



NOISE MITIGATION MEASURES OF NOISE INTENSE ACTIVITIES IN HARBOR AREA AND SURROUNDING (‡)

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Abstract: Environmental Noise in the Port of Tripoli - Lebanon and its surrounding area has been recently monitored for over one year. Short-duration measurements have been taken in various locations of the Port. Surveys of port visitors, ship workers and port workers were also conducted. The monitoring has targeted hereafter the noise-related activities of the Port, mainly: loading of metal scrap and loading of cargos which are generally accompanied by vehicles mobility especially in the Port primary quays. The data has been loaded into the Dutch Standard Calculation Method sheet for Road Traffic Noise in order to develop a comparative model. Results of Equivalent noise levels generated from the two most noise intense Port activities, with and without vehicles contribution, was elaborated. Mitigation measures for vehicles mobility are recommended. The interventions allow the reduction of the average sound pressure level generated due to vehicles mobility related to loading of scrap or loading of cargos.

Keywords: Environmental Noise; Port Noise; Mitigation measures

1. Introduction

The Port of Tripoli is a medium sized expanding port located on the eastern Mediterranean basin where vessels servicing the trade lines along the coastlines of Lebanon, Syria, Turkey, and Egypt, extending and contributing in a very important transit activities by giving accessible ways to the Arab World and Gulf areas.

Noise Pollution generated specifically from Port activities can have serious negative health effects and have been linked to hearing impairment, high blood pressure, sleep deprivation, reduced performance and even aggressive behavior. [1] In the Port of Tripoli - Lebanon and its surrounding area, noise has been monitored for over one year [2,3] within “MESP”: Management of Environment Sustainability of Ports, a project funded by the European Union, where monitoring of Water, Air and Noise pollutions resulting from Port activities is performed and mitigation methods are proposed. [4] Measurements of sound pressure level in dBA were taken at the Port of Tripoli, covering almost the entire port space, as to port quays, roads and the free zone.

As noticed through the entire monitoring process, the activities at the Port of Tripoli generating noise or contributing are: Vehicles mobility (cars, trucks, cranes, ships, forklifts, bulldozers), Loading/discharging of cargo (wood, glass, sugar, salt, coal..), Construction/demolition activities, Maintenance of ships and/or vehicles, Loading scrap merchandise and the berthing and manoeuvring of ships. It should be noted that vehicles mobility accompanies almost all the abovementioned activities. [5]

Since the overall objective of MESP project is to guarantee the sustainability of port activities and an high level of life quality in the nearby areas, and to reduce pollution sources nearby urban areas as well as ports, it was important to monitor noise levels in the surrounding area of the Port, in addition to the various measurements inside the Port.

2. Monitoring Methodology

The average, minimum and maximum of the sound pressure level “Leq” (dBA) was collected from diverse Sound Level Meters (SLMs) during the monitoring phase of the project.

Short measurements of 30 minutes, and occasionally 5 minutes were taken in the port and the surrounding area. Along with the Leq (dBA) the following information was registered: weather conditions (Temperature, humidity and wind speed), date, start time and duration of each test, operator name, location (grid) as well as the ongoing activity at the time of the testing.

The position of the SLM was as close as possible to the sources, with a distance of 3 meters from any solid barrier, and with the microphone of the SLM at 1.5 m height above the ground. Figure 1 that follows shows a geographical map of the Port of Tripoli and its surrounding, and a map divided into grids, with a surface of 100*100 m², used specifically for noise monitoring.



Figure 1: Port of Tripoli and surrounding – Port map divided into grids

2.1 Results

Initially, the monitoring of noise covered the entire area of the port; the roads, quays and the free zone. Following an in-depth analysis of the initial data, the monitoring hence targeted the specific activities of the Port generating noise.

