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COMPARATIVE STUDY OF THE NOISE GENERATED BY THE MOTO-COMPRESSOR AND THAT GENERATED BY THE TURBO-COMPRESSOR

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ABSTRACT

The fundamental aim of this study is to compare between the noise generated by the moto-compressor and the noise generated by the turbo-compressor operating 24H/24H on the continuous function mode; these two machines make part of the equipment of the GP1Z, a factory of hydrocarbon treatment. To attain the principal objective of this study we divided our work into two parts, in the first part we followed and evaluated the average level of the noise emitted by the two machines, whereas in the second part we studied the noise propagation emitted by the two machines and its impact on the generation of the noise. The results obtained from this study demonstrate that the noise generated by the turbo-compressor is higher than the noise generated by the moto-compressor.

Keywords: noise; moto-compressor; turbo-compressor; noise maping.

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1. INTRODUCTION

Noise is unwanted sound from activity in certain rate and time, which can cause human health problems and disturbs environmental comfort [1 and 2], Turbo-compressor (TC) are well known machines with a development of near a hundred years, Centrifugal compressors of industrial systems use mechanical energy to compress the working fluid [3].

Nowadays, there is a great concern about noise in city-based and industrial areas [4-17]

The noise generated from operating wind and gas turbines [18-35] is classifiable as an aerodynamic or a mechanical sound as a whole. Aerodynamic sound is generated from the blade passing through the air, and mechanical sound is emitted by some equipment in the nacelle [36].

Global warming and greenhouse gas emissions are a great concern. To reduce these emissions, there is a global trend towards cleaner energy sources [37]. In our study we studied the case of two compressors with two different coupling, the first coupling with a gas turbine and the second coupling with an electric motor, the gas turbine functions by the combustion of fuel gas causing greenhouse gas emissions and noise pollution, contrary to that, the electric motor is not polluting like the turbine, it is for this reason that we made a comparative study between the noise generated by the turbo-compressor and that generated by the motor-compressor. These latter machines are among the first sources that cause the problem of noise of industrial origin, several studies have been carried out in the world to treat the industrial noise problem [38], Noise is often one of the environmental variables seem more difficult to guarantee full compliance with legal limits in complex industrial situations and/or in other multi-source environments [39].

In addition to previously announced objectives, this study examined also the environmental impact of noise generated by both of the moto-compressor and the turbo-compressor in large, based on situ measurements of sound pressure levels and noise mapping.

2. MATERIALS AND METHODS

There no study whatever it is,that could get credibility without having field measurments, therefore we chose an important site (GP1Z) as a first step. After moving there as a second

step, we made synchronis measurments for both the turbo-compressors and the moto-compressors during 4hours(8h-12), we chose this time because the output of the compressors is maximal during this period of the day, and to get credible results;in the third stage we compared between the results of the noise measurments of both of the compressors. Finally and to know the environmental impact of the noise generated by the turbo-compressors and that generated by the moto-compressors we made a noise mapping.

Fig.1. Turbo-compressor of sequence 100

Fig.2. Moto-compressor of sequence 600

2.1. Site selection

To achieve the objective of the current study which is to compare btween the noise generated by the moto-compressors and that generatd by the turbo-compressors ,so, we chose the chemical plant GP1/Z, that contains several types of compressors. As shown in figures 03 and 04.

The plant GP1Z is situated in the west-north of Algeria in the industrial zone of Arzew,the province of Oran,the surface of this plant is 120 hectars,it is classified among the best african plants concerning chemical industries, the fundamental objective of this plant is to separate and transform the GPL to produce propane and butan in order to supply the algerian market and to export abroad.

