Benefits of noise management on the worker, in industries plastic injection
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Abstract

Was studied in this article the effects of noise on workers of the Industrial Pole of Manaus industries, specifically those working with injection molding, and what solutions can be deployed by companies to control the noise level. Data collected with measurement methodology in accordance with the rules show that the noise levels are above the tolerable and mitigation measures as Individual Protection Equipment and Collective protection devices accurately be observed.

Key words: Noise, Control, Vibration, machine

INTRODUCTION

Exposure to noise above the tolerance limits is harmful to health workers. And MORATA and Lemasters (1995) proposed the use of the term "occupational hearing loss", to be more comprehensive, considering the noise, as the most common agent, but without ignoring the existence of others. As mentioned above, exposure to high levels of noise can cause irreversible hearing damage as the noise induced hearing loss (NIHL) also known as Induced Hearing Loss Sound Pressure Levels High (HLSPLH). In addition to health damage, hearing loss affects the quality of life of workers in several respects. As already mentioned, unlike other occupational hazards, noise is considered more common in the workplace, being characterized as the factor most prevalent of the origins of occupational diseases (Padovani, Nova, Queirós Silva, 2004). It's no different in the Industrial Pole of Manaus, where there are numerous companies with activities that generate noise above the tolerance limit. So the impact of this physical agent and his remarks deserve study and dedication.

The sound is defined as any disturbance vibration in an elastic medium, producing a hearing sensation (MERLUZZI, 1981⁴). Noise is an aperiodic acoustic signal, originating from the superposition of several vibration movements with different frequencies that have no relation to each other (FELDMAN; GRIMES, 1985⁵), as the vibrations have no relation to each other, the noise is known as a type uncomfortable sound to be heard.

GENERAL ON NOISE

Some physical characteristics of the noise are intensity and frequency. Intensity: the amount of vibrational energy, which may be expressed in Newtons per square meter (N m²) or decibels (dB) (sound sensation unit).

Frequency: indicates the number of complete vibrations in a second and is measured in cycles per second or hertz (Hz).

According to the ISO 2204/1973 standard, the noise can be classified into:

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Continuous noise
It is one whose sound intensity level change is very small with respect to time. Noises are characteristic of liquid pumps, electric motors, gears, etc. Examples: rain, refrigerators, compressors, fans, etc.

Floating noise
It is one that has large level variations as a function of time.

Impulsive noise or impact
They show high levels of loudness in a very short period of time. Are the noise from explosions and impacts. Are characteristic noise riveting, automatic printers, crushers, presses, etc. It is observed that this classification takes into account the level of intensity variation with time. Risk factors for noise are:

A) Intensity above 85 db;
B) Frequency range (3000-6000 Hz);
C) Exposure time;
D) Individual susceptibility;
E) Noise type. When the noise is intense and exposure to it is continuous on average 85 dBA (decibels measured on scale A of the sound pressure meter device) in eight-hour workday, there are structural changes in the inner ear, which determine the occurrence of NIHL/HLSPLH (ICD 10 - H83.3).

IMPACTS OF NOISE ON WORKERS
As the noise is a noise disturbance that propagates in the air and penetrates the bodies, he ends up affecting various parts of our body, for example, when we hear the sound of a drum, or multiple instruments in close proximity percussion, we feel the sound vibration produced by the instruments, some people even feel the heart beat differently. This is nothing more than a forming as sound waves can influence matter, and it is also why soundproofing materials are made from materials that absorb sound. From what has been explained above, it can be said that in addition to hearing aid, all the worker's body is also affected by noise generated by machines and equipment with which he works. In an environment with multiple injection, intense and permanent noise can cause various disorders such as:

1) Significant change of mood;
2) Reduced ability to concentrate in human actions and observation of signs warning inside or outside the workplace;
3) Interference with the metabolism of the whole organism;
4) Risk of cardiovascular disorders;
5) Sexual impotence;
6) Changes in sleep;
7) Irritability;
8) Weariness;
9) Loss of productivity;
10) Altered breathing;
11) Altered production of gastric acids;
12) Poor digestion;
13) Headaches;
14) Nausea;
15) Tight muscles;
16) Physical fatigues and widespread mental.

