The ambient noise level in the city of Galati and surroundings

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Abstract
The intense and sustained noise to which we are subjected can cause disorders of the auditory system. It affects especially those who suffer from heart problems, but it also has dramatic consequences on the nervous system. It can cause stress, depression, sleep disturbances, cognitive problems and reduced ability to concentrate. The city of Galati is located in the southeastern part of Romania, in the southeastern part of the county with the same name. Galati ranked fifth in terms of noise pollution and unfortunately the local authorities do not run any noise reduction or control program. Through this paper we want to join those who sound the alarm to the authorities to take concrete measures in order to manage and control noise pollution. Data were collected in different areas of the city of Galati and its surroundings. Equivalent noise level was determined with a professional digital acoustic sound level meter with two frequency filters: “A” and “C”. The device can record sound values between 30 dB-130 dB in the 31.3 Hz and 8 kHz range. In general, the sound level exceeded the maximum admissible limit or came close to this value.

Keywords: noise level, frequency filters, Galati.

1. INTRODUCTION

The main objective of this paper is to determine the ambient noise level in the city of Galati and surroundings. Galati is located in the southeastern part of Romania.

The excessive and uncontrolled presence of unwanted and disturbing sounds can have negative effects on human health and can disturb the natural balance of the environment etc. [1]. Those who live in the urban environment have gotten used with the noise of the street and the noise from the workplace so that it doesn't even bother them anymore. Even if people have adapted to this environment, does not mean that these excessive and long-term noises do not have an important impact on health. After a long exposure, people will be able to ask themselves why they have insomnia, are tired or end up with sensori-neural hearing loss. Apart from hearing loss, noise pollution can also have other negative effects such as headaches, memory disorders, gastritis, high blood pressure, heart disease, etc.[1, 2, 3]. Therefore, it is vital that every person is aware of this problem and acts to reduce this type of pollution and the authorities take concrete measures in order to manage and control noise pollution. According to World Health Organization (WHO), noise is the second major environmental cause of health problems, after the effect produced by atmospheric pollution [1].
2. EXPERIMENTAL

Equivalent noise level was determined from Monday to Friday with a professional digital acoustic sound level meter with two frequency filters: “A” and “C”. An A-weighting filter takes into account the normal tolerance curve of the human ear and ensures a correct estimate of the risk level for human. C-weighting filters were intended for low and high frequency sounds, measure noise peaks which are usually those emitted by car engines, firearms, hammers, compressed air tools, etc. C-filters are used in noisy areas[4]. The sound level meter can record sound values between 30dB-130dB in the 31.3 Hz and 8 KHz range.

Data were collected in different areas of the city of Galati and its surroundings. To fulfil the proposed objective, 18 locations (measurement points) were chosen from the urban area of the city of Galati (Fig.1). In the measurement points there are either streets with intense traffic where various companies, shops, banks have their headquarters and there are apartment buildings, or there are adjacent streets where there are only buildings with apartments. Exceptions are locations 2, 3, 6 and 16, these registration points being located in green areas.

![Fig. 1. The measurement points in the city of Galati](image)

Independent samples t-test was run for all data sets. The analysis was done on frequency domains.

Pearson correlation coefficients were calculated to analyse the similarity between the noise series measured in the frequency domain A and C respectively.

The independent t-test and Pearson matrix were run in Excel.

3. RESULTS AND DISCUSSION

In all the monitored areas located on the main arteries, the average values recorded with A-weighting filter are significantly lower than those recorded with C-weighting filter (Fig.2 and Fig.3). These differences appear due to the existence of noise sources from car traffic that includes low-tonnage and high-speed cars. The lowest average values(41-42 dB) were obtained in the Parks and on the Lower Cliff, followed by the measurement points where there are no main arteries but only adjacent streets(46-49 dB). The average values corresponding to the A frequency domain are slightly higher than the average values corresponding to the C frequency domain in the following locations: 1, 2, 3, 4, 5, 10, 16. At the same time, the median values are generally lower than the mean values because the maximum values are much higher than those below the mean. The largest dispersions of data sets were obtained in high-traffic locations.
The lowest population dispersion for both frequency domains corresponding to the A-and C-weighting filters were obtained in areas without traffic (1, 2, 16). As we move away from the road, the sound intensity level drops significantly and the dispersion of the population is smaller. The values obtained for the sound level at the edge of the pavement bordering the carriageway are generally lower or equal to the maximum admissible value of 70dB [5]. The values of the noise level outside the building, measured 2 m from the facade, exceeded the admissible value of 50dB [6].

