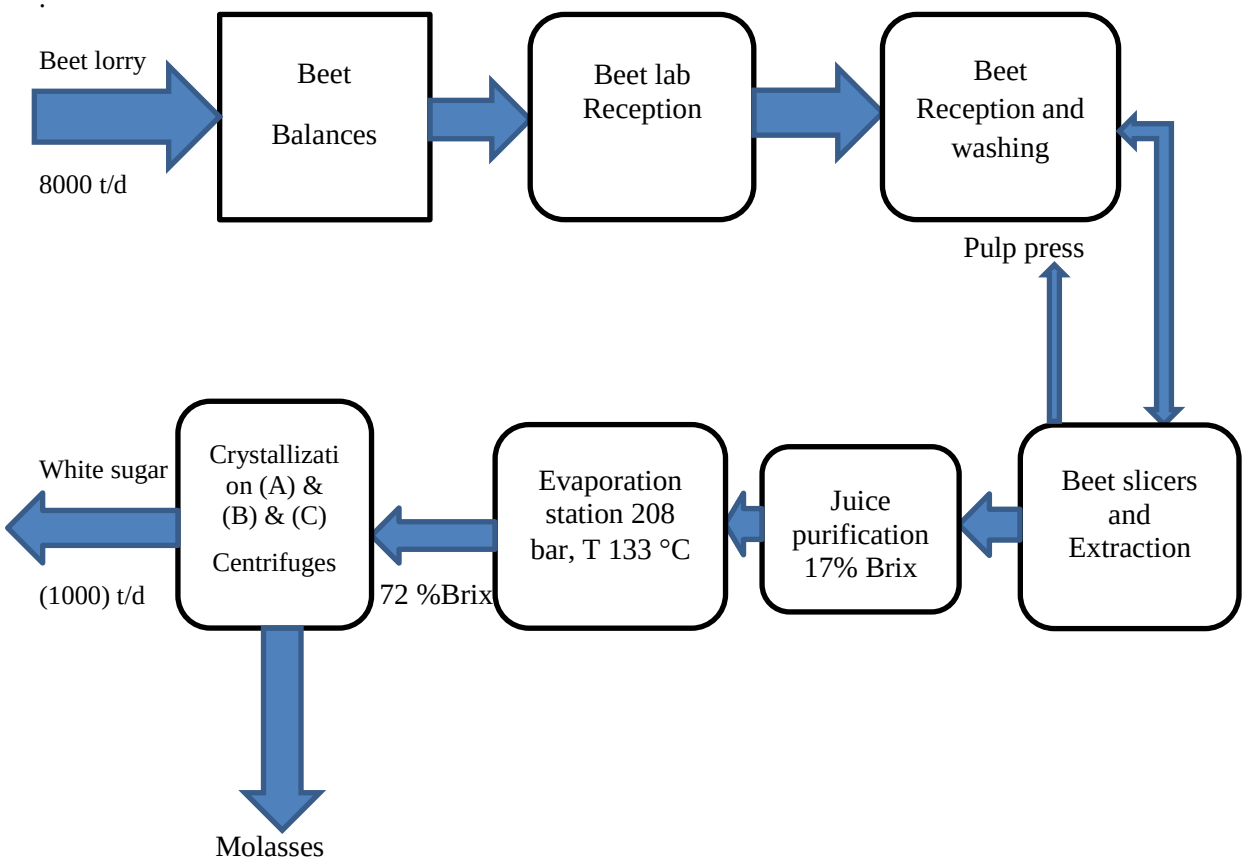

Fig (3): The flow diagram of Belkas Sugar Factory.

The flow diagram presented in figure (3) explains the process of sugar beet production where the beet passes through several stages. These stages are beet weighing, beet lab reception, washing, and slices. The pulp produced from extraction passes through pulp dryer and pulp press to produce animal feed

(Pulpbeltizing) products. In juice purification station, juice syrup is extracted to produce juice with 17% Brix. The juice purification passes through evaporation process to increase the concentration of Brix in the juice syrup from 17% to 72%. In the final process, the concentrated syrup passes through three crystallization units. Cyclones use centrifugal force to separate molasses from the white sugar. The produced sugar is then dried and Polly bag to customers.