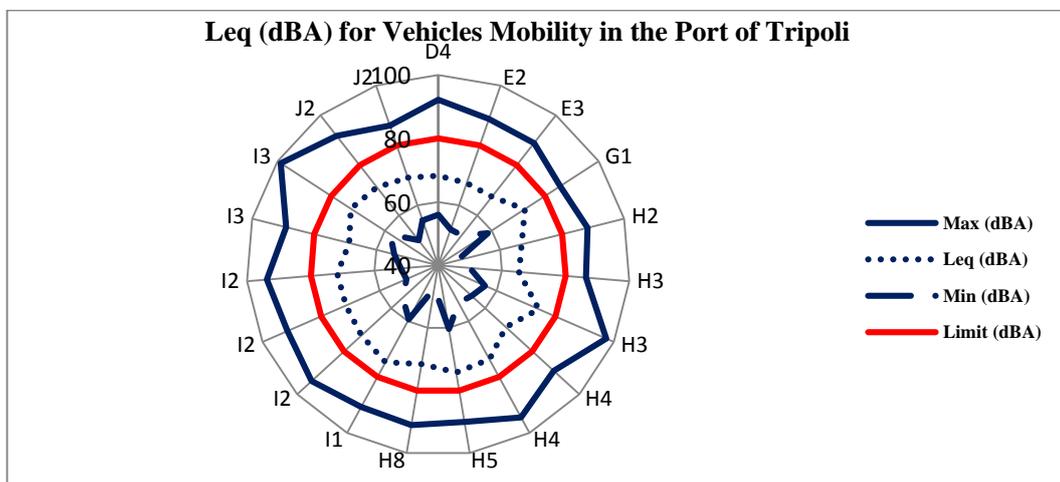
A noise survey for port visitors, ship workers and port workers was conducted, comprising questions regarding the precise occupation, working schedule, duration of service, health status and exposure to noise during their service at the Port; The survey contributed in the determination the sources of noise at the Port and suggesting intervention measures, all proposed by workers whose relevant experience on field was crucial for the understanding and analysis of noise levels.

The data illustrated in this paper in related to noise levels in the port, noise levels in the free zone and noise levels in the surrounding area of the Port.

2.1.1 Noise in the Port

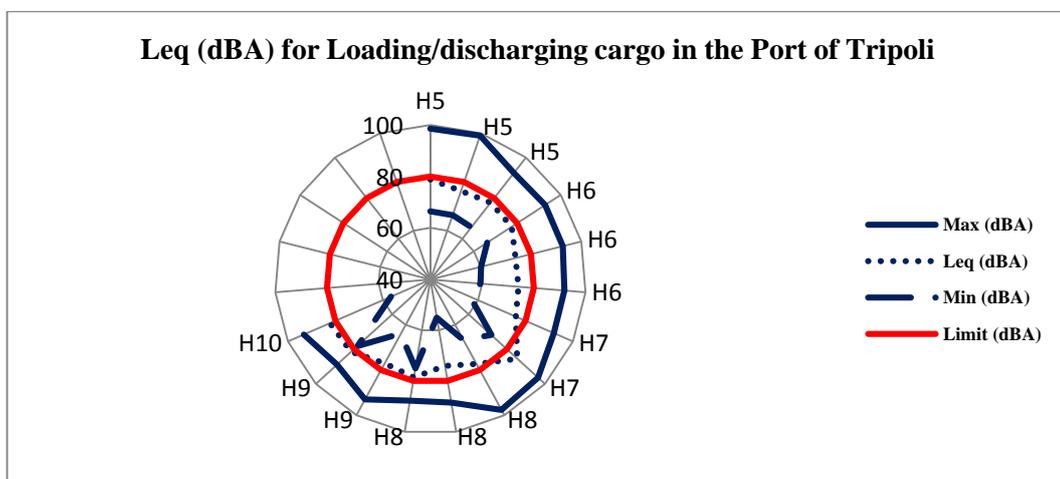
The below graphs show noise levels related to Port activities:

- Vehicles Mobility: The average Leq is 71 dBA.



