Urban noise, a source of discomfort

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Abstract. Noise pollution interferes with most daily activities and, last but not least, disrupts rest, causing psychological, physiological and sometimes pathological reactions in certain situations, when exposure is extended and noise level is above the permitted limits. Sources generating urban noise are varied, randomly distributed in space and time, distinguished from the noise generated by industrial activity that generates occupational exposure of workers, who are permanently exposed to noise generated by industrial operations that are relatively well defined in space and time. As a result of exposure to noise pollution the human body experiences various effects of a physiological and/or psychological nature that affect its health and daily activities. The research was carried out over a period of 4 months in the main intersections in the Eastern area of Jiu Valley, where the level of noise pollution caused by road traffic and the discomfort created to residents in the vicinity of traffic arteries were analysed. Data gathered during the monitoring period show that noise pollution is also accentuated in small urban agglomerations (under 100,000 inhabitants) and it is necessary to monitor it and apply the best measures to reduce the negative impact on neighbourhoods.

1 Introduction

Transport routes near residential areas and increased levels of traffic generate extensive exposure of population to ambient noise. Road traffic has become the main source of noise in residential areas [1].

Determining ambient noise level is a complex activity as there are a large number of variable parameters that must be taken into account when planning and making measurements. Each determination is influenced by the operating conditions of the source, respectively by meteorological conditions. Meteorological conditions generate a considerable measurement uncertainty which can be determined after carrying out some sets of acoustic determinations and collecting data regarding the operating conditions of the source, respectively of the important meteorological parameters for sound propagation (wind speed, wind direction, relative humidity, temperature, precipitations).

With urban development, noise has become a component of daily life, affecting the life quality of residents in areas where it occurs.

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The main causes of urban noise pollution are:

- Sounds from vehicles (cars, buses, ambulances, vans);
- Rail traffic,
- Construction activities;
- Activities in the field of HORECA (terraces, loud music, concerts etc.);
- Sounds from industrial activities carried out in the urban area or near it (fans, compressors, generators, etc.).[8]

Although there are a multitude of noise sources generated by daily activities, road traffic remains the main source of noise with a major impact on the activities carried out in urban agglomerations.

Noise pollution generated by road traffic is accentuated by the condition of roadways, the technical condition of vehicles, respectively their speed, also an important role being played by the intensity of road traffic, quality of the road, respectively the type of vehicles transiting the area (light/ heavy vehicles).

The increase in the number of vehicles has led to intensification of the level of noise generated in the environment, which mainly affects neighbourhoods located at a relatively small distance from it.

In order to quantify the effects and establish measures to reduce the level of noise pollution generated by road traffic, the following aspects must be taken into account:

- Identification of the main sources of noise and of the neighbourhoods likely to be affected by them;
- Determining the level of noise generated by road traffic at the monitoring points by performing sound measurements according to the applicable standards;
- Evaluation of noise level generated by road traffic according to national legislation by comparison with the maximum allowed values;
- Suggesting measures and works to reduce noise level;
- Evaluating the effectiveness of measures applied by performing a new set of sound measurements. [2,3]

Using the limits set by the SR 10009:2017 standard, the places susceptible to excessive exposure to noise levels, above the maximum allowed values at the limit of functional areas were identified, and spectrograms of the noise level were also drawn up where it was considered necessary to apply some noise reduction measures.

Urban noise pollution has negative health effects, affecting millions of people every day. The most common and frequent problem it causes is hearing impairment, but it can also generate other neuropsychic and physical effects, which can lead to:

- hypertension;
- headaches;
- gastritis;
- myocardial infarction;
- stress;
- sleeping disorders;
- memory disorders;
- behaviour disorders;
- depression, fatigue, anxiety;
- decrease in concentration skills;
- aggressive behaviour and irritability.

2 Materials and methods

To determine the noise level, Bruel & Kjaer type 2250 integrating sound level meters equipped with filters with a bandwidth of one octave and 1/3 octave, Bruel & Kjaer type 4231 calibrators and the BZ 5503 determination visualization software were used. Ensuring the quality of measurement's results is done by using metrologically verified sound level meters and calibrators in accordance with the requirements of legislation in force [3].

Fig. 1. Analyser type 2250A

Fig.2. Acoustic calibrator type 4231

The noise analyser type 2250 (fig. 1.) is used to perform single measurements or series of measurements for laboratory and in-situ analysis.

The acoustic calibrator (fig. 2) is used to check the sound level meters used in the determinations both before and after a series of determinations, to obtain results with a high degree of accuracy.

To perform the acoustic calibration, the acoustic calibrator type 4231 was used. It provides a stable sound pressure at 1 kHz and is least influenced by environmental factors.

If results of two successive calibrations differ by more than ± 1.5 dB, the sound level meter should be checked to see if it is metrologically correct.

