



Noise Reduction Solutions for Medicine Tablets Manufacturing – Specifically in the Sanofi Vietnam Joint Stock Company, HCMC

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Ho Chi Minh City is now considered one of the cities with a high proportion of industrial production, both in scales of operations and the level of technical and technological application, leading in the Southern region of Vietnam. Although the development of industrial manufacturing brings many economic and social values in this area, it also affects the quality of life and weakens the health of workers.

According to reports on occupational hygiene and health care for workers at enterprises, the current situation of working environment pollution, in which noise pollution at construction sites and manufactures remains many problems and no complete solution. Working noise is one of the common harmful factors that often causes occupational deafness when workers are in contact for a long time. Noise often arises due to the characteristics of production technology, old and outdated machinery, and working equipment.

This article focuses on analyzing and evaluating the current situation noise of the medicine tablets manufacturing of Sanofi Vietnam Joint Stock Company in Ho Chi Minh City, that uses production equipment such as vibrating screen machines, tablet presses, and compressed air blowers. At the manufactory, they generate high noise level that exceeds the allowable standard according to the working time and can affect workers' hearing health. According to measurement data recorded at the position of workers standing at the tablet press, the highest noise measurement result is 90.4 dBA (Leq). Therefore, based on the process of analyzing and evaluating the cause of the noise, the authors proposed a solution to add a silencer made of brass (SL) which is suitable for an air outlet of the tablet press and equipped with an acoustic form on the wall to reduce the noise level of vibrating screen machine. And so, the result of the proposed solution is a noise at the locations to be treated has decreased compared to the original measurement level from 10dBA – 15 dBA, adapt to the standards enable and improving the working environmental quality, and prevent harmful factors causing occupational deafness for workers.

Keywords: noise volume, silencer, occupational deafness, occupational health, Sanofi Vietnam Joint Stock Company in Ho Chi Minh City

1. Introduction

Pharmaceutical manufacturing and medical devices are one of the industries focused on investment and development in Vietnam. Currently, besides the application of scientific and technological advances in production are the development of solutions to protect the safety and health of workers in the process of working. In the past, the production often focused on issues to ensure the quality of pharmaceuticals and medical equipment in accordance with the relevant requirements, such as machines and equipment, factory premises, materials should be appropriate, not affect the product. Therefore, if in working conditions there are dangerous and harmful factors that may adversely affect the employee, the employer will prioritize the settlement at the end of the priority order in the safety solution tower, such as the solution of administrative management, labor organization or equipped with personal protective equipment. Therefore, it is not possible to achieve the meaning of occupational safety and health work, which is worker-centered, the means and tools of labor must be suitable for workers, but especially this is a manufacturing industry with health care products and treatment of human diseases. [8]

Pharmaceutical production is characterized by means and tools of production must comply with strict hygiene standards to ensure product quality, so most factories set up automated or semi-automatic systems to be able to control and manage

well. Therefore, it also limits the number of workers exposed to dangerous and harmful factors. However, through the process of surveying pharmaceutical factories and production facilities, the authors found that the outstanding problem of working conditions can adversely affect the health of workers but high noise from the production line of tablets and bottle stamping. Loud noises in production have been identified as the main cause of occupational deafness.

Occupational deafness is an occupational disease caused by frequent exposure to noise that exceeds the permissible limit for long periods of time at the place of manufacture, causing irreversible damage to the inner ear organ, which is a covered occupational disease in Vietnam.

Usually, the mechanism of occupational deafness due to noise progresses through 3 stages. The first is the auditory adaptation phase, which manifests it after a period of exposure to noise, the worker has the phenomenon of auditory adaptation to prevent the auditory organ from being damaged. At this stage the hearing threshold usually increases (10-15dBA) when exposed to noise. When you stop contact, the hearing threshold quickly returns to normal (after 2-3 minutes). This stage is difficult to detect; The second is the period of hearing fatigue, which manifests it through the employee's hearing threshold increases over the auditory adaptation stage (15-30dBA). The recovery time is slower (usually from 15 to 30 minutes), the auditory organ begins to reduce sensation with

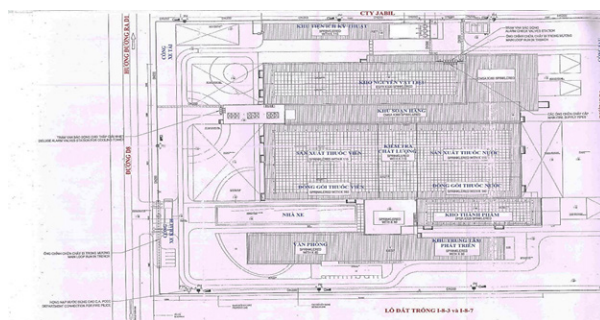


Fig. 1. Factory premises diagram
Rys. 1. Schemat pomieszczeń fabrycznych

Tab. 1. Results of noise measurement of locations exceeding allowable standards [2]
Tab. 1. Wyniki pomiarów hałasu w lokalizacjach przekraczających dopuszczalne normy [2]