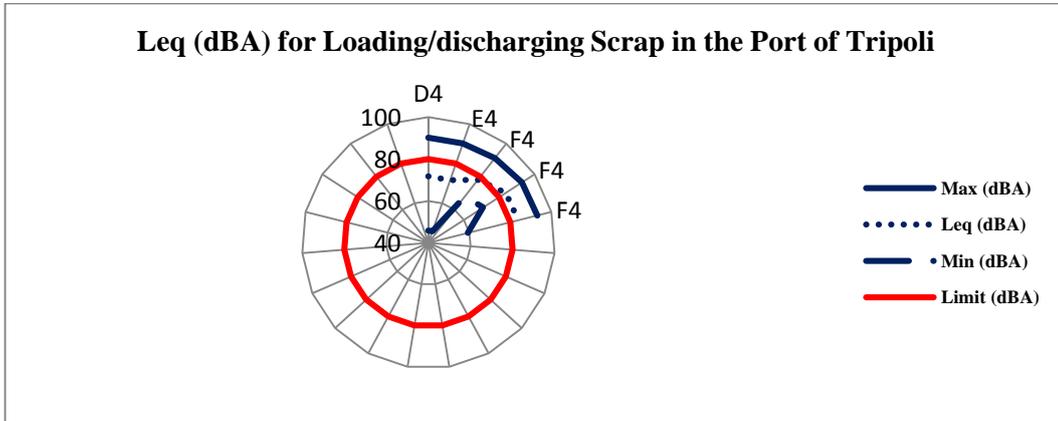
Graph 1: Leq (dBA) for Vehicles mobility in Port of Tripoli

- Loading/Discharging of Cargo: The average Leq is 78 dBA.



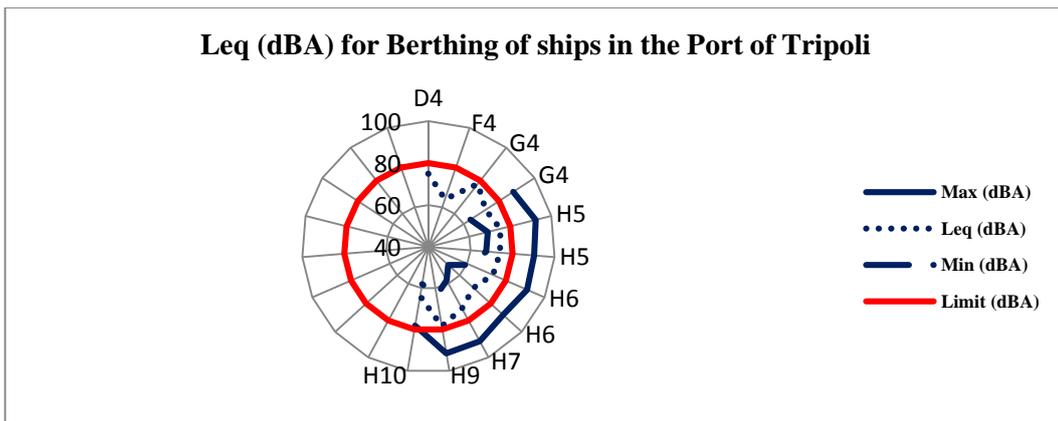
Graph 2: Leq (dBA) for Loading/discharging cargo in Port of Tripoli

- Loading/Discharging of Scrap Merchandise: The loading of scrap consists on discharging scrap merchandise from trucks to Port ground, compressing scrap using bulldozers, then loading it into the ship using huge metallic nets. The average Leq is 78 dBA.



Graph 3: Leq (dBA) for Loading/discharging Scrap in the Port of Tripoli

- Berthing of Ships: The average Leq is 72 dBA.