2.2. NOISE MEASUREMENT AND ANALYSIS

For each sugar plant (Old and New), noise measurements were carried out at strategic locations depending on the type, number and layout of machineries. The noise measurements included Maximum and Minimum SPLs at the individual octave bands. Other relevant data such as the operation, type and number of machinery, construction materials for roofs, floors, walls and ceilings etc. were also recorded. Noise was measured at each location using the Sound Level Meter SL – 4010 as shown in figure (4). It has measurement range (35 -130) dBA. The noise was measured at 1 m from the source and1.5 m from the floor. The noise measured from all possible sources. The calibration of the instrument was checked before and after each set of measurements as recommended by the SLM manufacturer (B&K) multi-function acoustic calibrator, model: 4226. The measurements were taken over duration of 10 min at each location. The data were statistically analyses using Excel. For each factory, frequency tables for Max and Min SPL levels were constructed.

Fig (4): The sound level meter instrument

3. RESULTS AND DISCUSSION

The dB (A) Means of Leq, Max (SPL) and Min (SPL) of the surveyed factories are given in Tables (2&3) and graphically shown in figures (5&6) and figures (7&8). The results proved that sound pressure level exceeded the national limits assigned by Egyptian Environmental Law No (4/94) in several sites. Maximum SPL was (110) dB (A) at boiler soot blower and the minimum value of SPL was (78) dB (A) in the new sugar plant. In the old Belqase sugar factory, it has been found that the maximum SPL reached to (112) dB (A) at boiler soot blower and the minimum value was (83) dB (A) in the air composer. Noise exposure also is

assessed to protect the employees in the old and new Sugar plants. As the working shift is (12 hours) in our investigated plant, a model is used to estimate the equivalent noise dose according to (8 hours) exposure. The results presented that the workers in the old Sugar plant are suffering from the high emitted noise levels. Control measures are essential to reduce the noise especially from the old sugar plant. In the Belkase sugar and refining plants, there are suggested and designated the new covering in the soot blower station to decrease the sound level pressure from (110 dB (A) to 85 dB (A) by adsorption as this drowning Fig (9).

Table (2): Production season 2017 for Dakhlia sugar and refining old plant

Station	Max. SPL (dBA)	Average. SPL (dBA)	Min. SPL (dBA)
Beat Lab reception	87	81	75
Beet washing and Slicers Slicers	90	87.5	85
Vacuum Pump area	88	88	88
Centrifugal mixer station	88	87.5	87
Power station	92	80	68
Boiler water treatment	84	77	70
Boilers house	92	79.5	67
Boiler house (soot blower)	110	103.5	97
Cooling tower pump station	78	78	78
Pulp dryer station	95	85	75
Lime kiln area	83	77.5	72
Air compressor area	87	87	87