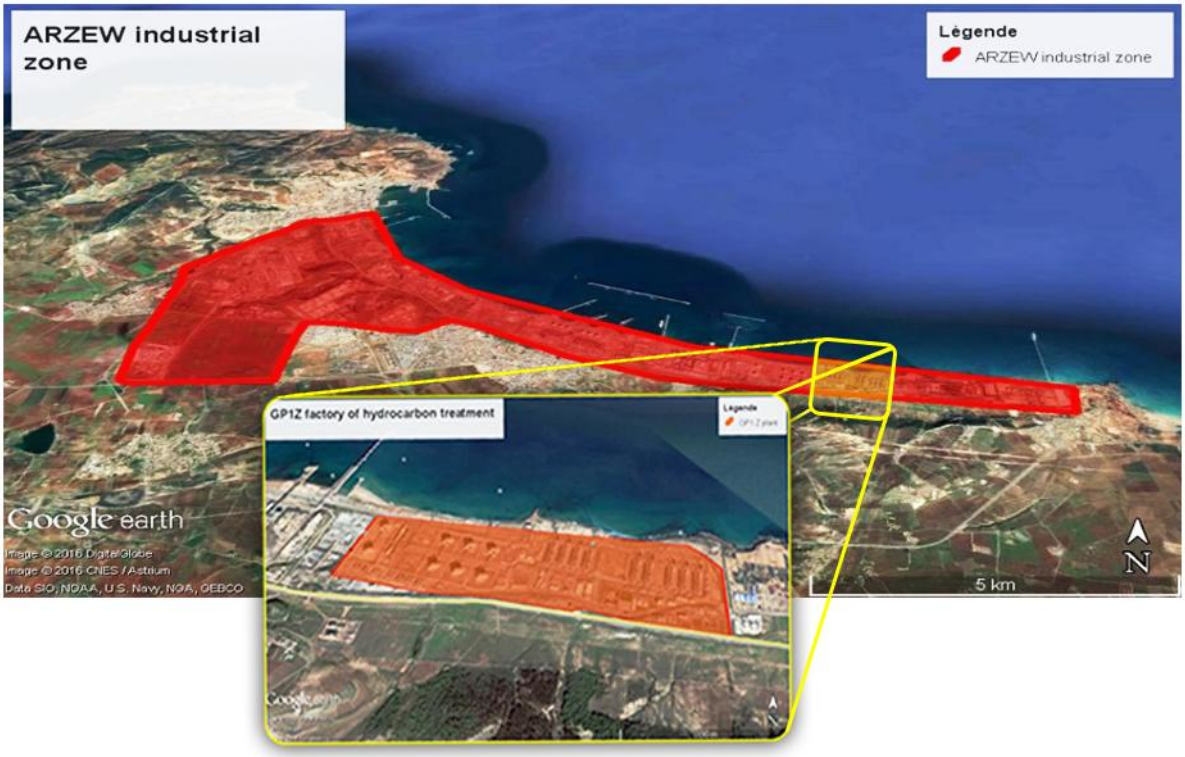

Fig.3. Arzew industrial zone's geographical location and GP1Z plant's geographical location.

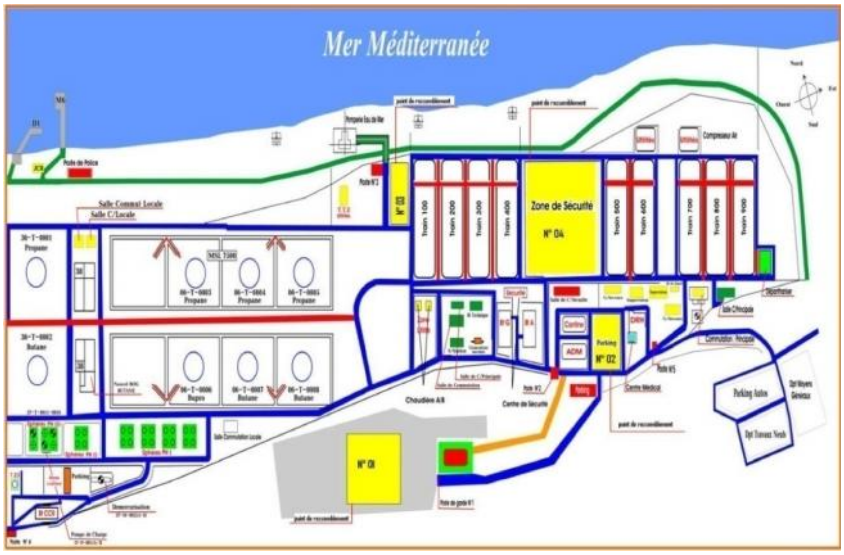

Fig.4. General ground plan on the main installations GP1 / Z[40]

2.2 Materials used

The Sound level meter used is Roline RO-1350, 94 dB calibrations, with “Fast” temporal balance and “A” frequency.

