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Noise Level in Textile Industries: Case Study Al-Hillah Textile Factory-Company for Textile Industries, Al-Hillah-Babylon-Iraq

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Abstract

In this study, Al-Hillah Textile Factory, in Al-Hillah city-Iraq follows to State Company for Textile Industries was selected to study the intensity of noise in 2014. Measurements of the noise level were carried out in different workshops for each of the production stages including the spinning machinery workshop (parts 1 and 2), the rotating machinery room, the preparations room, and the textile machinery room (Roti model), weaving machines: Techmash model room Russian-made model room, Sheets' machinery room, and operator machines room; using two noise meters (model 2237 Fulfici). Fifty samples were collected in each part of these rooms to give realistic results for the noise level. After recording the noise level data, the highest and lowest values and the average of noise intensity readings were calculated in each of the rooms and compared with the global standards permitted by the EPA for industrial facilities. The results of this study showed that the general rate of noise intensity in all rooms exceeded the permissible limits, which impose a noise level of 65-70dB for such industrial establishments according to EPA recommendations in 2008.

Keywords: Industrial, Noise, Textile Factory; Machines, Al-Hillah Textile Factory, Al-Hillah-Babylon-Iraq

1. Introduction

There is no doubt that the circumstances surrounding the work greatly affect the performance of workers, quantity, and speed of production. Some of these conditions can facilitate work performance and others may hinder it. A person's behavior may be considered as a product of the interaction of two sets of variables. The first one consists of the personal characteristics, such as abilities, qualifications, mental and

emotional habits of response, like attitudes, opinions, and beliefs. The second set of variables are represented in some characteristic features of the workplace itself as part of the surrounding environment called working conditions.

Industrial psychologists argue that there are three categories of working conditions: natural conditions (lighting, noise, ventilation, and temperature), time-related conditions (working hours and breaks), and social aspects concerning the work situation (McCormick & Ilgen, 1981; Ernest et al., 1985; Bruel & Kjaer, 2001).

Many Industrial psychologists studied deeply these three categories of work conditions that led to providing the available information about the work-facilitating environment that the workplace needing to increase productivity and provide worker psychological comfort. Therefore, the mentality of such studies has changed that uncomfortable workplace has negative impacts like reducing productivity, increase of mistaking and rate of accidents, and leave the workers their job (Gharib, 1988).

Noise is a type of pollution that was classified as harmful to human health, animals, birds, plants, and others. The problems of noise pollution are increasing on daily basis, especially in crowded urban areas, mining vicinities, highways, airports, industrial zones, and other areas where there are construction movements or projects (Atmaca et al., 2005).

Noise is a sub-category of air pollution that emits in the form of waves as the term "noise" is derived from the Latin "NAUSES." There are many different definitions of noise. For example, the British Encyclopedia defines it as "unwanted sound" and the American Encyclopedia defines it as "undesired sound." Noise pollution depends on the extent to which the human ear can absorb it because some can tolerate noise in different proportions. It also depends on psychological factors. In other words, any sound that produces noise is annoying and, from the legal point of view, known as air pollution, that inflicts physical harm to humans (Al-Shawky, 2011). There are two types of factors affecting the work environment (Gharib, 1988). The first factors are the normal noise environment. The workplace with a noise level of 50-62 dB is considered safe for noise levels in various work environments (McCormick & Ilgen, 1981; Ernest et al., 1985; Bruel & Kjaer, 2001). The second factors are a high noise environment that consists of a workplace that has a noise level of 80dB or higher (Schultz, 1978; Schultz, 1986).