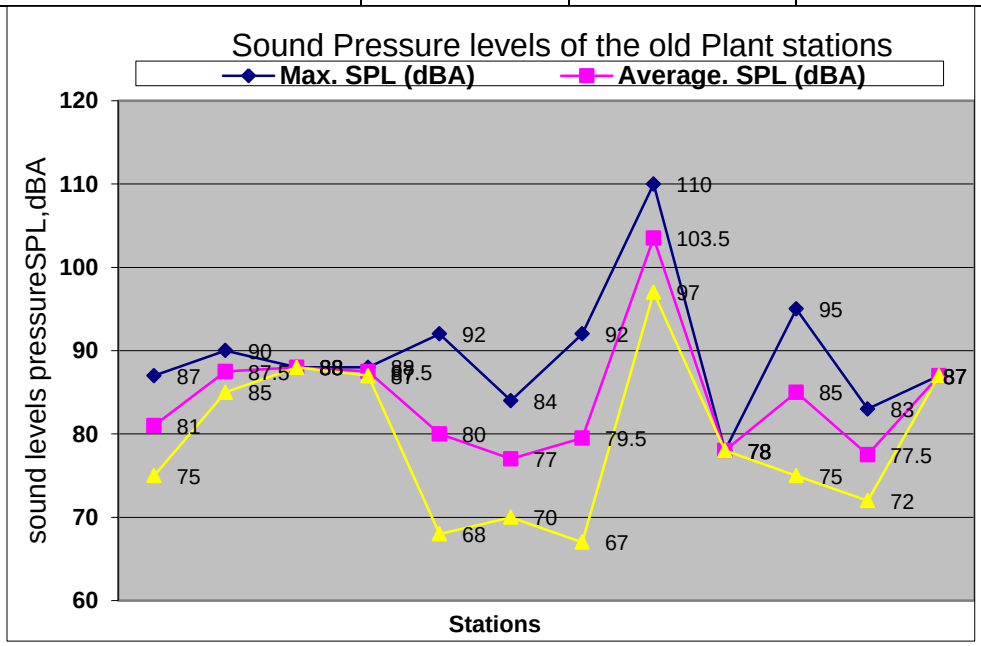

Fig (5): Measured noise level in Dakahlia Sugar and Refining old plant

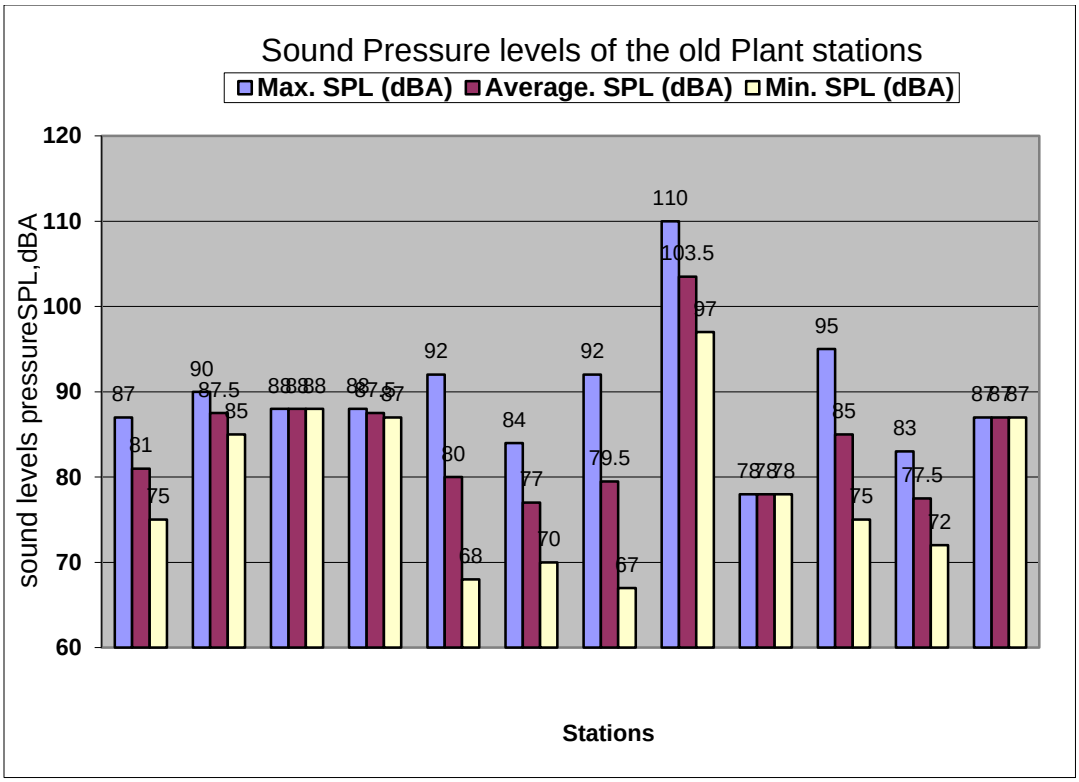

Fig (6) measured noise level in Dakahlia Sugar and Refining old plant From figure (5) and figure (6), Maximum SPL was (110) dB (A) at boiler soot blower and the minimum value of SPL was (78) dB (A) in the Cooling tower pump station. The results proved that sound pressure level exceeded the national limits assigned by Egyptian Environmental Law No (4/94) in several noise sources