It is observed that the low concentration, combined with fatigue, facilitate the occurrence of accidents. The labor legislation provides that the normal working day is 8 (eight) hours per day and 44 (forty-four) hours per week, but considering that many companies in the Manaus Industrial Hub work a few more
minutes to make the Sabbath (for example 8:48 hours) the worker is exposed to noise over time. In the Industrial Pole of Manaus, the noise issue is directly related to the use of machines and tools in production, and the source of the noise in motors can be classified into three main categories:

1) Magnetic - originated mainly by magnetic forces acting on the stator x rotor assembly, through the air gap between the two, which is defined in the motor design. As a function of the magnetic flux density, the number and shape of the poles, the number and shapes of the slots and the geometry of the air gap;
2) Mechanical - focused on the physical structure of the machinery. Identifies as key sources of noise the rotor unbalance, bearings and bearings, friction of the brushes in the rings of slipping, accidental friction components of the stators and rotors and noise due to loose parts (which implies the need for a rigorous and ongoing maintenance);
3) Aerodynamics - created by eddies and turbulent flows of cooling air that are produced by the rotor wings moving relative to the stationary elements.

Industrial noise is also caused by:

1) Impact - Caused by applying a sudden force on a workpiece for shaping or cutting. For example: forming machines and presses.
2) Friction: Friction is the force that opposes the relative motion of two bodies, and that depends on the strength and the area of the contact surfaces. This noise increases the degree of roughness of surfaces and decreases if it can be done lubrication of the parts that are in friction. For example: contact between gears x chain links; parts x fixtures.
3) Pneumatic: Held by the compressed air passage holes in pipes, expansion or abrupt compression of the air. For example: compressed air leakage by holes in hoses, pipelines or connections; when there is overflow in the trip pneumatic equipment; pressurization and depressurization systems.
4) Ventilation systems: noise caused by insufflation or room air removal. For example: fans and blowers.

As the transmission of noise usually has multiple causes, noise reduction techniques viability requires professional create alternatives based on existing solutions or develop new ones.

METHODOLOGY
For this work, the following topics were raised:

1) What should be contemplated with regard to noise upon the implementation of a new plant? It is observed today, in the same layout of the new plants only show the location of the machines, and there is no concern about noise disruption that this equipment can generate;
2) The Industrial Zone of Manaus has several production centers besides the famous polo electronics, will be the existing poles mentioned and which equipment/machines that generate noise:
3) Detailed description of the noise caused by the injection of workers and the measures that can be taken to minimize noise disturbance.
Illustrative photos of existing equipment will be presented. The photos of the places could not be taken because they are directly in the production process, and many of the companies did not agree with exposure of its dependencies.

NOISE MANAGEMENT IN THE IMPLEMENTATION PHASE OF A NEW PRODUCTION UNIDE / MANUFACTURING
Building on the implementation of new plants or new product production units injected using injection molding machines, the first step is the formation of a team that includes all sectors that will work in this new unit, surveys of all are made the production and administrative items required.
What about the productive part, are raised which equipment will be used and the level of noise they shall, if new machines, the manufacturer shall take this specification, if it is not, it can be acquired by referring other companies that use the same equipment. As the new unit is being planned, the
The arrangement of equipment in the plant should be discussed taking into account the acoustic comfort with the financial part of the company, one of the methods is a better distribution of equipment, but one has to check the area available for equipment and other parts of the process are well-conditioned areas without exaggeration that could compromise other investments and endanger the building work.

It started noise management in the engine room, when we do the verification of injection molding machines that will be used, quantity, type, noise level, and it is fully possible to know, or have a close value of the noise level to be issued in Machine room. And with this amount verify that the building project is compatible or need some acoustic treatment, if you need some acoustic treatment, the values of these possible expenses are measured, and compared with other ideas in order to get the lowest investment value that can meet the security area with the economic viability of the project, both have to go together with the already pre-budgeted amounts for the project.

With this management in the initial phase of the project will be avoided problems with inspections. The modernization and upgrading of labor rights and studies on the noise emission and its consequences to the employee, made the inspections of the Ministry of Labour started to be more intensified, and improvement requirements in the workplace are being required of factories under penalty heavy penalties if detected problems are not resolved, and is known to modify a machine or a production process already underway is a more complicated and expensive task. Another benefit is regarding the number of workers that could be removed if this study was not done, a worker who already knows how to operate the injection machine, you know your cycle and optimizes your time, when it replaced cause a drop in production, due to:

- New operator take a long time to understand the process;
- Because setting the new operator with the machinery;
- Lost parts also due to the ambiance of the worker process.

