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## NOISE PROTECTION IN MANUFACTURING PLANTS

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**Abstract:** The production facility is limited and confined space whose dimensions of significantly higher compared to the wavelength of the spectral components of the emitted sound pressure level (sound power) noise sources that are widespread in the area. During operation of sound sources in the plant comes to complex phenomena in the sound field (reflection, interference, diffraction, attenuation) that are more or less successfully explain existing theories. Acoustics manufacturing plants is of great importance in solving noise protection.

Noise sources can be any machines and mechanisms, the flow of gases and liquids in pipelines, devices, and in the atmosphere, variable electromagnetic fields in electric devices, speech, music etc. The protection system design methods can be divided into two groups: active methods and passive methods. Active methods involve the intervention of the noise source in decreasing while passive methods related to specific interventions along the main routes of transmission of the noise source to the receiving stations. This paper analyzes the noise sources, their characteristics, the physical phenomena that occur and ways to reduce noise and increase the comfort and safety of the workplace.

**Key words:** Noise sources, workplace, noise protection

### 1. INTRODUCTION

The rapid development of modern society, since the beginning of the twentieth century, the construction of new roads, industrialization, have led to a new environmental problem – noise.

The European Noise Directive 2003/10/EC defines the minimum health and safety requirements regarding the exposure of workers to the risks arising from noise. Under this Directive the employer is required to investigate whether “workers are or are likely to be exposed to risks from noise as a result of their work” [1].

Noise level has been increasing in human living and working environment. This is supported by the following facts:

- Noise is the third environment polluter (after air and water pollution),
- Over 40% of the adult population feel some kind of discomfort caused by the influence of noise and vibration
- In industry and at workplace, noise level often exceeds acceptable level.
- Product development and productivity growth lead to increase of the installed power capacity, speed increasing, automation of the operations and processes.
- As consequence, vibrations are increased leading to enhancement of the overall noise levels.

Table 1. Maximum measured noise level in industrial plants

Industrial plants	The noise level
Shipbuilding	135 db
Metal industry	130 db
Metallurgy-Forge	130 db
Metallurgy of non-ferrous metals	122 db
Electrical Industry	122 db
Paper industry	122 db
Textile industry	121 db
Printing Industry	120 db
Wood industry	120 db
Leather industry, rubber and customs	120 db
Food industry	115 db
Chemical industry	115 db
Oil processing	112 db
Energy production and distribution	111 db

### 2. THE DIVISION OF NOISE

The basic classification of noise is: noise in workplace and environmental noise.

a) Noise in the workplace include:

- Noise generated by the device on which the employee works directly
- Noise from other devices
- Noise from the so-called. non-production sources - eg. ventilation units and air and sounds from the environment (eg. traffic)

b) Environmental noise include:

- Traffic noise
- Noise is heard from industry
- Street noise of various origins (cafes, playgrounds, etc.).
- Noise in households (from electrical and electronic devices, from neighboring apartments, etc.).

In addition to direct harmful effects on human health, noise indirectly affects the results of work, and all the more visible and more significant if it is stronger. Decline in labor productivity, an increase in the number of errors and injuries at work is evident in all sectors. In industrial plants, where this noise, change of machines or changes in the technological process, noted as significant improvements in product quality and productivity achieved.

There are very different types of noise. Most noise is classified by duration and spectrum. For partition its duration is taken as the criterion time form of the noise level. Thus we have:

- constant noise level when the source radiates sound always the same strength
- varying levels of noise, which is characteristic of traffic
- impact noise, which occurs in a crash two solid bodies and the beats or irregular.

The degree of interference depends very much on how to change the time format of the noise level. At least interferes with noise whose level is constant in time, while varying levels of noise and impact noise have a greater adverse effect on humans.

Therefore, the measurement and valorization of harmfulness introduced specific procedures to the impact of noise can be properly assessed [2].



Fig.1. The correlation of the phenomenon of noise and environment

Figure 1 shows the correlation of the phenomenon of noise and vibration and the environment in which they are manifested.

Vibrations caused by any of the above causes, through rigid or flexible connections between certain mechanisms or assemblies, shall be transferred to the entire machine or plant, generating a noise level emitted to the workspace to the workplaces.

The overall noise levels in the workplace greatly affect closed industrial space, starting with the construction of the facility and its size, the choice of materials for the interior of the facility. Solutions in construction of buildings (walls, roofs, openings for volume lighting and ventilation based machines) have the greatest impact on the transmission of noise and vibration in the open space outside the industrial plant, where the noise is still spreading in the environment.