Table (3) Production season 2017 for Dakahlia sugar and refining new plant

Station	Max. SPL (dBA)	Average. SPL (dBA)	Min. SPL (dBA)
Beat Lab Reception	85	80	75
Beet washing and Slicers	92	84.5	77
Vacuum Pump area	82	82	82
Centrifugal mixer station	86	85.5	85
Power station	91	80	69
Boiler water treatment	87	77.5	68
Boilers house	95	81.5	68
Boiler house (soot blower)	112	105.5	99
Cooling tower pump station	85	85	85
Pulp dryer station	98	84	70
Lime kiln area	85	77.5	70
Air compressor area	83	83	83

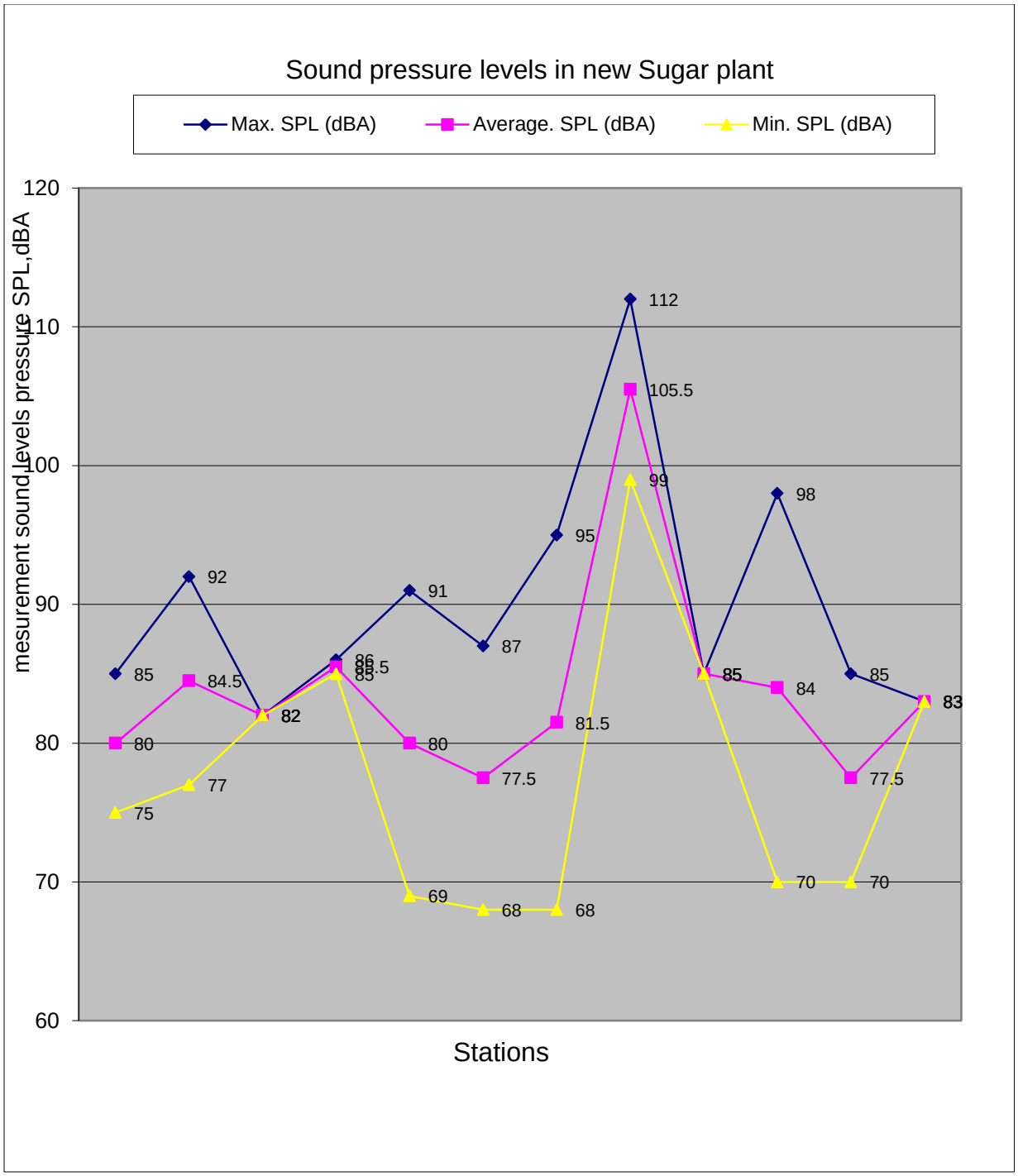

Fig (7): Measured noise levels in Dakahlia Sugar and Refining new plant

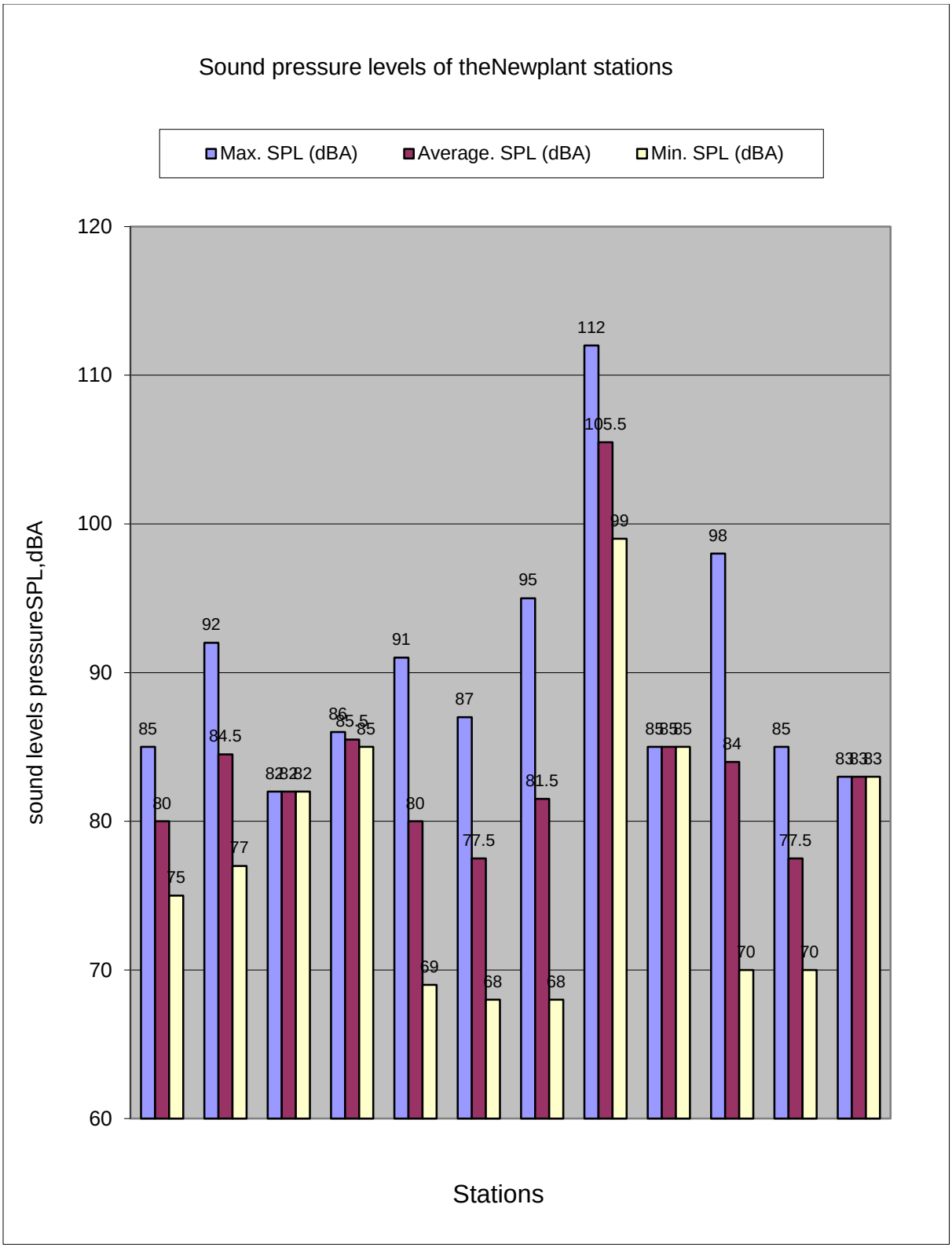

Fig (8): **Measured noise levels in Dakahlia Sugar and Refining new plant**

From Fig (7) and Fig (8), Maximum SPL was (112) dB (A) at boiler soot blower and the minimum value of SPL was (83) dB (A) from cooling tower pump station. The results proved that sound pressure level exceeded the national limits assigned by Egyptian Environmental Law No (4/94) at five production stations.

Table (4): Workers noise diseases in Dakahlia sugar and refining company

Dakahlia Sugar and refining company	Operation Date	Worker Exposure /12 hrs.	Workers Noise Diseases
Old plant	1995	323	6
New plant	2011	323	0

From Table (4) as the working shift is (12 hrs.) in our investigated plant, a model is used to estimate the equivalent noise dose according to (8 hrs.) Exposure as Unified Labor Law (No. 12 of 2003). It is found that the length of exposure time of the workers to the noise gives higher levels of noise than allowed in Egyptians labor law and environment. It is found that 6 workers have been got noise diseases in old plant as a result of long periods of noise pollution. This is due to not follow the safety and occupation health instructions in the factory and the poor overall maintenance of the equipment and machinery. The results presented that the workers in the old Sugar plant are suffering from the high emitted noise levels. Control measures are essential to reduce the noise especially from the old sugar plant as given in Fig (9).