Since the introduction of the EU ambient noise directive, strategic noise mapping has been used as a tool for noise policy in many European countries [41]. For this reason we have carried out the mapping of the noise in order to prove the impact of the turbo-compressor and moto-compressor on noise pollution; we have made a noise mapping of GP1/Z plant. As an indication, Several simulator have been adopted for making noise maps[42-47] such as ; Sound City, CadnaA, OUIE2000, DBlink (Industry) and IMMI dB Vib instrumentation [45], we chose the CODE-TYMPAN, which is adapted to industrial noise as a tool for interpreting our results.

3. RESULTS AND DISCUSSION

The figures 05 and 06 demonstrates that the recorded level of noise generated by the turbo-compressor during four hours (from 8:00 to 12:00) of continued work is very high and attains the 95,1 dB (A) ; the origin of this noise is fundamentally due to the gas turbine which is feed by fuel gas, which enters the room of combustion to produce vigorous gas of exhaust, this energy of the fluid transforms into a rotating mechanical energy on a shaft allowing a

compressor to be driven. The compressor is linked to the turbine through a common shaft; the principal role of the compressor is to compress the gas.

Several origins of noise can be distinguished in the turbo compressor system:

- It's evident that a small fraction of this energy is converted to an acoustic energy, it can propagate into the whole system and be manifested as noise, and the vibration of the body can also contribute to the generation of noise.
- The vibration of the compressor's components or surfaces because of the variations of the pressure generated in the fluid.
- The unbalanced rotors, the rubbing of the shaft, the partition of the vibrating pipes.

The figures 7 and 8 represent the level of noise on average recorded in moto-compressors during four hours of continued work (8:00 to 12:00), a moto-compressor is a combination of an electrical engine and a compressor, the engine transforms the electrical energy to a mechanical energy to rotate the compressor; the total emission of noise in the moto compressors is considered to be a combination of the two sources of noise not correlated together: magnetic and mechanical. The noise of mechanical origin in a moto-compressor is created by several elements:

-the function of the cooling fan creates the majority of the mechanical noise.

-the interaction between the shaft and the bearing contributes also to the generation of noise.

The noise of the mechanical origins is an audible noise coming from the vibrations due to the magnetic forces, and it stops consequently when the machine is switched off, this type of noise depends on the shaft's charge, the voltage, the current, the frequency, the enrolment's parameters, and the groove's geometry, etc.