For Previous Literature, many studies have been conducted on noise impact on humans and future effects. Jorkman et al. (1980), was conducted a laboratory measurement of annoyance resulting from different noise sources and determine individual differential in the individuals' assessments of persons themselves subjective to the noise. The test group consisted of 40 students from the Medicine School (20 males and 20 females) with an average age of 25 years and 5 months. The study tools included sound-record tapes of four noise sources (large trucks, airplanes, motorcycles, and trains), as well as questionnaire papers. The noise level at the end of the experimental room was 36 dB, while the peak noise resulting from the passage of any of the four vehicles ranged between 70dB to 80dB. the people that participated in the questionnaire with the noise of 36 dB said their home environment was quiet, and they were felt less disturbing during the experiment than the people (with the noise of 70 to 80 dB) who indicated in their responses that their home environment was noisy.

Glass and Singer (1972) studied the investigate of physiological, performance, and psychological effects of noise on workers. Two equivalent groups were selected (experimental and control) and the experimental group was asked to perform a variety of activities in a situation of generating intermittent noise of 108dB. Noises were voices of two people speaking Spanish and a third person speaking English, sounds of a weaving machine, a calculator sound, and a typewriter sound. Two styles were used in the presentation of noise. First, the noise was presented intermittently. Second, the noise was presented in an

intermittent random way. Additional measures were used including the appearance of a warning light that alerts the subjects to the coming noise and informing the subjects that they can stop the noise if they press a certain key. The measurements of the subjects' responses included a nervous system test by General Service Representative (GSR), vascular contractions in the fingers, and muscle contractions. The results of the study showed that the different conditions of the expected, unexpected, and perceived noise by the persons with the ability to control noise caused tension as an initial response that exceeded the amount of tension in the group of persons who were not exposed to the noise.

Glass and Singer (1972) studied the behavioral effects resulting from noise on workers after the noise stops (behavioral effects). many persons were exposed to noise waves, and after finishing the noise waves, they were given additional duties to perform such as measuring frustration tolerance, which is attempting to solve a series of puzzles, where two of which were unsolvable. The dependent variable in this part of the experiment was: the number of attempts subjects try to solve the two puzzles. The second duty in the study was for the persons to perform a proofreading process, whereby they had to read and underline the wrong words on a typewritten paper. The results of the study showed that performance after noise exposure was unexpected, where the persons in this experiment could not control their performance and behavior. Moreover, the experiment was given negative effects on persons, and their ability to withstand frustration, as well as the efficiency of the reading and correction processes were decreased. Furthermore, the results also indicated that persons who realized that they could not bear the noise felt more distressing and anxious by comparing them with the subjects who were allowed to control the noise. From above, it becomes clear that noise has harmful effects on the psychological stability of workers in the textile industries, as well as an effect on the physiological aspect, especially hearing loss. For this reason, the subject of the study was chosen because of the importance of this topic in knowing the performance of industrial processes in the chosen facility and the effect of noise on the psychological and physiological conditions of the employees.

2. Theoretical Framework

To define the noise, it is necessary to distinguish between the words *sound* and *noise*, where that the *sound* is the result of changing in air pressure that ears are picked up. The physical characteristics of sound are frequency and intensity. Psychologically, these two characteristics are conventionally equivalent to pitch and noise or loudness/noise. Frequency is expressed by child protective services (CPS) and noise intensity is measured with a logarithmic unit called decibel (dB) (McCormick & Ilgen, 1981; Ernest et al., 1985; Brüel & Kjaer, 2001). The word noise is a psychological concept indicating an unwanted, undesired, and unbearable sound that causes hurt to the ears. A very loud sound may be considered by some people as an unacceptable thing, while others see a low sound as a source of noise (Cohen, 1981).

In fact, the noise effect is not equal to what can be caused by tightness, discomfort, and stress because the effect of noise depends on several factors including the characteristics of the noise itself. One of the most important characteristics of noise is the way it occurs, meaning that it is either continuous and static or intermittent. Intermittent noise is more disturbing than continuous or static noise because humans can be adapted to the last type (Schultz, 1978, Schultz, 1986). The second characteristic of noise, which determines the amount of annoyance or distress it causes to a person, is familiarity. The third characteristic is acoustic oscillations, and the fourth is how important noise is to work.