Graph 4: Leq (dBA) for Berthing of ships in Port of Tripoli

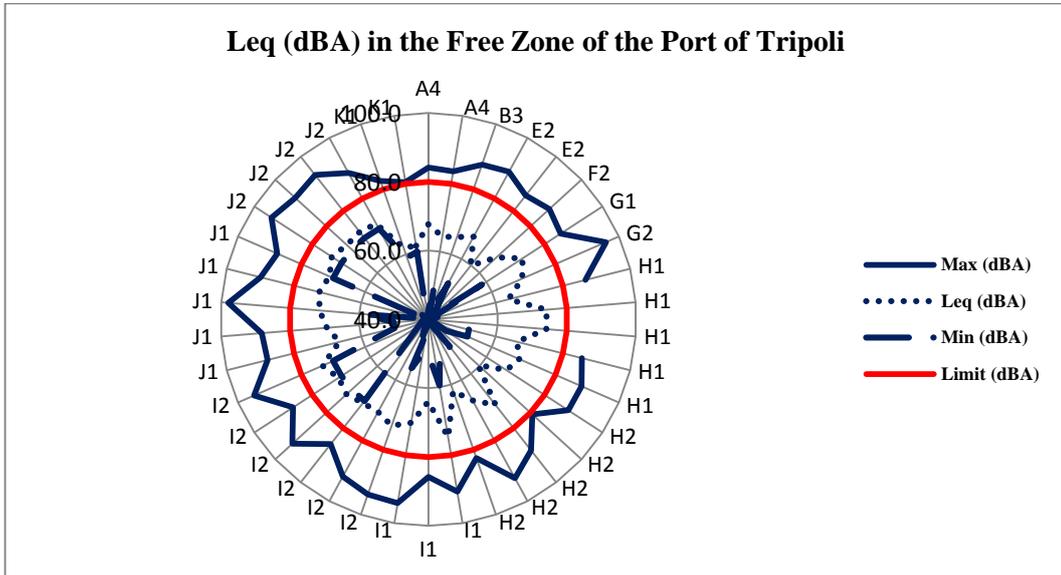
2.1.2 Noise in the Free Zone of the Port

The monitoring of noise in the free zone of the Port is studied individually in this paper, since after several observations, it was noticed that generally noise levels are not continuous and consist of vehicles mobility intermittently accompanied by maintenance of equipment and/or discharging of cargo into storage areas. (Fig. 2)



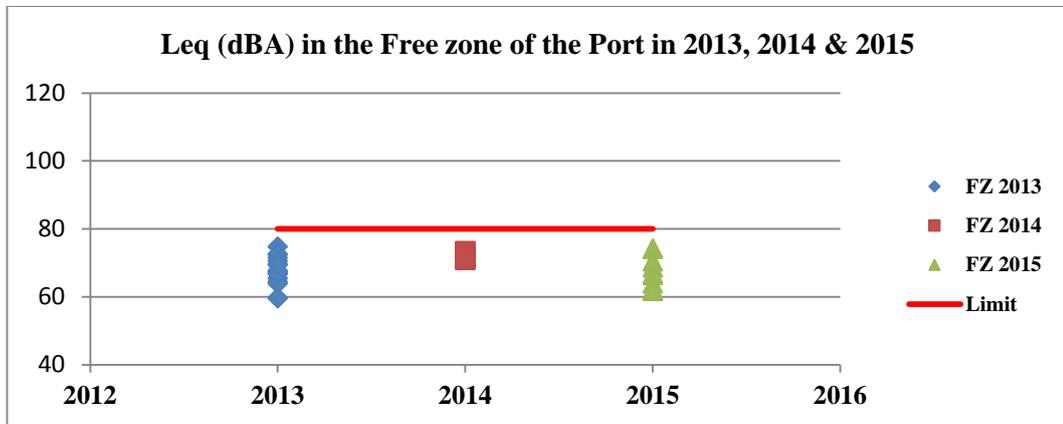
Figure 2: Free zone at the Port of Tripoli

The free zone is very close to the surrounding area, only separated by a high wall and separating the highway from the Port; hence, noise levels in this zone are highly demonstrative of those in the surrounding area distant only by few meters.