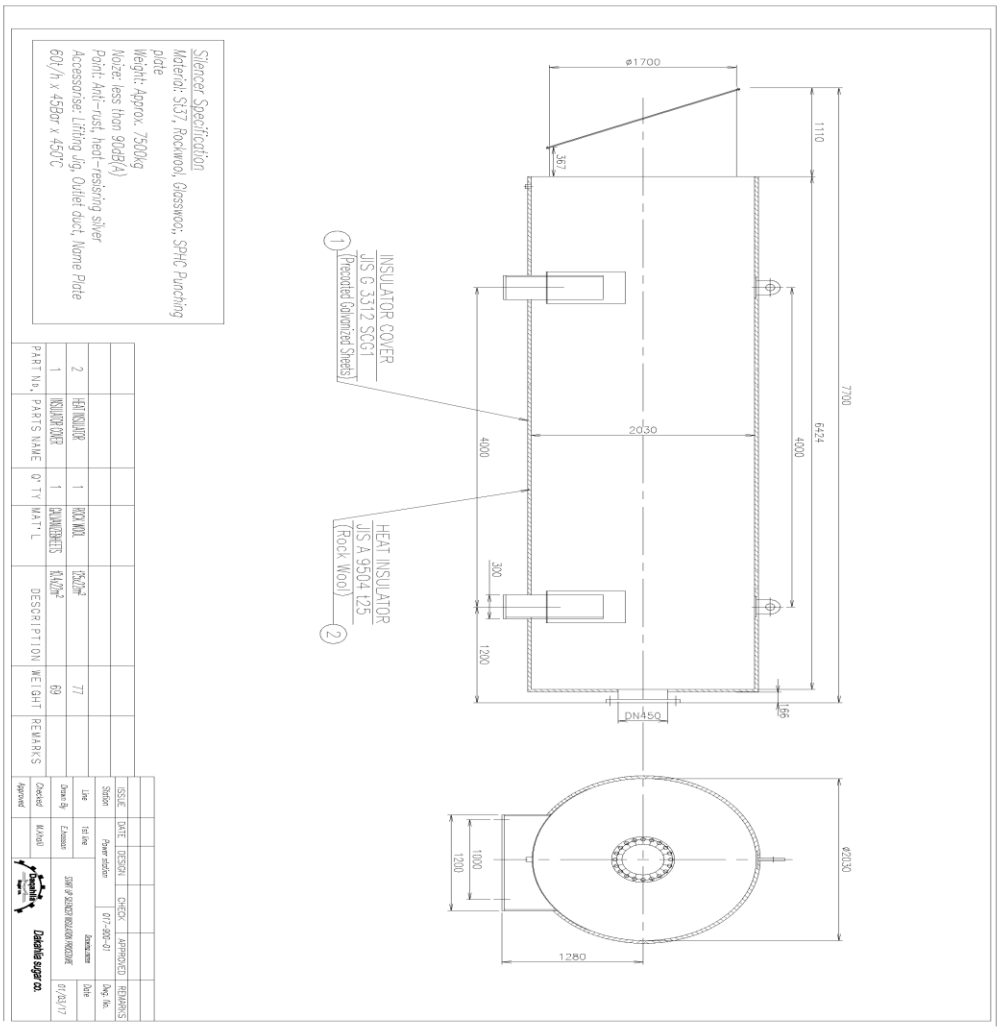

Figure (9): **The covering of soot blower station to decrease the sound level pressure**

4- CONCLUSION AND RECOMMENDATIONS

The results of this study indicated that the workers at the two factories were exposed to high noise levels during working hours. The sound pressure level measured in the old plant is higher than the new plant; due to the old machines and the poor maintenance. Several control measures are suggested to decrease the noise levels such as designing, fabricating and using quieter machines to replace the noisy ones. Also, proper lubrication, better maintenance of machines, installing sound proof chambers in noisy machines, guarding the parts with sound-absorbing materials are also effective methods of noise control. Reducing the noise produced from a vibrating machine can be achieved by vibration damping i.e. making a layer of damping material (rubber). Using silencers is also effective methods to control noise from automobiles, ducts, exhausts etc. and convey systems with closed ends opening into the atmosphere and using glass wool or mineral wool covered with a sheet of perforated metal for the purpose of mechanical protection.

6- REFERENCES

1. **ACGIH: 2000, 'Threshold Limit Values for Chemical Substances and Physical Agents and Biological**
2. **Exposure Indices', *American Conference of Governmental Industrial Hygienists*, Cincinnati, Ohio, U.S.A.**
3. **Al-Idrisi, M., Jamil, A. T. M., Al-Jifry, M. S., Jifri, M. A. and Erturk, F.: 1990, 'Evaluation of noise stresses in Jeddah industrial estate', *J. Environ. Sci. Health* A 25(8) 873–896.**
4. **B&K: 1978, *Application Manual for Acoustic Noise Equipment*, Bruel and Kjaer, Naermark, Denmark.**
5. **B&K: 1982, *Noise Control: Principles and Practice*, Bruel and Kjaer, Naerum, Denmark.**
6. **Bies, D. A. and Hansen, C. H.: 1985, *Engineering Noise Control*, Chapman and Hall, London.**
7. **Van deer poel, H.Schiweek, T.Schwartz ''Sugar technology – beet and cane sugar manufacture '', 4thed. Verlag Dr.Albert.b.k.c, Berlin 1998.**