Reporting of measurement results also includes an estimate of the global measurement uncertainty, taking into account the influence of factors such as:

- measuring equipment;
- microphone location;
- number of measurements;
- meteorological conditions (temperature, humidity, wind speed, its direction, etc.)
- variation in time and space of the noise source [6].

3 CASE STUDY

As part of research activities carried out by NRDI INSEMEX Petroșani, a series of determinations of the noise produced by road traffic in the eastern area of Jiu Valley were carried out. The monitoring points were located in the main intersections (fig. 3), especially in the areas crossed by national roads (DN 66) as well as county roads (DJ 709K) and boulevards (December 1, 1918).

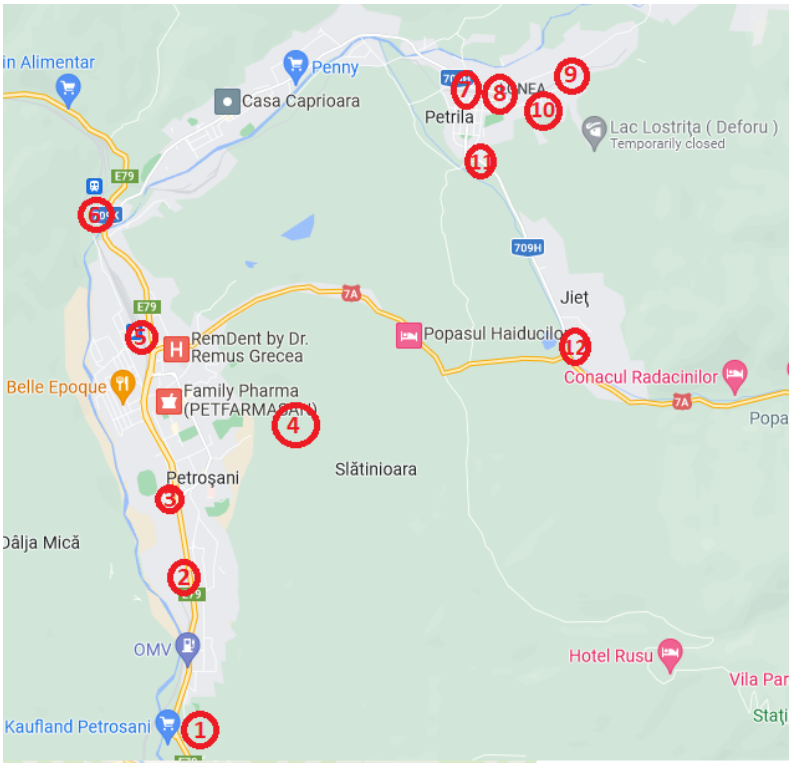

Fig. 3. Location of monitoring points

Fig. 4. Location of monitoring points (points 7 and 8)

Fig. 5. Location of monitoring points (points 7 and 10)

Table 1 shows the noise level values for each monitoring point (dB).

Table 1. Values obtained during the monitoring period

No.	Location	February	March	April	May
1	Roundabout General Trans	70.2	66.6	71.3	71.4
2	Livezeni street	64.2	71.2	70.1	69.3
3	Airplane roundabout	69.6	68.9	69.8	69.3
4	University	52.3	51.8	53.6	52.1
5	Piața Victoriei roundabout	59.9	70.1	68.9	65.3
6	Rotary Petrila	56.3	67.5	66.3	68.9
7	Town hall Petrila street	69.6	70.9	72.3	71.3
8	Petrila Police	65.0	67.5	65.1	68.2
9	Intersection Mine	64.1	65.3	63.5	65.1
10	Mina Lonea	43.3	49.2	53.6	44.5
11	Lonea Firefighters	65,2	64.1	63.5	64.5
12	Jieț Lonea intersection	57.4	53.8	53.1	54.1

Quantification of the noise level was done by comparing the values obtained with the values specified by SR 10009:2017 for determination of the noise level at the limit of the functional premises.