**MANAUS INDUSTRIAL PARK**

Since its foundation in 1967 until today, the Manaus Industrial Park had many changes, several factories came to town, the production was modernized, the demand for labor, skilled workers forced the improvement in technical education, and there is a plurality of branches plants. Among the segments that exist in the Manaus Industrial Park, we include:

- Electro-electronics (manufacture of TV sets, DVD, sound devices, and the like);
- Two wheels (motorcycles and bicycles);
- Weaving (tarpaulins, jute bags);
- Chemical and Pharmaceutical (cleaning products, concentrates for beverages, medicines, and the like);
- Power generation (thermoelectric park Mauá);
- Oil and gas (refinery and bottling of gas bottles).

And these poles/segments, we find various machinery/equipment that produce noise, among them those who stand out as generators of noise, and also exist in greater quantity, are:

1. Injection;
2. Press;
3. Mats;
4. Industrial ventilators;
5. Stationary engines to generate electricity;
6. Forklifts combustion;
7. Looms;
8. Mills;
9. Compressed air compressors.
ANALYSIS OF NOISE GENERATED BY MACHINES INJECTION - INJECTION MACHINES

Injection machine is the equipment used for discrete manufacturing molded products by injecting plastic material into the mold. The mold is a "block" containing one or more cavities in which the product is formed. These products can be molded in thermoplastic or thermoset.

The injection molding machine consists essentially of the following components:

1) Clamping unit;
2) Injection unit;
3) Drive systems and command.

The injection molding machines have a significant amount in the industrial park, based on them is that several companies had to fit the requirements of the Ministry of Labour inspections were conducted studies and implemented measures to reduce the sound pressure levels, according to studies in technical literature, such as:

1) Study to replace the current injection by new quieter machines (intervention in the emission source);
2) Study for modification of the production process flow with merge between starting and stopping of the injection;
3) A change in the layout of the machines, increasing the distance being the same;
4) Verification about the preventive maintenance;
5) Reducing the emission of noise, with the following actions:
   5.1) Total Enclosure or part of the injection;
   5.2) Installing barriers;
   5.3) Dampened supports installation;
   5.4) Installation of silencers;
   5.5) Fonoabsorvente treatment.

With regard to workers the following actions were taken:

1) Implementation cabin with sound insulation in the production. With this the operator would remain in production, but would make the monitoring process at a station that would offer less exposure to noise ratio, and even when there was any need for intervention on the machine or process, he could act without problem or delay;
2) Exposure time reduction. The operator enters into the process time and has already been estimated that it can stay in the area, after that it exits and is time away from other process.

Companies across studies and insulation deployments continued giving workers the individual protection equipment, given that the noise level even though diminished, would be above or very close to the tolerated by humans.

Some results obtained were:

1) The partial insulation of injection were not effective, being broken;
2) Power Improvement of funnels with injection material, caused the permanence of operators near the machines could be diminished;
3) In some factories, the cabins which serve only to operators began to be used for maintaining, improving the maintenance service and improving the performance of equipment;
4) Barriers and other similar ideas were discarded;
5) Studies for replacement of machinery and process changes were more appropriate when:
   5.1) finish the depreciation of machinery, getting the same apt to be replaced;
   5.2) Or when their maintenance with spare parts were to become too expensive, or if the pieces could no longer be found in the square were no longer being produced by the manufacturer.
With the help of the figure below, one can understand why that items 01 and 04, which deal with "sound insulation" generally were ineffective:

1) Injection molding machines not only have a noise generation point, as it has an injection unit and a clamping unit, which is the mold, it ends up having noise generation over its entire length. Consequently, along too units that compose it, we also have control points, and control, which becomes more inefficient deployment of any type of insulation in the machine, is isolated from an area and a non-visually is an aspect "ugly" and without practical effect.

2) Injection work together and in the same area. If we were to isolate the machine by machine, the required area would be much greater than the open area of the installed machines as shown in Figure 1.

**Figure 1.** Plastic injection machine, components of an injection molding machine present in the injection and clamping units.


With regard to direct interventions in machinery, it is represented in the figures below, demonstrations of three types of direct intervention in the noisy source. On the left is the machine with the option of isolation, and on the right a graph showing the noise emitted by the machine behavior, we verify that the most efficient. This study was conducted by Santos et al (1994), machine assembly on a vibration damper:
Figure 2. Rigid shield and mounting of the machine on the vibration damper, there was no effect on noise reduction.