8. **C.H.I version. Revised by D.L.Stewart, ''beet – Sugar technology'', The Environment –noise ,pp. 673-PP 676'', 3rd,Ed,USA,1982.**
9. **A.M. Eslam, ''Pollution problem of the times '', Series world of knowledge, Kuwait, 1990.**
10. **Egyptian Environmental Law No 4; 1994.**
11. **European Environment Agency, Noise Inventory; Guide book, 2005**
12. **El Nagreedy Essam, 2011,'' Air control pollution from beet sugar factories'' , Master Degree, Thesis presented to Sugar Technology Research Institute, Assiut University.**
13. **Unified Labor Law No.12 of 2003 fifth book Occupational health and safety and secure work environment**
14. **Environment Protection Agency, ''Noise pollution '', 2013.**
15. **WHO, world health organization, ''Noise pollution ''.2013.**
16. **International Labor Organization (ILO), Reports on Occupational Safety and Health, 2001.**
17. **Noweir, M. H., Moslehi, M., Hussein, M. and Nofal, L: 1985b, 'Noise exposure as related to nonauditory health conditions among Egyptian textile workers', Bull, H. Inst. Publ. Health 15, 53–76(Suppl.)**
18. **OSHA (1981): 1986, 'Final Regulatory Analysis for the Hearing Conservation Amendment. Reported in Noise Induced Loss of Hearing', Morbidity and Mortality Weekly Report, 28 March, Vol. 35, No. 12, PHS, U.S. Department of Health and Human Services.**
19. **Egyptian standard specifications No 358 / 2005 and European standard specifications for white sugar production.**
20. **World Bank, 1995.''Industerial pollution prevention and Abatement ;sugar Manufacturing ''Draft Technical Back Document. Environment Department ,Washington ,D.C.**
21. **Assessment and Control of Noise Pollution in Mining Industry, Proceedings of National Seminar held by Institution of Engineers at Madras, 1989.**
22. **. Environmental Noise Pollution and its Control, Proceedings of Specialist Course, Institution of Engineers, Roorkee, India 1992.**
23. **Industrial Safety and Pollution Control Handbook, Associate (Data) Publishers Pvt., Secunderabad, 1991ed.**