Monitoring location	Leq	Sound pressure level in octave bands with center frequency (Hz) not exceeding (dB)							
		63	125	250	500	1000	2000	4000	8000
Utilities									
Boiler (U-4)	85.6	53,1	66,3	74,2	78,4	79,6	80.8	76.3	68,5
Pure Water (U-15)	86.8	44,3	56,1	69,0	73,8	78,2	83.4	81.0	75.2
Pills/tablets									
Stamping (SP-36)	90.0	48,0	60,9	73,9	82,7	85.1	84.4	81.2	76.6
Stamping (SP-66)	90.4	52,5	69,7	78,2	81,1	81.4	84.3	86.3	76.8
Stamping (SP-37)	85.7	43,5	63,0	74,1	80,2	81.2	78.9	75,0	66,1
Stamping (SP-54)	86.9	58,0	64,4	73,1	79,5	82.1	78.5	80.3	75.4
Pills/tablets									
Blister packing (82)	86.9	52,4	61,6	69,4	76,3	77,4	81.6	81.8	79.1
Blister packing (102)	87.5	56,8	67,9	75,0	77,4	77,9	82.0	82.3	79.0
Packaging (SP-94)	85.4	55,5	64,5	71,8	76,1	76,0	79.3	79.5	77.4
Packaging (SP-98)	85.3	42,9	62,0	73,7	79,3	80.8	78.1	73,3	63,6
Solution									
Bottled Jasper 2000L (LC-23)	90.3	58,7	69,5	73,4	75,1	77,2	79.0	84.5	83.2
Solution									
Jasper Packing 2000L (LC-24)	87.2	40,0	49,9	60,3	69,1	74,0	78.5	83.0	82.7

sound (decreased hearing) especially the sounds at the frequency of 4000 Hz. If detected at this stage, it can interfere with the phenomenon of developing to the deaf stage. However, detection is often difficult; The third is the occupational deafness phase, manifested through workers who have had irreversible lesions in Corti organs and auditory nerves in the inner ear. Speaking out loud is also difficult to hear; patients with tinnitus regularly, difficulty talking; Reduce hearing at all frequencies. With such an effect on hearing, workers will be limited in the process of earning information, safety warning signals when working, possible incidents or occupational accidents. At the same time, it also affects the quality of life of the worker. [1]

In addition, when workers work regularly and prolonged in places with high noise levels, it also affects other organs, such as physically, workers feel full-body fatigue, headache, dizziness, bad eating, anemia, weight loss, high blood pressure, vestibules damage, balance disorders, movement; Psychologically, workers feel depressed, anxious, resentful, fearful, distracted thoughts and thoughts, insomnia, confusion, inaccuracy, easy conflict; Workers are also likely to have a vegetative neurological disorder manifested through increased heart rate, increased respiration, altered blood pressure; Changes in gastrointestinal movement, salivation, basic metabolism, decreased taste secretion, affecting the contraction of the stomach; Eyes reduce night vision, poor color difference, decreased adaptation. With the basis analyzed above, the team conducted a case study at a pharmaceutical factory with tablets and bottling lines to collect information and measurements of noise levels to analyze and determine the cause to find the most feasible solution to reduce noise levels. The

purpose of the study is to both ensure pharmaceutical production requirements and protect workers' health.

2. Methods

2.1. Study area

Sanofi is a French multinational pharmaceutical company, has been present for more than 25 years in Vietnam and now has 3 manufacturing plants in our country with modern technology lines, large production scale, diverse products in many medical fields, also surveyed, Study the working environment conditions of factories in Vietnam to bring about root solutions to improve working conditions and ensure safety and health for workers. Sanofi Vietnam joint stock company holds the number one position in the market in Vietnam, leading in the categories of prescription, over the counter and vaccine pharmaceuticals. As a pharmaceutical company, the work of occupational safety and hygiene at the factory is always focused to ensure the quality of products and working environment for employees. Harmful factors in the working environment through periodic measurements are largely within the permissible limits of the prescribed standard. However, the problem that still exists here is the noise level when measured at the lines and equipment producing tablets, which have the potential to cause distraction, psycho physiological effects and adversely affect the hearing of workers when working regularly and prolonged in this position.