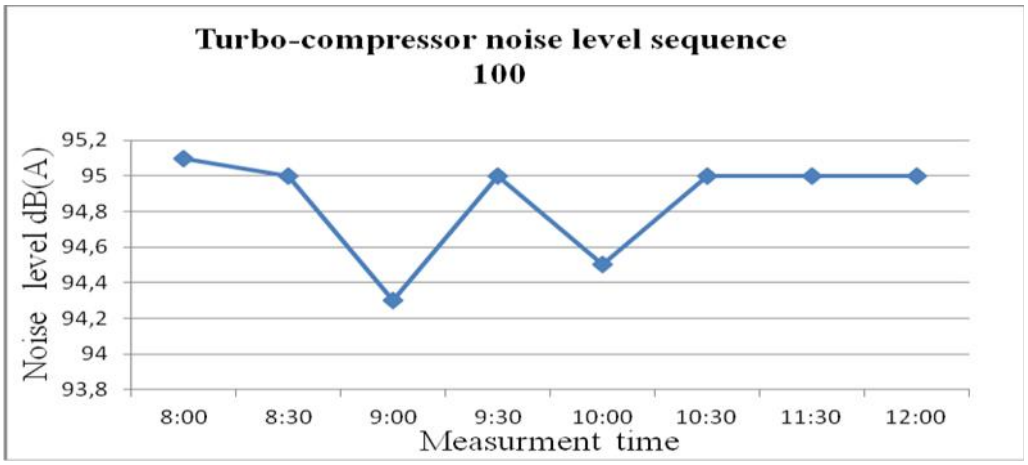

Fig.5. Noise level recorded in sequence 100

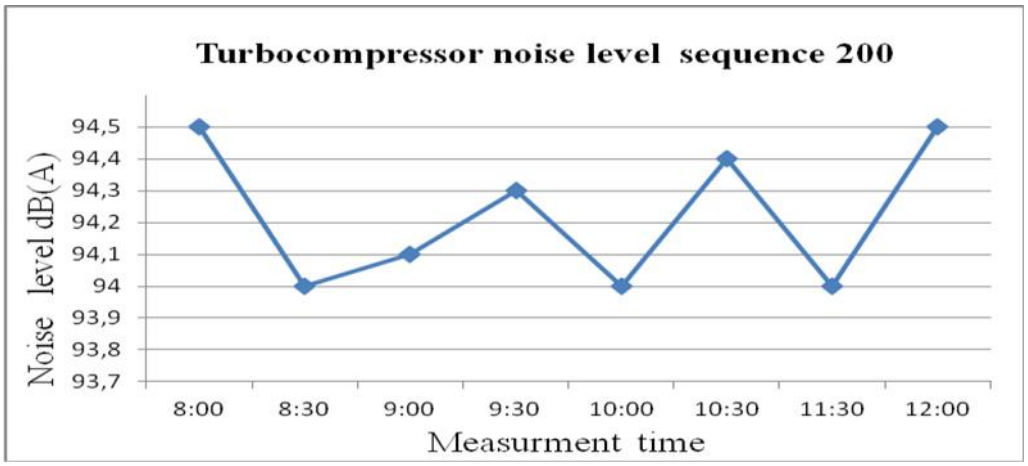

Fig.6. Noise level recorded in sequence 200

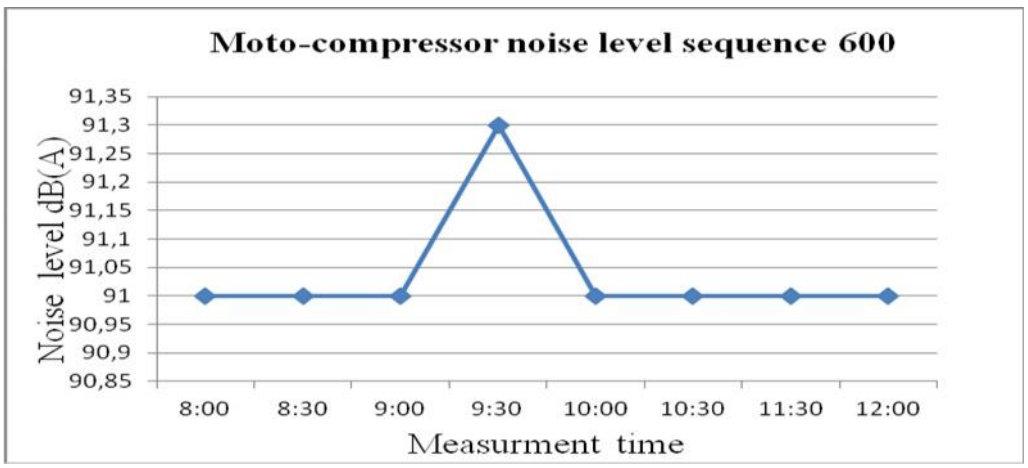

Fig.7. Noise level recorded in sequence 600

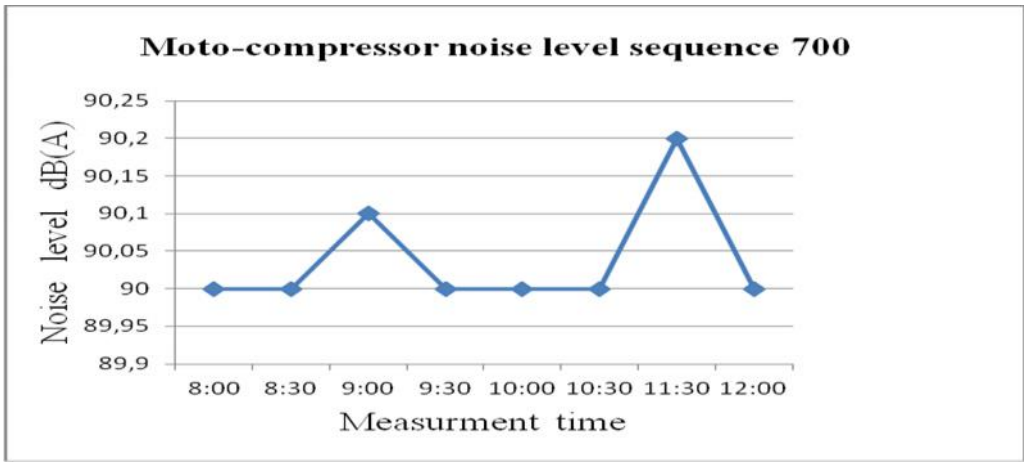

Fig.8. Noise level recorded in sequence 700

3.1. A comparison between the noise level generated by the turbo compressors and that generated by the motor compressors:

The histogram below represents a comparison between the noise generated by the turbo-compressor and the noise generated by the mto-compressors. These results demonstrate that the turbo-compressor is noisy compared to the mto-compressor.

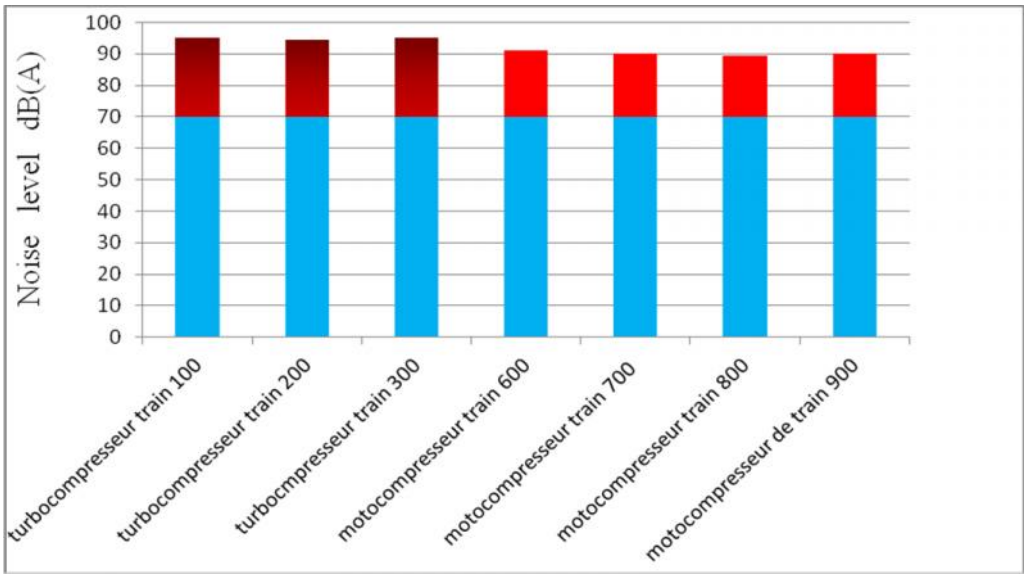

Fig.9. Histogram of comparison between the noise generated by the turbo-compressor and the noise generated by the Moto-compressor

3.2. The impact of the noise generated by both the moto-compressor and the turbo compressor on the increasing of noise pollution

The complex GPLZ contains much equipment that contributes to noise pollution (pumps, Chaudières, fans……), but the noisiest equipment in this complex is the motor compressors and the turbo compressors, and to confirm that result, we have made field measurement to all the complex's machines.

In order to prove to huge impact of the turbo-compressors and the moto-compressors on noise pollution ;we have made a noise mapping (figure 10), in the first stage, we have measured the noise level generated by all the other machines of the complex(without the compressors) ,we have noticed that the noise level has significantly decreased, in the second stage we have introduced the compressors' data again with all the other machines of the complex and measured the noise generated by the whole complex's equipment, the results we have got form a simple comparison between the results in the two stages specifies the great effects of the turbo-compressors and the moto-compressors on the generation of noise pollution.

