EVALUATION AND MANAGEMENT OF NOISE AT A CONCRETE PLANT

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The noise assessment for industrial sources requires a combined approach, using noise mapping and acoustical measurements, as well as the analysis of the effectiveness of the noise reduction measure. The purpose of this paper is to analyze the noise produced by a concrete station in a mixed urban area, which has both residential and commercial areas, as well as the analysis of the efficiency of implementing a measure of noise reduction at the source. Special attention was given to the noise assessment mode, both in the initial situation, prior to the application of the noise reduction measure and, in the final situation, after its application, by building a carcass for concrete station.

Keywords: noise map; noise assessment; noise mitigation; industrial noise

1. Introduction

There are very variable dimensions for the industrial sources. Large industrial plants as well as small concentrated sources like small tools or operating machines are used in factories. Therefore, it is necessary to use an appropriate modelling technique for the specific source under assessment [1].

The analysis of the noise produced by the industrial sources requires a careful assessment of these characteristics of the sources and it is necessary to perform both acoustical measurements and estimations obtained by noise mapping, considering the provisions of European Union legislation about environmental noise field [2].

A concrete station is an industrial noise source and the assessment of noise in such a situation requires a combined analysis of both the source and residential buildings from neighborhood.

Therefore, by acoustic measurements combined with acoustic modeling, it is possible to assess the impact of the noise produced by the concrete station and the way the noise at source is reduced, in order to protect the residential buildings located near the concrete station.

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There is a small residential area of houses in the neighborhood of the concrete station, represented in Fig. 1.

Fig. 1. The area with houses near the concrete station

Also, in Fig 2, the 3D model of the area is presented where can be easily distinguished the following: the residential area (near point B), the noise sources (the concrete station 1 with access road 2 and 3, the street that gives access to the residential area 4), the deposit area (near point A) and the points where acoustical measurements were done (points A and B).

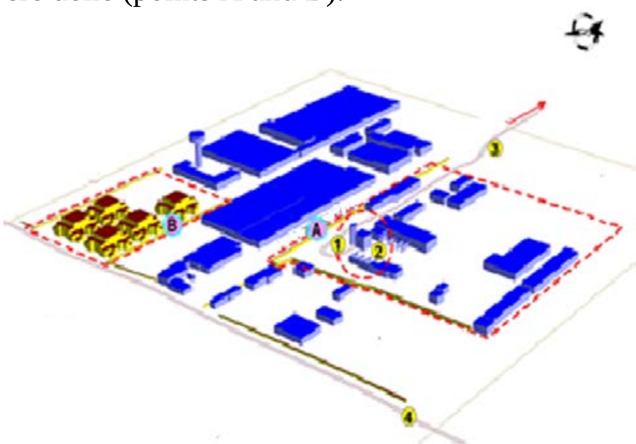

Fig. 2. The 3D model of th area

2.1. Determination of sound power

It is highly necessary to determine the sound power of the source, in order to characterize the noise source, by making acoustical measurements.

The method for determination of the sound power of the source is provided by the ISO 9613-1|:1996 Acoustics – Attenuation of sound during propagation outdoors - Part 1: Calculation of the absorption of sound by the atmosphere [3].

The concrete station is located on a reflecting surface (concreted courtyard) and has been associated with a hemisphere, with a radius of 10 m (R) for acoustical measurements in points P1, P2, P3 and P4 for determination of sound power level, as can be seen in Fig. 3.

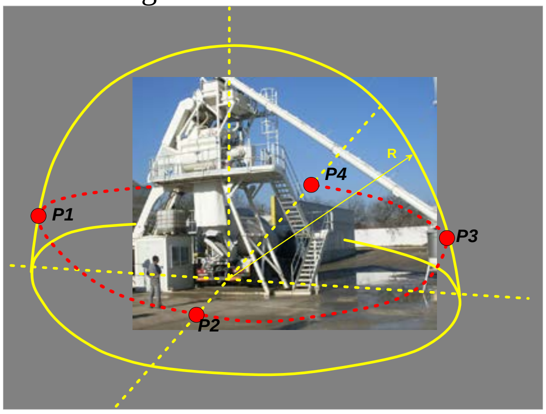

Fig. 3. Hemisphere for acoustical measurements for determination of sound power.

In the first stage of the analysis, by acoustical measurements, the values of the noise levels at the measuring points were determinated, according to Fig. 3 and Table 1, and the sound power of the source was calculated.

In order to determine the sound power of the concrete station, the associated measurement points were located at a height of 2 m, because of the inaccessibility of other points at a higher height, which does not affect significantly the distribution of the noise levels, because in this cases the horizontal propagation of the sound waves is important.