Research shows that the criteria of efficiency and costs of noise protection can be decisive in the choice of technical equipment and the design of the technological process. Better quality and more expensive equipment with lower levels of noise and vibration, which is due to the quality characteristics expensive, often resulting in lower total cost of investment. By choosing less expensive technological equipment necessary to design and carry out a set of protections.

Mechanical oscillations occur due to:

- collision of machine elements,
- their friction,
- excitation forces,
- magnetic fields,
- changes in fluid pressure and
- other factors.

Industrial space (the construction of the facility, its size, the choice of materials) affects on overall noise level.

The main causes of noise (Fig. 2) can be categorized into four groups: structural parameters, production technology, workflow and maintenance technologies.

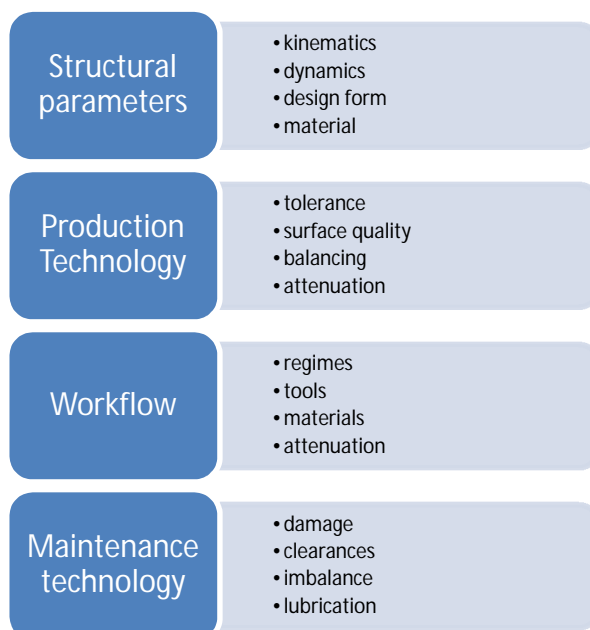


Fig.2. The main causes of vibration and noise sources

These four groups represent research and development areas in which it is necessary to actively influence the

agents noise and vibration to equipment was reduced to that value which corresponds to the level of development of technology.

Machines and mechanical equipment used in the industry are a group of stationary noise sources that generate noise in the workplace but also can generate significant levels of noise in the factory halls and environment space. Generated noise is mainly dependent on the machine power [3].

Mechanical equipment includes machinery used in industrial applications such as motors, compressors, boilers, pumps, transformers, generators, cooling towers and ventilation equipment. The main mechanisms of noise generation can be divided into three groups:

- mechanical (gear transmission, bearings, belt drive, fans and other rotating components)
- aerodynamic (fluid flow-air or some liquid) and
- magnetic (periodic force between the stator and rotor).

Is necessary a constant active attitude towards the problem in the product lifecycle, starting from the origin of the idea of the research and development stage of structural parameters, through development production technology parts and components, proper operation, to maintenance of appropriate technology products and systems.

There are two basic types of the vibration and noise effects:

- Effects on technological equipment and
- Medical effects (biological effects on human and living organisms) Fig. 3.

These two groups cause large number of adverse events and changes that are located in the general areas: human-machine-workspace-environment.

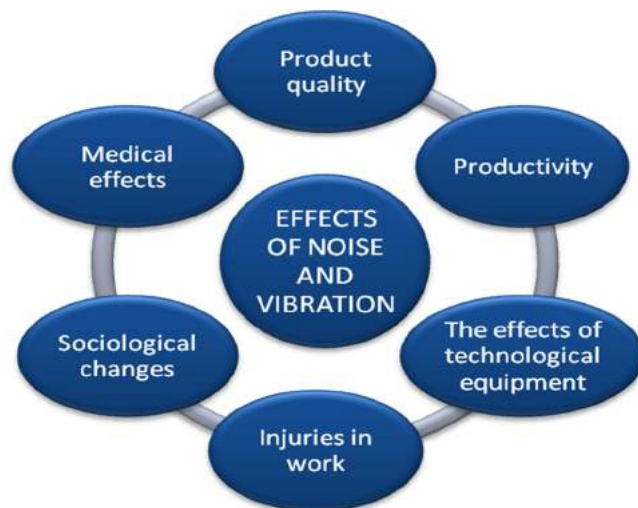


Fig.3. The effects of noise and vibration

### 3. ACOUSTICS OF INDUSTRIAL PLANTS

In industrial plants is a major source of noise and the jobs assigned to the requirements of the technological processes in the whole space. In relation to the demands of classical architectural acoustics, acoustics main tasks of industrial plants can be defined with the main objectives:

- Noise in the workplace must not interfere with the performance of certain types of jobs, or to be

ahead of the prescribed limit values and total levels of spectra, and

- Existing optimal balance between direct and reflected sound to total (minimal) costs necessary to meet the objectives of the previous and the expected positive effects psychoacoustic.