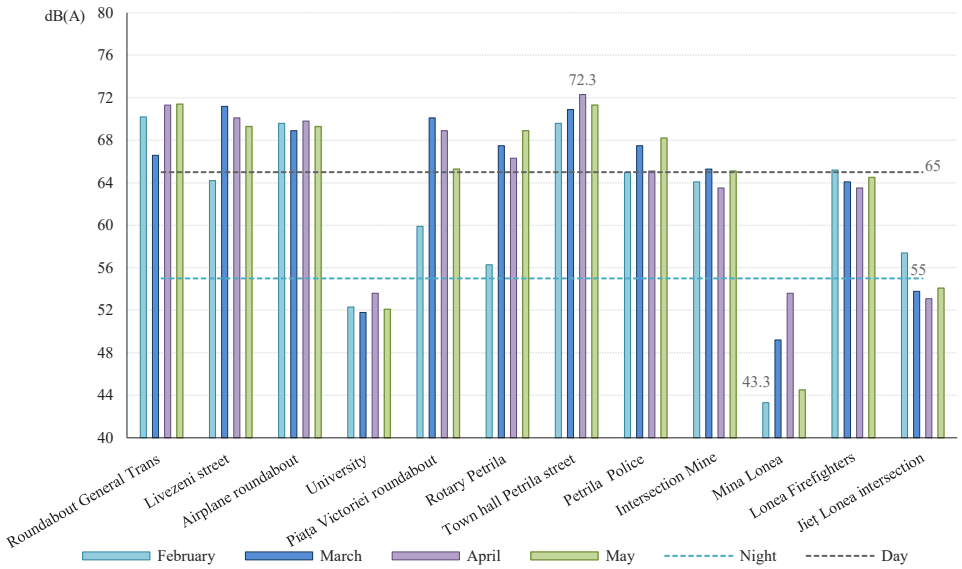

Fig. 6. Graphical representation of the results obtained and the limits established by the legislation in force for the night and day period.

Exposure to noise is a risk factor for health. It was found that the low-intensity, disturbing noise generated by the external traffic of vehicles or transmitted from neighbouring rooms that propagates in homes, because of being permanent / semi-permanent (day and night), constitute risk factors with an irritating effect for the human body.

Sleep disturbances generated by exposure to ambient noise contribute to emergence / aggravation of cardiovascular diseases, neuroses, can induce states of fear and / or aggression. Noise creates difficulties in the learning process, especially in schools, where it is necessary to ensure a very low level of noise in order not to disturb the learning process.

Although constantly surrounded by sounds, in most cases the activity can be carried out ignoring them, but with the increase in the level / intensity, the sensation of "noise" appears, defined as a disturbing sound that becomes a polluting factor of the living and working climate.

The influence of noise on the human body is accentuated by several characteristic factors such as:

- the type of noise: intensity, frequency, action time, continuous or intermittent;
- individual characteristics: age, activity, state of fatigue, habit, mood, sensitivity, culture, education;
- environmental factors: space size, architectural structure, etc.

Within the European Union, almost 40% of the population is exposed to road traffic noise with levels exceeding 55 dB, as A-weighted sound pressure level, during a day, and 20% of the population is exposed to levels exceeding 65 dB. If the noise generated by all sources of transport is taken into account, it turns out that almost half of the citizens of the European Union live in areas where acoustic comfort is not ensured.[7]

For the nighttime period, it is estimated that more than 30% of the population is exposed to levels exceeding 55 dB, levels that disturb sleep.

The quality of environmental factors and especially urban noise influences the health of population, therefore monitoring noise levels outside buildings and assessing the impact on health is an essential component of preventive activities.

In accordance with the provisions of Order MS 119/2014, chapter I, art. 16,

a) during the day, the A-weighted equivalent continuous sound pressure level, measured outside the home according to the SR ISO 1996/2-08 standard, at 1.5 m above the ground, should not exceed 55 dB and the curve of Cz 50 noise.

b) during the night, between 11:00 p.m. and 7:00 a.m., the A-weighted equivalent continuous sound pressure level, measured outside the home according to the SR ISO 1996/2-18 standard, at a height of 1.5 m from ground, should not exceed 45 dB respectively the noise curve Cz 40.

4 Conclusions

Following the monitoring and analysis of the level of noise generated by road traffic, the following conclusions were drawn:

• The analysis of noise determinations showed that the level of exposure to noise is between 43.3-72.3 dB and there are exceedances of the limit of 65 dB in most of the respective monitoring points during the 4 months monitoring period.

• The determined acoustic pressures show exceedances of up to 7.3 dB, compared to the legal limits regarding the noise level at the functional limit (max 65dB).

• The analysis of spectrograms showed that the exceedances are in the medium and high frequency bands considered to be the most disturbing, with values between 0.1-9 dB.

• Reducing the noise generated by road traffic is a complex problem that requires the allocation of massive financial resources, the ultimate goal being to reduce the exposure of inhabitants and obtain an acoustic comfort, at an acceptable price; the primary variables of the system are the acoustic characteristics and the cost price. In order to have a system to reduce the exposure of population to noise generated by car traffic, it is necessary to adopt some technical and organizational measures such as: asphalting the streets, reducing speed limits, establishing one-way traffic on adjacent streets, promoting electric vehicles, soundproofing homes located near traffic arteries, planting ornamental shrubs, installing sound-insulating barriers, building bypass roads (ring roads) to decongest road traffic in cities, etc.

In conclusion, road traffic represents an increasingly urgent problem in most cities, not only in large urban agglomerations (LAW no. 121 of July 3, 2019 on the assessment and management of ambient noise) with over 100,000 inhabitants [4]. The problem of noise generated by road traffic is omnipresent in most cities crossed by national and/or European roads that do not have ring roads to divert transit car traffic.

Measures to reduce the level of exposure to noise must be applied uniformly for all cities affected by noise pollution generated by road traffic, not only for large urban agglomerations that are subject to monitoring in the form of noise maps made according to Law 121/2019.

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