Graph 5: Leq (dBA) in the Free Zone of the Port of Tripoli

The monitoring of noise in the free zone of the Port started in November 2013 until March 2015; hence, a comparison between the Leq (dBA) during these 3 years follow:



Graph 6: Leq (dBA) in the Free zone of the Port in 2013, 2014 & 2015

It is noticed that the average of the sound pressure level in dBA in the free zone of the Port of Tripoli was continuously below the permissible limit which is 80 dBA: The average of all Leqs is 69 dBA.

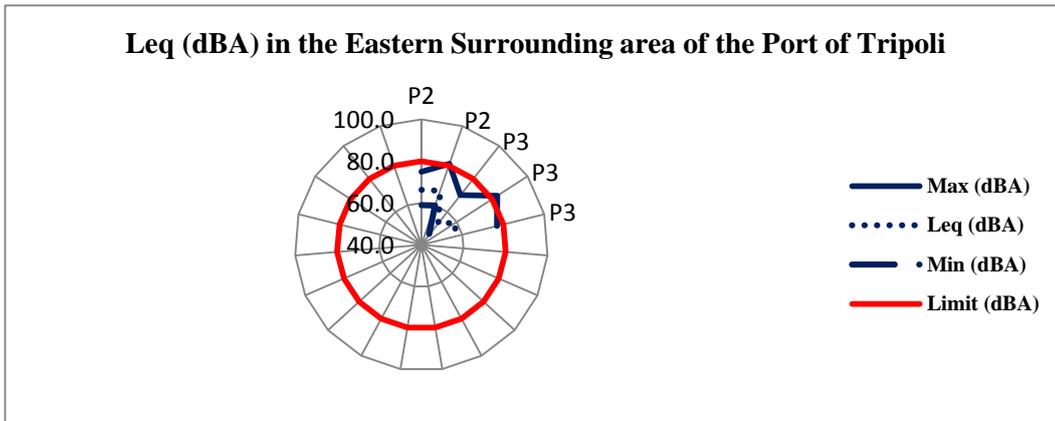
2.1.3 Noise in the surrounding area of the Port

The surrounding area of the Port consists at most on the highway loaded with vehicles; hence, it was essential to measure in a surrounding area of the Port that has no or minor activities generating noise, in order to assess accurately if the noise at the Port is reaching the surrounding area. From the Eastern side, there is the landfill and the waste water treatment plan, and from the Western side there is the Fishery port (Fig. 3)



Figure 3: Port of Tripoli and surrounding area

From the Eastern side of the Port, very close to the landfill five short measurements were taken in an open area almost 500 meters far from the Port (Grids P2 and P3).

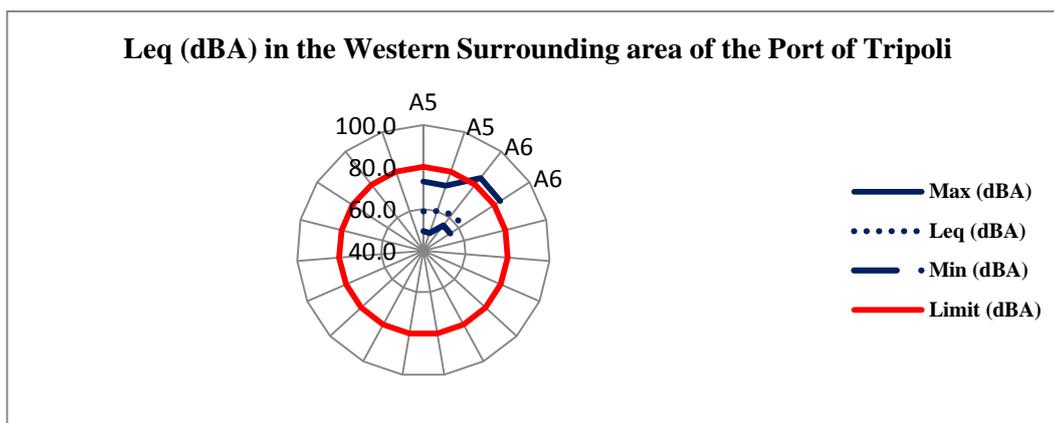


Graph 7: Leq (dBA) in the Eastern Surrounding area of the Port of Tripoli

From the Western side of the Port, five short measurements were taken in the area very close to Fisheries Port where maintenance activities occur; it is almost 50 meters far from the Port (Grids A5 and A6).



