

## INDUSTRIAL NOISE POLLUTION AND ITS EFFECTS ON HUMAN HEALTH

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**ABSTRACT:** *The development of industrial activities has led to a diversification of noise sources and to higher sound pressure levels. Although it is considered as being a pollutant, noise is the only pollutant that does not leave residual traces in the environment. Miscellaneous research papers conducted in the last years have shown that noise exposure triggers different kind of health problems, some of them being not extensively studied yet. Also, it was found that people react differently to noise exposure and so far there were not identified accurate correlations between different levels of exposure and the occurrence of certain health problems. This study aims to identify the main industrial noise sources, the impact of noise on human health, the noise measurement methods, the maximum admitted values for noise in Romania and also few methods that can be used to decrease the noise level.*

**Keywords:** *noise pollution; industrial noise;*

### Introduction

Among the definitions of noise, the best known is the following: „Noises are irregular overlaps of sounds having different frequencies and intensities”. Sounds are produced by periodic movements, while noises are associated with irregular movements.

The decibel (dB) is the standard accepted unit used for the measurement of sound level, due to the fact that it can be associated with high variations of sound pressure amplitude.

The perception of sound by the human auditory system is possible between two limits: the inferior limit (0 dB), also called „audibility threshold”, and the superior limit (130-140 dB), also called „pain treshold”.

When describing the sound and its effects on human beings, there are usually used “A weighted” sound levels dB(A) for the assessment of human ear response. The term “A weighted” refers to a filtration of audio signal in a manner in which the human ear

perceives the sound. The level of noise A weighted is well associated with human noise assessment, being also commonly used worldwide for many years for the measurement and assessment of industrial noise.

In the last years, the issue of noises and their negative impact on human health and human activities has been increasingly discussed. Some noises can be endured, but they may also be annoying when they disturb a creative activity or human rest hours.

Noise is perceived as being one of the factors that interfere with sleep, work or human recreation and a prolonged exposure is often resulting in physical and psychological damage, reduced quality of life or simply the disruption of daily activities.

Also, noise may be considered a form of energy emitted by a vibrating body, which is audible due to a frequency of over 20 Hz. It is perceived by human beings physiologically, by sensing in the subconscious the vibrations of sound wave, while the psychological perception consists

in concentrating the individual's attention on that noise, without ignoring it intuitively [1].

Industrial noise comes from different technological processes, being produced during the functioning of different internal combustion engines and also while operating different machineries located on the industrial sites, because of the friction between different compounds of these machineries and the raw materials and/or final products; this friction produces vibrations which propagate in the environment, being perceived by human ear as noises. Noise generating mechanisms are depending on the noisiest operations and machineries. High levels of sound pressure are caused also by different high-speed gas flows, produced by fans, steam and pressure valves. Most industrial machineries and production processes generate unwanted noise, whose mechanism depends on the production operations, the strongest noises being generated by impact production processes, by the handling and processing of various materials, by compressors and pneumatic equipment and also by heavy equipment.

Noise standards focus on the measuring of: noise level generated by industrial activities, noise level at workplace and level of sound pressure admitted at the limit of industrial facilities or at the limit of protected receivers. Industrial noises can be continuous or intermittent and they can have variable sound intensities.

The structure of the buildings supports the transmission of noises, as blocks of flats have metallic reinforcements covered in concrete, which makes them much louder than the buildings made of brick. Noise propagates along the reinforced concrete walls or along heating pipes, from one floor to another.

Noise pollution is one of the most important environmental issues. Noise is the most common pollutant and, even though it doesn't produce a physical, perceptible residue, it produces a series of negative

effects on human health and on environment. Although in the past noise pollution has been approached in different ways by researches – some of them tackling it in accordance with its seriousness and others having a shallow approach – now it became an environmental problem whose complexity grows with the development and progress of humankind. One of the reasons why the effects of noise are not a priority, as for example economic issues are, is the difficulty of quantifying them in monetary form [2].

Noise does not affect only ear, as hearing organ, but also other organs and systems, as it follows:

- Ear and hearing: noise may lead to temporary hearing loss and, in the worst cases, even to a complete hearing loss, in which affected persons can no longer perceive faint sounds, and this loss is irrecoverable.
- Central nervous system: noise may trigger psychological and emotional effects, stress, lack of concentration, anxiety and mental fatigue. There are also signs that night noise may contribute to mental illnesses.
- Decreased attention and memory, headaches – sound can interfere with communication and it can lead to decreased attention and focusing ability, causing also frequent headaches.
- Sleep disorders – noise may interrupt night sleep and, if this happens periodically, it may lead to extreme fatigue and decreased work capacity. There are three types of effects: effects on behaviour during the sleep (primary effects), effects on the performance and mood during the next day (secondary effects) and long-term effects on human well-being and health. The effects on the performance and mood during the next day include: sleep disorders, low-quality sleep and increased sleepiness, fatigue and irritability. Although other effects, such as depression and low performance are also linked to noise, the evidence

existing so far is not conclusive yet for researchers. The effects of night noise on sleep disorders begin at quite low sound levels and they intensify as the intensity of noise increases. The changes between sleep stages, body movements and acceleration of cardiac rhythm begin at 32 dB. In addition, the quality of sleep is probably affected at a noise level exceeding 40 dB. Awakenings during night are also caused by noise that exceeds 40 dB [7].