With a total area of 72.397,5 m², Sanofi Vietnam factory located in District 9 Hi-Tech Park started production in 2015, there are 03 main production technology lines to serve the production of pharmaceuticals, cosmetics, and functional foods. The entire production processes of the project are arranged in

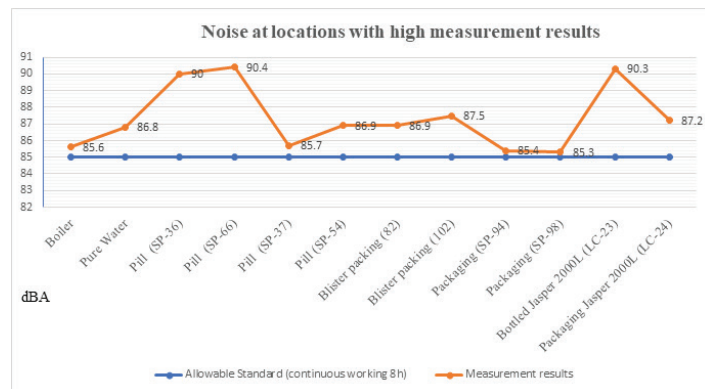
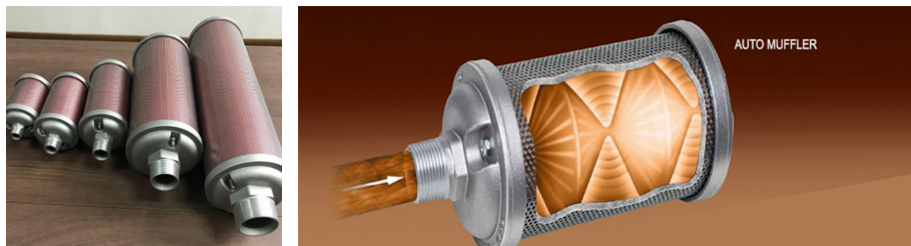


Fig. 2. Results of high noise levels after measurement

Rys. 2. Wyniki pomiarów poziomu hałasu w lokalizacjach o największym natężeniu hałasu



Img. 1. Example of silencers (sound-absorbers). Reference at <https://3dtoancau.com/loc-tieu-am-xy-15-dung-cho-may-say-khi-hap-thu/>

Zdj. 1. Przykład tłumików (pochłaniaczy dźwięku)

closed rooms, strictly controlled by high-tech technology, and corresponding to each room is a stage in the process. Therefore, the company's production stages are carried out, monitored, and controlled automatically, including dry product production technology (capsules, capsules, tablets, powder); technology for producing liquid/semi-solid products; high-tech production technology – granule medicine. [2]

The characteristics of the production line and equipment here are automatic so the noise generated during the production process is mainly from machines and equipment. Loud machines noise affects workers' health and can also hinder concentration and reduce employee productivity, ultimately having an impact on the company's bottom-right. Although at the factory still take some measures to improve noise such as earplugs, earplugs; Maintenance of machinery, but the efficiency is not high, the noise level is not reduced, so it still affects the health of workers.

The total number of employees in Sanofi is 404 people, including people working in occupational safety and hygiene are 03 people; The person doing medical work is 02 people; Female workers are 216; Labor working in heavy, toxic, and dangerous conditions (occupational conditions of type IV, V, VI) is 158 people; Working time at the factory 03 shifts, each shift 8 hours. When adjusting the product structure and adding new products, the working time is constant.

2.2. Data collection

Noise measurement principles are followed "Vietnam Standard 9799:2013 (ISO 9612:2009) Acoustics – Determination of occupational noise exposure – Engineering method" and "Method 1910.95 App G (OSHA – Monitoring noise levels)".

Noise monitoring time: The continuous measurement time of each measurement is 10 minutes, within 01 hours make a minimum of 03 measurements, after a take averages

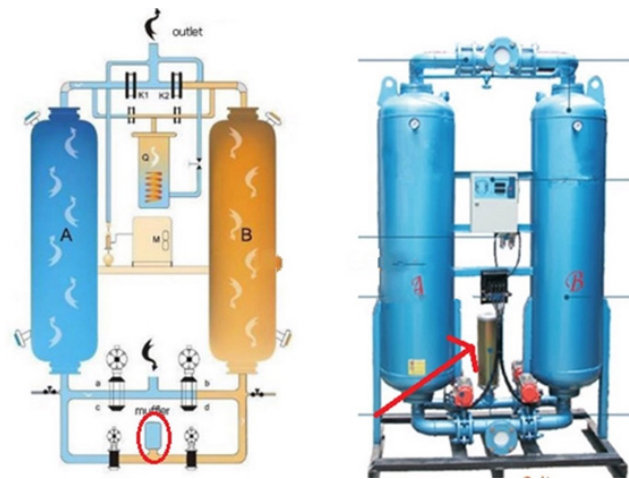
value of 03 measurements. The results are the average value of that hour measured.