As far as the noise mapping is concerned, the comparison between the noise level with and without the turbo-compressors and the moto-compressors, we notice that the compressors have an important effect on the generation of noise pollution:

-The global noise average has increased

-The surface of the noise spreading has enlarged outside the complex, this increasing and enlargement of the noise has deep negative effects on the complex's neighboring inhabitants

From the results of the noise mapping, we conclude that the noise generated by the moto-compressors and that generated by the turbo-compressors has a great impact on the environmental noise generation inside and outside the plant, we could also observe that the propagation of the noise's surface is increasing if we take the noise in consideration, then we can talk about its impact on health of the workers inside the plant for 8 hours a day and on the health of the neighboring inhabitants who are exposed to a higher rate of that noise.

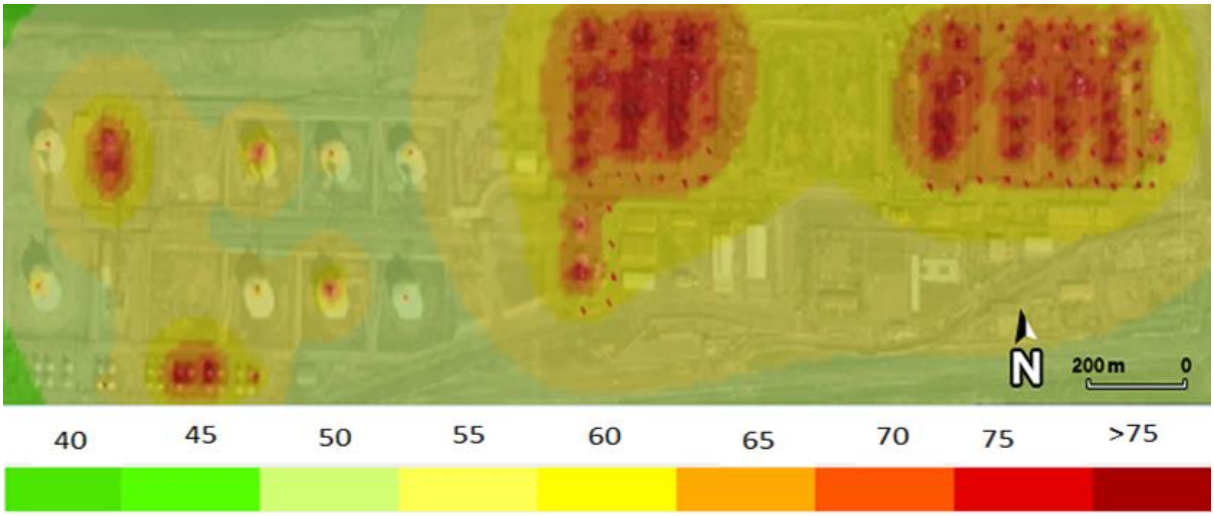

Fig.10. General noise mapping of the GP1Z plant

4. CONCLUSION

From all results obtained in this study we concluded that:

1-The turbo-compressors is noisier than the motor compressor.

2-The noise level of the turbo-compressor of the sequence 100 and 200 is so high and intense, it's unstable and varies between 95.6 dB (A) and 94.3dB (A) during four hours of measurement by a continued regime.

3-The noise levels of the moto-compressor of the sequence 600-700 is less high compared to that of the turbo compressor(100-200),moreover it's almost steady on the value 91 dB, by contrary, the noise level of the noise generated by a turbo compressor 100-200 varies by an aleatory manner.

To this end, we recommend that those who are responsible for changing the turbo-compressor by moto-compressors to reduce the noise level and the percentages of gases (CO_2, NOx, etc.) escaping from the torches. This will also save gas, reduce flue gas emissions and improve environmental working conditions. But this idea requires an economic study in order to take the economic aspect on consideration. So concluded from the steps above, any future intention to solve such kind of industrial solution inside such plants should take the compressors quality improvement in consideration.

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