In the first situation, the machine is installed on shock absorbers, and not directly on the floor. This damping system reduces the intensity of the noise by 20 dB in the match; untreated it part of 90 dB, and with treatment he part with 70 dB. However, it was observed that with the load receiving, machine finished with its intensity in the amount of 90 dB, in both cases with and without acoustic treatment. No method was efficient in operation at full load.

Figure 3. Installation of rigid armor and shock absorber on the machine for noise attenuation, good efficiency checked for noise reduction.


Now the second situation where the machine is installed under the buffers and receives a housing (insulated). They were carried out vibration reduction work directly with the soil and the isolation of the emitting source. The performance of the two systems together reduced the noise in the machine also starting at 20 dB without treatment was 90 dB, and with treatment the value reduced to 70 dB. The set proved to be effective when the machine has reached its full capacity, with a difference of 35 dB. The more work less noise disruption, it reduced from 90 dB to 55 dB. Rigid shield with window, with noise attenuation and damping assembly.
In this third and final situation, we will use the dampers, as well as sound insulation, but along with it we have a business window. In both situations starting with and without treatment had the same value of 90 dB. With load receipt, the final value also fell just as the second case. He was 90 dB, and holds 45 dB. A reduction of 45 dB in the machine's noise level at full load. Showing a greater efficiency relative to the first and second cases.

Then are some injection models that exist in the industrial park, and being replaced because of its operating time.

**Figure 4.** Rigid shield installation with attenuation window and anti vibration mounting, showed much better efficiency.


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**Figure 5.** Injection model with depreciation over time and it was replaced.

Figure 6. Injection model with depreciation over time and it was replaced.


Figure 7. New injection less noisy model, which are replacing older models.


GUARDS HEADSET - ADVANTAGES FOR COMPANIES AND WORKERS
The earplugs are the Individual protection equipment preserving hearing health worker. He and other Individual protection equipment, are mandatory and expected use in Instruction No. 6 (NR-6). For businesses, the benefits of using these protectors are numerous. In economic terms, for example, reducing the number of accidents causes the decrease of expenses and safe aid. And also with hiring. From a legal point of view, by requiring their employees to use Individual protection equipment, organizations begin to enforce the labor laws, avoid penalties and are also classified as socially responsible. The low number of accidents in the company can also be used as a powerful marketing tool, improving the company’s image in the market. For the worker, the benefits also exist, mainly with your health is protected, and this

6 It is the Brazilian standard regulating the use of personal protective equipment and training new employees to replace those who were dismissed.
is an item that is important even to achieve better positions in the labor market. For hearing protection shield there are two models:

1. Plug Type;
2. Concha.

For both there are advantages and disadvantages to know:

**ADVANTAGES PROTECTIVE TYPE PLUG**

1. Different models;
2. Compatible with other protective equipment such as masks, respirators, goggles, helmets, etc;
3. They are small and can be easily transported and stored;
4. Comfortable in hot environments;
5. Do not restrict movements in very small areas;
6. As they are inserted, the facial features of the person does not interfere with their seal.

**DISADVANTAGES PROTECTIVE TYPE PLUG**

1. Continuous speech and chewing movements can move the plugs;
2. Before use it is necessary to explain the correct way to insert it to obtain the same effect;
3. Due to its smaller size it is easy to be forgotten or lost;
4. The supervision of its use is more difficult.

**ADVANTAGES PROTECTIVE TYPE SHELL**

1. One size;
2. Placing quick and does not require specific training;
3. All components can be replaced;

**DISADVANTAGES PROTECTIVE TYPE SHELL**

1. Discomfort in warm areas;
2. Due to its size there is some difficulty in handling it during displacement;
3. Demands specific place to be saved;
4. Interferes in the use of other PPE;
5. You can restrict head movement;
6. Difficulty activities in small environments.

There are some companies that use both types at the same time, as in the thermal. Evaluations before and after use of the two models together gave the necessary attenuation so that operators and maintainers need to work within the Machine Room.
CONCLUSION
As described by analyzing the noise sources that exist, our entire body is affected and not just the hearing aid, as is thought by many. It is the duty of every worker the use of Equipments for individual safety provided by the company, mainly to their health protection. The type of PPE, determined by Sesmt, it is also essential so that workers' health is maintained. Its supervision on the use by the company have to be done daily; and taking advantage of the DSD (Daily security dialogue), popularize information about the
benefits that its use brings. With these daily discussions, the use of Equipments for individual safety will gradually passing requirement for a healthy routine, which will be made by the workers.

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