In order to correct the residual noise influence, the residual noise levels were calculated before and after the station started working.

Table 1 shows the results obtained by acoustical measurements and by calculations for determination of the sound power level of the concrete station.

Table 1.

Results obtained by acoustical measurements and by calculations for determination of the sound power level

	P1	P2	P3	P4
L_f [dB(A)]	68.0	69.5	70.5	66.2
L_t [dB(A)]	78.0	77.4	79.1	76.8
L_s [dB(A)]	77.5	76.6	78.4	76.4
$L_{s,average}$ [dB(A)]	77.2			
$L_{W,s}$	105.2			

Notations:

L_f - the residual noise level (measured);

L_t - total noise level (measured);

L_s - noise level calculated with the following relation:

$$L_s = 10lg\left(10^{\frac{L_t}{10}} - 10^{\frac{L_f}{10}}\right); \quad (1)$$

$L_{s,average}$ - the average value of the noise levels at the four measuring points, calculeted with the following relation:

$$L_{s,average} = 10\ lg10^{\frac{L_t}{10}}; \quad (2)$$

$L_{W,s}$ - sound power level of the source calculated with the following relation:

$$L_{Ws} = L_{s,average} + 10\lg(S); \quad (3)$$

Where:

$$S = 2\pi R^2 \quad (4)$$

Therefore, as a result of the acoustic measurements and of the calculations made, given in Table 1, the sound power level of the concrete station of 105.2 dB (A) was determined.

2.2. Noise map of the area for initial situation

In the second step of the analysis, the 3D acoustic model obtained according to figure (2) and the value of the sound power level, are used in a noise mapping software to generate the noise map using the calculation method specified in ISO 9613-2: " Acoustics- Attenuation of sound during propagation outdoors, Part 2: General method of calculation [4].

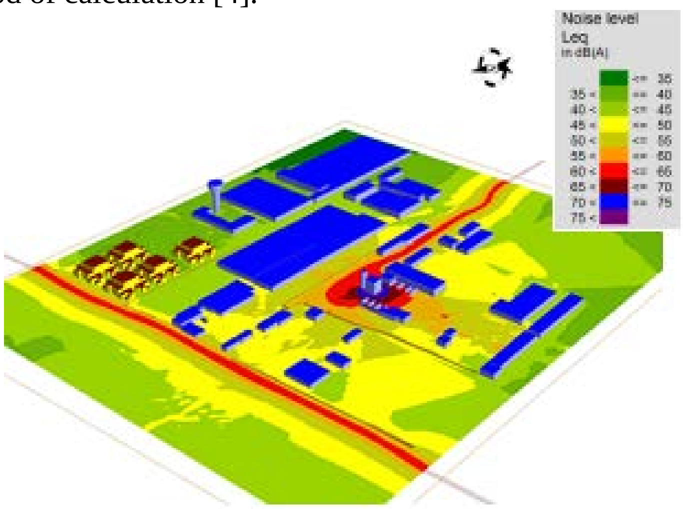

Fig. 4. Noise map for initial situtation

Fig. 4 shows the noise map in the initial situation with the sound power level of the source of 105.2 dB (A), before applying the noise reduction measure at source and taking into account the influence of the road traffic on the street that gives access to the area of residential buildings.

It can be noticed that the residential area is not affected by the activity of the concrete station, the noise from the road traffic being the one that is disturbing in that area, but at the boundary between the concrete station area and the area with deposits of vegetable and fruits, the noise from the concrete station is disturbing.

2.3. Noise mitigation in the area

Reducing noise, either from the source or along the path of propagation, must represent the core staff of noise control programmes, considering the design and maintenance of both the equipment and the working place [5].

A very effective, although sometimes expensive, noise control procedure is to enclose the sound source in an acoustic enclosure or to enclose the receiver in a personnel booth [6].

In order to achieve a higher attenuation of noise, where practical conditions allow, the equipment shall be provided with an acoustic enclosure, resulting attenuation for all over the frequency range [7].

Therefore, the proposed solution for noise reduction for concrete plant analyzed is to build an enclosure that surrounds the concrete station.

Fig. 5. Enclosure that surrounds the concrete station

Fig. 6. Concrete station before and after building the enclosure

As can be seen from Fig. 5 and 6, the enclosure that surrounds the concrete station is provided with a series of ventilation windows, which, if kept closed all the time, would reduce even more the noise at the source, but acoustical measurements were made with open windows, taking into account the worst situation in practice.

2.4. Evaluation of noise mitigation in the area

As a result of the construction of the enclosure that surrounds the concrete station, the acoustic measurements were made again at the points P1, P2, P3 and P4 of Fig. 3, in the same way as in Chapter 2.1, and it was obtained a sound power level of the 96.3 dB (A) for concrete station.