Obviously, the only method of acoustics can not meet the requirements of protection, but can significantly contribute to their implementation in other passive and active methods of noise protection in industrial facilities. This requires, in addition to knowledge of the acoustics of the rooms, good knowledge of technology and technological equipment, construction machinery components and assemblies, methods of measurement and analysis of vibration noise, maintenance methods, as well as special materials and equipment for protection against noise and vibration. For this reason it is necessary to supplement and specialist knowledge in this field gained in mechanical engineering.

Increased noise levels at workplaces in industrial plants occurs for two reasons:

- due to a distribution of a large number of noise sources and plant
- due to the negative effects of indoor space.

Types and selection of process equipment is connected to the design of manufacturing technology. More favorable distribution can be influenced by matching requires noise protection with the demands of technology and equipment selection, given the acoustics.

The second reason was never fully be eliminated regardless of the acoustic processing plant, which closed space uizvesnoj much closer to the open air [3].

### 4. DESIGN METHODS FOR NOISE PROTECTION

Design methods of protection from vibration and noise are developed based on the study of the process of their generation and transmission. Transmission of noise and vibration by air and the conductive space.

The methods of designing the protection system can be divided into two main groups:

- Active methods, which include interventions at the source of noise and vibrations in decreasing and
- Passive methods, related to the particular requirements along the main routes of transmission of the noise source to the receiving stations.

### 5. ROUTES OF TRANSMISSION OF NOISE AND VIBRATION

The main objective in the design of the protection system is to broadcast the level of vibration and noise of appropriate technical solutions lead to limits on specific workplace or part of the plant. To such devices need every source analyzed from this perspective.

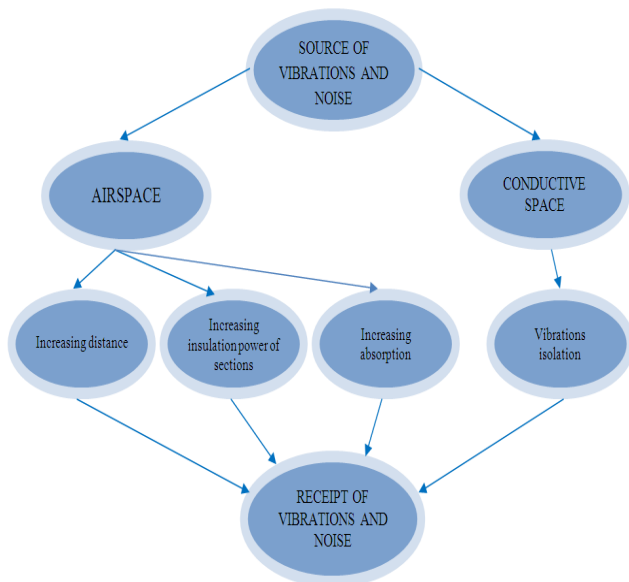


Fig. 4. Routes of transmission and methods protection vibration and noise

Figure 4 shows the two main routes of transmission vibration and noise from the source to the observed point in space. These routes of transmission point to both primary care practices (reduce) noise and vibration. Noise transmission by air is achieved in an open or closed space. During the translation of the main open space protection procedures are increasing the distance between the source of admission ii, and also increase the insulation of partition in active and passive safety. In enclosed spaces, such as industrial plants, a very important process to protect and increase the absorption of enclosed space [4].

## 6. CONCLUSION

Under the European Directive 2003/10/EC on noise at work employers are required to investigate whether “workers are or are likely to be exposed to risks from noise as a result of their work” [5].

Solve the problems of working and the environment from noise and vibration protection system design, implementation and verification of projects can be successfully implemented if the following conditions are met:

- Won the necessary knowledge and methods of calculation for vibration and noise, which requires knowledge of the physics of the process of their generation and transmission, as well as the method of designing the protection system.
- Achieved methods of determining the characteristics of the source of noise and

vibration in the laboratory and in real terms, and won verification methods designed and executed security solution;

- Developed the necessary materials and equipment renowned mechanical/acoustic characteristics for the execution of projects, including their production and availability in the market under known conditions of purchase and delivery;
- Establishment of specialized firms for execution of projects;
- Adopted the legal and technical regulations, and established the necessary inspection authorities.

The main objective in the design of production systems should be to reduce the noise level. Measures for noise protection must be provided for in the works of major projects in the planning of factories and office schedule. Noisiest facilities to deploy in separate complexes. The conclusion is that noise should be reduced by all available means, wherever and however possible.

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