For noises generated from production facilities affecting the outdoor environment, measurements must be conducted during working hours. [6], [7]

3. Results and Discussion

The results after the measurement were compared to NTR 24:2016/MOH collected 12 working positions with noise exceeding the standard and 59 working positions meeting the requirements of the standard, of which the positions of the stamping machine SP-36, SP-66 and LC-23 bottling machine had the highest noise levels. The HSE department at the plant must continue to improve and develop noise reduction measures in 12 work locations exceeding allowable standard, if the noise level exceeds the standard for a long time, it will affect the hearing health of employees and the compliance with the provisions of law.

Causes of noise in each substandard area, including in the utility area there is a boiler (U-4), when the boiler in the U-4 position operates the parts, the engine in the boiler moves leading to noise. Depending on the structure of each boiler, the level of noise generated varies. This mechanical noise is required to be generated when the boiler is operating and the noise of some nearby boilers with a measured noise of 85,6 dB exceeds the allowable standard of NTR 24:2016/MOH. Considered an area with high noise, when working nears this area, ear protections must be used. Frequency of contact of employees when starting the furnace, recording parameters; In purified water purifiers (U-15) there are water pumps with different capacities when the operation takes water through each stage to meet the water filtration process that will generate noise, which is the mechanical noise that must be generated when the pump is operating. In addition, the general



Img. 2. Simulation when installing sound absorber [9]

Rys. 2. Symulacja montażu pochłaniacza dźwięku [9]

noise of filters, machines operate when filtering water. With multiple sources of noise generated at the same time, the pure water production area (U-15) has a measured noise of 86,8 dB exceeding the NTR 24:2016/MOH requirement of 1,8 dB. Frequency of employee contact when recording waters quality parameters; In the tablet-stamping area (SP-36) for Panadol Extra tablets, the noise emitted is the obligatory mechanical noise that arises when the stamping unit moves up and down. After that, the tablet is put through the sieve machine to separate the dust of the pill, clean the tablet. Depending on the drug material, the amount of dust produced varies. The amount of drug dust generated must increase the capacity of the sieve, resulting in the greater the vibration of the sieve, resulting in a high noise intensity. In addition, there is general noise when machines and parts are operating at the same time. With many high-powered machines operating at the same time, the noise emitted by the stamping room (SP-36) is 90 dB exceeding the permissible standard of NTR 24:2016/MOH of 10 dB. The frequency of employee contact is continuous throughout the shift. The number of employees working in this stamping room are 02 people / 01 shift / 08 hours; The tablet stamping machine (SP-66), like the stamping room (SP-36), the pill product in this room is also Panadol Extra. The noise generated in the stamping machine is also from the up-and-down movement part of the stamping machine. The sieve machines in the SP-66 room have been built, the technology of the parts has been for a long time, so the noise is greater than in other stamping rooms. Panadol Extra produces more dust than other pills. Therefore, the sieve always increases the operating capacity to screen for dust clinging to the tablet leading to vibration and noise from the sieve machine. In addition, general noise comes from parts of the stamping machine and the sieve machine. The noise of the stamping room (SP-66) is 90,4 dBA, which is also the room with the highest noise at the factory. The frequency of exposure of employees to noise continuously throughout the shift, the number of employees working in the stamping room (SP-66) are 02 people / 01 shift / 08 hours.

The authors, after researching the specifics of production, technological processes, and existing conditions, have proposed a solution that is to install silencers (SL) for compressed air machines and equip additional sound-absorbing

wall panels (acoustic form) in rooms where machines with measurement values greater than 85 dBA are located. Install silencers (sound-absorbers) for air compressors. Silencers are installed in Compressed air blowing dust from bottles (noise reached to 90,3 dBA).

Silencer should be made of copper or stainless steel, it has certain durability, long life and easy clean and can work in different environment with high pressure and temperature. [9]

Installing a muffler filter for an absorbent air dryer helps to reduce 85% of the noise emitted by the air compressor, making the working environment for more workers' health and fresher. Operating principle is the gas escapes, if discharged directly through the throat to the outside, the noise level will be high, but when it goes through the absorber filter, the air will be blocked through the filter layers and the sound will dissipate by an absorber and noise are reduced. Sound absorbers can be made from porous materials or resonant structures, and the main mechanisms for sound absorption are acoustic impedance matching on the absorbers' boundary and acoustic energy dissipation inside the absorbers. Porous absorbers are materials where sound propagation occurs in a network of interconnected pores so that viscous and thermal effects cause acoustic energy to be dissipated. Resonant absorbers have two common forms membrane/panel absorbers.