Figure 4: Western Surrounding area of the Port of Tripoli



Graph 8: Leq (dBA) in the Western Surrounding area of the Port of Tripoli

The sound pressure level for both surrounding areas was continuously below 80 dBA, with an average of 61 dBA.

2.2 Analysis of data

For vehicles mobility, Leq levels were below the standard, and the maximum Leq values reached was 75 dBA. Several factors contribute into the increase of noise levels for the Vehicles activity: Port Drivers' behaviour (speed, honking), Traffic Jam on port quays, Old equipment and engines, Cargo Handling (types and quantity of Cargo, and loading manner). The berthing of ships is 72 dBA which is below the permissible limit.

The loading/ discharging of cargo occurs every day at the Port of Tripoli and covers an important area and is always accompanied by vehicles mobility. The Leq (dBA) average for the loading/discharging of cargo is 77 dBA, which is relatively high yet below the limit.

The loading of Scrap is also continually escorted by vehicles mobility, mainly trucks and bulldozers which contribute in the loading process. The average of Leq (dBA) for loading scrap (78 dBA) is slightly below the limit yet considered a high value; the primary cause of the high levels is the loading process, intense and noisy, and several factors contribute to this fact: Type of cargo (metallic mostly), multiplicity of sources of noise (vehicles/compression of cargo/loading) and the long duration of this activity that lasts for hours.

The free zone of the Port, as mentioned earlier, can be considered as a surrounding area, since any monitoring of noise on the highway near the Port is contributed to vehicles mobility on the highway, and hence the monitoring is not relevant to noise generated from Port activities. Noise in the free zone was monitored from November 2013 until March 2015; through this duration, Leq (dBA) was below the permissible limit, and the area is considered not noisy, with a total average of 69 dBA.

The surrounding areas of the Port where the monitoring of noise was possible, and would not interfere with other external noisy activities were in the Eastern and Western sides of the Port. It was noticed that no noise from the Port reached both surrounding areas, distant respectively by 500 meters and 50 meters. The average of Leq recorded 61 dBA, a value indicating a relatively quiet area, unaffected by noise from Port of Tripoli.

3. Conclusion and Discussion

The monitoring of noise in the Port and its surrounding area within MESP project aims to determine the sources and activities that are generating high levels of noise at the Port, and whether this noise is affecting the surrounding area.

The implementation of noise survey and noise measurements in the port area intends to create a basic information to identify the existing potential noise sources generated in the port area that cause the greatest impact in order to take the needed actions to reduce noise pollution.

Identified as the significant port activities, Vehicles mobility loading of cargos in the Port have recorded Leq averages below the national permissible limit, yet significant. Therefore, mitigation measures are currently ongoing at the Port of Tripoli, such as road signs, speed limits and possibly solid barriers in order to decrease noise levels inside the Port. Earplugs for protection of port workers will also be a part of the mitigation measures of noise.

Noise monitoring in the surrounding area was essential for the assessment of the impact of Port activities on its environment: It was concluded that noise generated from port activities do not reach the surrounding, after monitoring in eastern and western sides, in addition to the fact that the fee zone inside the port is also unaffected by noise generated from loading cargos and vehicles mobility. Continuous monitoring of noise in the Port and its surrounding is recommended for ensuring the sustainability of the measurement campaigns and a proper assessment of noise, especially with the development and expansion foreseen at the Port of Tripoli.

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