- Cardiovascular system: noise can increase pulse rate and blood pressure (oscillating hypertension) and it can cause artery contraction and disturbances in blood circulation, although there is only limited evidence on this subject [7]. Professional exposure at high noise levels increases the risk of hearing deficiency and high blood pressure [9].
- Respiratory system: noise exposure increases the respiratory rate (polypnea) and the amplitude of respiratory movements; rarely, it can occur even apnea (intermittent cessation of breathing).
- Digestive system: high level noise exposure is associated with: esophagitis, gastritis, duodenitis or colitis, which are caused by increased peristaltic movements of these organs.
- Eye and its function: diminished vision and reduction (narrowing) of the visual field, visual accommodation disorders.
- Endocrine glands: hormonal disorders may occur as a response to severe noise aggression, the most common disorders being hyperthyroidism and insulin dependent diabetes mellitus [2].

As far as noise effects on children are concerned, the main problems identified are: attention and concentration difficulties, weaker dissociation between sounds and weaker speech perception, memory difficulties, poorer school performance [7].

Noise generates communication problems

and leads to high stress levels and also behavioural effects on human health [4].

The relationship between traffic noise and its effect on work efficiency shows that this type of noise affects work efficiency regardless the position of the workplace [5].

Cardiac disease risks are higher for persons living in areas with medium noise levels exceeding 65-70 dB. For these people, cardiac disease risks are ca. 20% higher than for those living in quieter areas. However, risk is also influenced by individual characteristics [7].

A study on workers exposed to industrial noise has shown that 86,5% of them were affected by noise: 36% were suffering from headaches, 19% were having tinnitus, 15% were confronting with anger episodes, 9% with insomnia and 7% reported hearing loss. Also, the study revealed that 65% of workers did not use ear protection equipment [6].

## 1. Noise emission limits

In Romania, the maximum limits for noise level in urban areas are regulated by SR 10009-2017 "Acoustic. Noise emission limits in the environment" [8].

This standard establishes outdoor noise emission limits for each type of area and functional space, in accordance with their definitions from specific technical regulation concerning localities systematization and environmental protection.

*Noise emission limits (level of continuous equivalent A weighted sound pressure LAeqT) at the limit of functional areas:*

- recreational and resting spaces, medical and balneo-climatic treatment facilities: 45 dB;
- school premises, nurseries or kindergartens and children's playgrounds - 75 dB;
- stadiums, cinemas and open-air theaters, spaces for outdoor cultural, sports and entertainment events - 90 dB measured throughout the space;
- industrial premises and spaces with

activities assimilated to industrial activities - 65 dB;

- markets, commercial spaces, outdoor restaurants - 65 dB;
- car parking - 70 dB.

*Noise emission limits (level of continuous equivalent A weighted sound pressure LAeqT) inside the functional areas:*

- recreational and resting spaces, medical and balneo-climatic treatment facilities: 45 dB;
- school premises, nurseries or kindergartens and children's playgrounds - 85 dB;
- markets, commercial spaces, outdoor restaurants - 70 dB;
- car parking - 70 dB.

*Noise emission limits (level of continuous equivalent A weighted sound pressure LAeqT) at the limit of functional areas:*

- parks: 45 dB;
- industrial areas (harbor area included): 65 dB;
- railway areas: 65 dB;
- airports: 90 dB;
- residential area: 60 dB.

*Noise emission limits (level of continuous equivalent A weighted sound pressure LAeqT) inside the functional areas:*

- parks: 60 dB.

*Noise emission limits (level of continuous equivalent A weighted sound pressure LAeqT) at the limit of property, for residential buildings with fenced land (yard), having maximum two levels of height:*

- residential buildings with courtyards and two levels or less: 60 dB.

*Noise emission limits (level of continuous equivalent A weighted sound pressure LAeqT) at the limit of property, on the facade of residential buildings, which is the most exposed to noise sources originated from outside the building.*

The limit for external noise on the facade of the residential building which is the most exposed to noise sources originated from outside the building is:

- any type of residential building or assimilated to it: 50 dB.

Noise modeling is also a complex task, as the propagation of noise is nonlinear, there are a series of interactions between noise levels and the distance between receiver and source varies [1].

The monitoring of noise level should be a habit, not an activity implemented when there are public complaints.

## 2. Noise level reduction methods

In order to reduce noise at the workplace, the most common method is to provide workers with hearing protection equipment; also, to a lesser extent, there are taken actions to reduce noise at the source. Hearing protection equipment must reduce noise to an acceptable extent, but it also should allow communication at workplace.

The control of the industrial noise level can be done by interventions on at least one of its three component parts: noise source, noise propagation way and noise receiver; this implies: the reduction of sound energy emitted by the source, a deviation or a reduction of sound energy along the propagation way and the protection of receiver using different methods.

Noise barriers are frequently used to reduce the propagation of sound between the source of industrial noise and the protected areas. They must be placed as close as possible to the source or to the receiver and they can be of several types:

- right absorbing barriers, covered with absorbent material on the side located near the noise source, which helps absorbing some of the incident sounds and reducing the reflections that could affect receivers situated on the propagation way,

- upper-side curved absorbing barriers, whose role is to reduce the risk that sound waves cross over the top of the barrier;
- embankments and earth berm built between the noise source and the receiver.

Amendments to the sound source are usually considered to be the best solution to a problem of noise control. The components of a machine can be modified to obtain a significant reduction in the noise emission [9].

Noise reduction is also possible by using noise absorbing materials for walls, doors, windows and ceilings of industrial buildings and by using vegetal barriers that can attenuate the level of noise.

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## Conclusions

Industrial noise contributes to increased urban noise level, together with road traffic, these two types of noise being considered the main sources of noise pollution. Exposure to high levels of noise may trigger different negative effects on human health, from hearing impairing to serious psychological issues.

Regulatory authorities in the field of environmental protection and work safety must take action to reduce industrial noise, which may cause health problems to workers and people living near industrial facilities. Also, there must be promoted those technologies associated with reduced noise levels.