Furthermore, in points A and B of figure 2, the acoustic measurements which are presented in figures (7) and (8) were done after the construction of the enclosure that surrounds the concrete station.

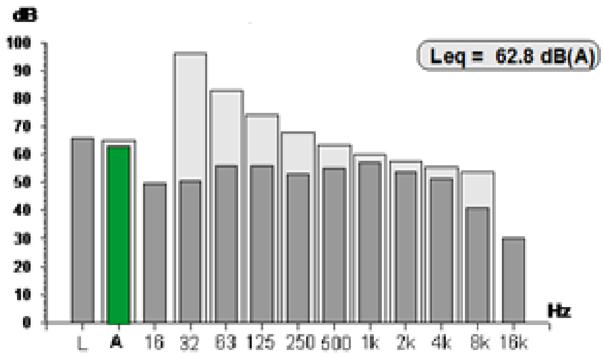

Fig. 7. The result of acoustic measurement in point A

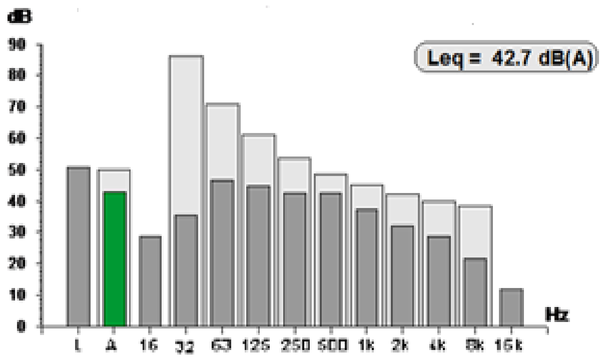

Fig. 8. The result of acoustic measurement in point B

3. Discussions

Therefore, from the analysis which was done we can see the need to perform acoustic measurements both in the initial situation before the construction of the enclosure that surrounds the concrete station, and in the final situation after the construction was done.

The accuracy of the acoustic measurements is very important both for obtaining a noise map of the initial situation and for presenting the benefits obtained after the construction of the enclosure that surrounds the concrete station, i.e. for the reduction of the noise in the analyzed area.

In case that the determination of the sound power level is erroneous for the initial situation, this will lead from the start to a mistaken assessment of the initial state of the noise in the area and implicitly to taking erroneous decisions about noise reduction measures.

Also, in the case of erroneous determination of the sound power level of the concrete station after the construction of the enclosure, a faulty assessment of the final state of the noise at the source will result.

Last but not least, in the case of erroneous determination of the noise levels in points A and B, after the construction of the enclosure that surrounds the concrete station, an incorrect evaluation of the noise reduction in the analyzed area will result.

In the case of an industrial site, it is necessary to take into account all sources of noise related to the equipment of this site such as excavators, backhoe loaders, front loaders, compactors, demolition hammers or punching machines, asphalt mixers, vibrating plates, as well as others depending on the specificity of the industrial site [8].

Also, the assessment of environmental noise, in cases where there are several types of noise, must take into account the following aspects:

- the assessment of the noise level and vibration transmitted to humans, due to new construction equipment imported or produced in Romania, must be carried out by accredited testing laboratories and/or certification bodies [9].
- the assessment of the noise and vibration level transmitted to the mechanic parts of the equipment in operation or which was imported at second hand shall be carried out by accredited inspection bodies on the basis of the results of the tests by accredited laboratories [9].

4. Conclusions

It can be concluded that the initial sound power level of the concrete station did not lead to noise levels in the residential area higher than the limit values, and the noise from road traffic near residential buildings are more significant. However, in the neighborhood of the concrete station, where vegetable and fruit deposits are located, the influence of noise from the concrete station was significant.

After the construction of the enclosure that surrounds the concrete station, a reduction in the sound power level of the concrete station of approximately 9 dB (A) is achieved and a value of 62.8 dB (A) in measurement point A near vegetable and fruits deposits is obtained, which means the maximum limit value of 65 dB (A) [10] is not exceeded.

Also, the measured value at the facade of the closest residential building to the concrete station is 42.7 dB (A), i.e. less than the maximum admissible value of 50 dB (A) [10].

Therefore, it can be seen that the proposed solution for reducing the noise at the source, by making an enclosure for the concrete station, is efficient.

This noise assessment approach in an initial state and application of a noise reduction measure at source for an industrial site can be broadly applicable to many similar cases, if the judicious assessment of noise is made by experts who have proper measurement equipment and sound knowledge of noise mapping and measuring.

Also, in Romania, this type of noise assessment can be used in future in environmental assessment made in order to obtain environmental permit, if environmental legislation in Romania is update.

R E F E R E N C E S

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