Figures 4, 5 and 6 show Boxplots for the Cliff area (locations 1 and 3), for LMK High School (measurement points 12 and 13) and for Last Lion area (locations 14, 15 and 16).
In the LMK High School area (Fig. 4), the average values do not match with the medians. Near the roadway (measurement point 12-Brailei street), the average value of the measurement set is 10 dB higher than the average value corresponding to the data set obtained in front of the high school (on an adjacent street with less intense traffic-measurement point 13). Dispersions are not uniform. The same results were obtained for the domain corresponding to C-weighting filter.

In the area of the cliff (Fig. 5) there is a difference of 20 dB between the average value of the sound intensity level of the Upper Cliff (measurement point 2) and the Lower Cliff (measurement point 3). This difference is due to traffic. There is no road traffic on the Lower Cliff. The dispersion of the population corresponding to the Lower Cliff is much smaller than that corresponding to the Upper Cliff. The mean values coincide with the medians. The dispersion around the median is symmetrical. The same results were obtained for the domain corresponding to C-weighting filter.
If we compare the values of the sound intensity level in the area of the Last Lion intersection (Fig. 6), significant differences in the average value are observed as we move away from the traffic area. The lowest data dispersion was obtained in the Park(16), the lowest mean value and the lowest median value were obtained behind the buildings(15). For points 14 and 16 the dispersions are symmetrical around the median value, while for point 15 the dispersion is smaller between quartile 1 and the median value.

In conclusion, we can say that the main source of noise pollution in the urban area is car traffic. In general, the sound level exceeded the maximum admissible limit or came close to this value. For frequency domains corresponding to the A-and C-weighting filters the t-test for independent samples was run (Tables 1 and 2).

If the values of the parameter t are high, then there are significant differences between the two data sets. In the t test, the probability of making an error if we reject the null hypothesis is denoted by p. p-value is also called significance value. When p-value is lower than the chosen significance threshold ($\alpha=0.05$) then we accept as true the hypothesis H1 and reject the hypothesis H0 [7].

Table 1. Independent samples t-test parameters corresponding to channel A (selection from the 324 variants)

<table>
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<tr>
<th>Group 1 vs. Group 2</th>
<th>t value</th>
<th>p</th>
<th>p 2-sided</th>
<th>p variances</th>
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110
Both for A frequency range (Table 1.) and C frequency range (Table 2.), the values of the parameter $t$ have significant values (large values) for all data series, with two small exceptions, which indicates that the differences are significant, that is, the analyzed points are different and can be used as fingerprints for identifying places.

Pearson correlations were also performed between all data series corresponding to the A-weighting filter (Table 3) and separately between all data series on C Channel corresponding to the C-weighting filter (Table 4). The closer Pearson coefficient, $r$, is to 1, the stronger the correlation between the data series.

For a correct interpretation, the Pearson correlation coefficient is accompanied by a significance test. In the significance test, $p$ represents the level of confidence factor. The Pearson coefficient has statistical significance only if the value level of confidence factor, $p$, is smaller than 0.05 [8].

In tables 3 and 4, each measurement point has two rows. The first row indicates the values of the Pearson coefficient, $r$, while the second row represents the values of the of confidence factor, $p$.

From the values of the Pearson coefficient, $r$, and the parameter $p$, it follows that there are no strong correlations between the data series, fact that proves that there are significant differences from one measured series to another and there are no repeating patterns. It can be said that the traffic level is running randomly.
Table 3. Pearson Correlations for sound intensity level values corresponding to the A-weighting filter

<table>
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<tr>
<th>Variable</th>
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**Note:** The table shows Pearson correlation coefficients (r) for sound intensity level values corresponding to the A-weighting filter. The values range from -1 to 1, indicating the strength and direction of the linear relationship. Positive values indicate a positive correlation, while negative values indicate a negative correlation. The table includes partial correlation coefficients to control for the effects of other variables.
<table>
<thead>
<tr>
<th>Variable</th>
<th>Point 3</th>
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</table>
4. CONCLUSIONS

In this article, the level of noise pollution in the city of Galati was determined. For this purpose, the sound level was measured in 18 points in the city of Galati with the help of a professional digital acoustic sound level meter with two frequency weighting filters: “A” and “C”. The values obtained for the sound level at the edge of the pavement bordering the carriageway are generally lower or equal to the maximum admissible value of 70dB. The values of the noise level outside the building, measured 2 m from the facade, exceeded the value of 50dB.

From the calculated Pearson matrices it emerges that there are no repeating patterns. It can be said that the traffic level is running randomly.

Also the t-test for independent samples indicates that the differences are significant, that means the analyzed points are different and can be used as fingerprints for identifying places.

References

1. Noise pollution is a major problem, both for human health and the environment, European Environment Agency Newsletter 01(2020).
4. A, B, and C Contour Filters for Sound Measurement. hyperphysics.phy-astr.gsu.edu.