24. **Sugar world magazine, sugar integrated industry company Egyptian, SIIC, 2016.**

25. Bolt, Beranek and Newman, Inc.: 1976, 'Economic Impact Analysis of Proposed Noise ControlRegulation', BBN Report 3246, U.S. Department of Labor, Washington, DC.

26. J. Hum. Ecol., Noise Pollution- Sources, Effects and Control Narendra Singh and S. C. Davar Department of Commerce, Kurukshetra University, Kurukshetra 136119, Haryana, India, 16(3): 181-187, (2004) .

التلوث الضوضائي: التقييم والتحكم في صناعة سكر البنجر

محمد أبو القاسم محمد[1]، محمد محمود حافظ[2]، رجب ربيعي[1]، عصام عبد الفتاح أبوزيد[2]

قسم التعدين بكلية الهندسة- جامعة أسيوط[1]، مصانع السكر[2]

الملخص:

حماية العمال المهرة في صناعة السكر أمر ضروري لتحقيق الإستراجية القومية لحماية القوي البشرية. التلوث السمعي يعتبر نوع من التلوث الفيزيائي الذي يصيب العاملين. في هذه الدراسة تم رصد مستويات الضوضاء من مصادرها في صناعة سكر البنجر. وبفحص المصانع المدروسة إتضح أن مصادر الضوضاء عديدة مثل استقبال المختبرات للبنجر، غسل وتقطيع البنجر، منطقة مضخة التفريغ،ومحطة خلط الطرد المركزي، محطة توليد الكهرباء، مكان الغليات وغيرها. تم قياس مستويات ضغط الصوت (SPL) للمصادر وفقًا لتوصية ISO ، في حين تم قياس مستويات التعرض للضوضاء باستخدام مستوى الضجيج المكافئ. أثبتت النتائج أن مستوى ضغط الصوت تجاوز الحدود الوطنية التي حددها قانون البيئة المصري رقم ٤ لسنة ١٩٩٤. كان الحد الأقصى للحجم الصافي هو ١١٠ ديسيبل في منفاخ الغليات وكان الحد الأدنى SPL 78 ديسيبل. في مصنع بلقاس القديم للسكر وجد أن الحد الأقصى ل SPL بلغ ١١٢ ديسيبل في منفاخ الغليات وكانت القيمة الدنيا ٨٣ ديسيبل في ضاغط الهواء. كما تم تقييم التعرض للضوضاء لحماية الموظفين في مصانع السكر القديمة والجديدة. بما أن فترة العمل هي ١٢ ساعة في هذه المصانع، تم إستخدام نموذج لتقدير جرعة الضوضاء المكافئة وفقًا للتعرض لمدة ٨ ساعات. أظهرت النتائج أن العمال في مصنع السكر القديم يعانون من مستويات الضوضاء المرتفعة. لذا يجب عمل تدابير الرقابة ضرورية للحد من الضوضاء وخاصة من مصنع السكر القديم .