Calculating the noise reduction effect after installing the sound absorber in the air compressor according noise reduction rating (NRR = 85%). The measured noise is: $(85\%) \times 90,3 = 76,6$ dBA. This noise is in allowable standard (< 85 dBA). [3]

To increase the efficiency of noise reduction, other solutions can be used at the same time such as encourage your employees to wear earmuffs while working to help reduce the effect of the noise. Considering their low cost, you can even supply these earmuffs to workers. They should be worn just before the air compressor is activated. While this may be harder to pull off for industrial air compressors, it is still an option worth considering, depending on the layout of your workspace and if there are any provisions for the constructing of a soundproof air compressor enclosure. The inside of such a room or enclosure should be padded with convoluted foam boards to help absorb most of the noise. Sound blankets are typically made from quilted fiberglass, popularized through their use in recording studios. They can also be used to wrap around your industrial

air compressors to help further reduce noise levels. Alternatively, they can be wrapped around the outside of a soundproof room or enclosure for further affect. [5]

4. Conclusion

With the solution of installing sound absorber at the blown throat of the air compressor has significantly reduced the noise emitted during work. Depending on how the device emits noise, choose solutions to suit the actual situation of the

business, the most important is to protect the hearing health of workers during long periods of exposure to high noise.

Excessive noise levels over a long time will damage the hearing. This may happen so gradually and painlessly that you may not notice the minor deterioration from one day to the next. Excessive noise in the workplace presents a risk of hearing damage and other health problems. So, we must propose some key solutions to reduce noise pollution as much as possible to protect occupational health for employees.

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Rozwiązania do redukcji hałasu w procesie produkcji tabletek medycznych na przykładzie wietnamskiej spółce akcyjnej Sanofi HCMC

Ho Chi Minh City jest obecnie uważane za jedno z miast o wysokim udziale produkcji przemysłowej, zarówno pod względem skali działalności, jak i poziomu technicznego i technologicznego, przodujące w południowym regionie Wietnamu. Chociaż rozwój przetwórstwa przemysłowego niesie ze sobą wiele dodatnich wartości ekonomicznych i społecznych w tym zakresie, to jednak wpływa również na jakość życia i osłabienie zdrowia pracowników. Według raportów z zakresu higieny pracy i ochrony zdrowia pracowników w przedsiębiorstwach, obecna sytuacja zanieczyszczenia środowiska pracy, w którym hałas na budowach i w zakładach produkcyjnych pozostaje problemem który nie ma pełnego rozwiązania. Hałas w miejscu pracy jest jednym z powszechnych szkodliwych czynników, które często powodują głuchotę zawodową. Hałas często powstaje z powodu charakterystyki technologii produkcji, starych i przestarzałych maszyn i urządzeń roboczych. Niniejszy artykuł skupia się na analizie i ocenie aktualnej sytuacji hałasu produkcji tabletek leczniczych w Sanofi Vietnam Joint Stock Company w Ho Chi Minh City, która wykorzystuje sprzęt produkcyjny, taki jak przesiewacze wibracyjne, tabletkarki i dmuchawy sprężonego powietrza. Fabryka generuje wysoki poziom hałasu, przekraczający dopuszczalne normy i mogące wpływać na zdrowie i słuch pracowników. Według danych pomiarowych zarejestrowanych na stanowiskach przy tabletkarce, najwyższy wynik pomiaru hałasu to 90,4 dB(A). Dlatego też, opierając się na procesie analizy i oceny przyczyny powstawania hałasu, autorzy zaproponowali rozwiązanie polegające na dodaniu tłumika wykonanego z mosiądzu (SL) odpowiedniego dla wylotu powietrza z tabletkarki i wyposażonego w wytłoczkę akustyczną na ścianą, aby zmniejszyć poziom hałasu wibrującej maszyny przesiewającej. I tak, efektem proponowanego rozwiązania jest zmniejszenie hałasu w miejscach poddawanych zabiegowi w stosunku do pierwotnego poziomu pomiarowego z 10dB(A) - 15 dB(A), dostosowanie do norm jakości środowiska pracy oraz zapobieganie szkodliwym czynnikom powodującym głuchotę pracowników.

Słowa kluczowe: natężenie hałasu, tłumik, głuchota zawodowa, higiena pracy, Sanofi Vietnam Joint Stock Company w Ho Chi Minh City