2.1 Definition of Noise

Noise is unwanted sounds caused by the vibration of bodies and affects in one way or another the general health and the quality of the daily life of human beings. Noise intensity the human ear is exposed to is

measured with the decibel "dB", which is calculated as the difference between the logarithmic pressure in of the sound the intensity of which is to be measured (A) and the lowest sound pressure (P_0) the human ear can hear (20 Micro Pascals), as determined by a measuring device conforming to the international standards ISO-176 (2005) (Yassin, 2005).

Noise has physiological and psychological effects that harm an increasing number of people daily. The rapid urban growth has helped increase the intensity of noise and exacerbate this problem. International research and studies have proven that a certain increase in noise leads to deafness, and scientific research facts have proven that the intensity of noise causes heart pathological disturbances that abound in cities affected by noise pollution.

a. Standards of exposure to Internal Noise Levels

according to the requirements of EPA (2008), the permissible limits of noise levels in various places within buildings of various industrial facilities shall be based on dB(A) noise level (**Table 1**) (Yassin, 2005).

Table 1. Permissible limits of noise levels in buildings of various industrial facilities (Yassin, 2005; EPA, 2008).

Internal space/Activity	The recommended noise level in dB (A)
Type of room: industrial facility	
Laboratory, measurement, or inspection room	55
Repair workshop	65
Manufacturing and power generation rooms	87

The limits of the permissible noise levels in the various places within the buildings of the industrial facilities are based on the noise level dB (A) as shown in **Table 2**.

Table 2. Permissible noise levels limits in the various places within the buildings of the industrial facilities (<https://www.enoshmink.com/author/ibrahim/page/3/>).

Permissible noise levels limits dB(A)	Type of room
35 – 40	Conference room
40 – 45	Offices
45 – 50	Workshop offices
50 – 55	Laboratory, measurement, or inspection room
60 – 65	Repair workshop
50 – 55	Canteen
85 – 90	Manufacturing places and power generation rooms

Table 3 shows the limits of noise levels that can workers expose to them inside factories and the permissible exposure time according to the Occupational Safety and Health Administration (OSHA, 1970) (<https://www.enoshmink.com/author/ibrahim/page/3/>).

Table 3. Noise level/work hours (OSHA, 1970).

Exposure time	Noise Level (L_{eq}) dB(A)
8 hrs.	85
6 hrs.	87
4 hrs.	90
3 hrs.	92
2 hrs.	95
1.5 hrs.	97
1 hr.	100
30 min.	105
1 min.	115

Work hours range in the companies of Iraqi Ministry of Industry and Minerals between 6 to 8 hours per day (6 hours in the present time, but the official work hours approved by the Ministry are 8 hours), so the noise level allowed for workers to be exposed to for 8 hours ranges between 85 and 87dB according to OSHA requirements.

2.2Impacts of Noise Pollution

Studies indicate that noise pollution may cause unbalanced reactions, such as mental distraction, inability to concentrate, high blood pressure, and excessive secretion in some glands, which causes high blood sugar, ulcers, headaches, fatigue, and insomnia. Also, some studies made by Austrian scientists indicate that human lifespan is less than 8 to 10 years in large cities compared to rural residents due to noise pollution. In Los Angeles, studies have shown that blood pressure in school children near the airport is higher than that of school children that are far from it, and their speed of solving mathematical problems is less, and when they fail to solve the problem, they quickly throw it aside and do not try again. According to the results of some studies published in England, one of four men and one of three women suffer from noise-related diseases (Atmaca et al., 2005). A scientific study also reported that exposure to loud noise for long periods may increase the possibility of a tumor in the nerve that connects the ear to the brain and is associated with hearing loss, tinnitus, dizziness, or loss of balance. Researchers conducted interviews with 146 patients and 564 healthy people who were subject to observation regarding the types and duration of exposure to loud noise. Exposure to loud noise, which was defined as exceeding an average of 80 auditory units, was associated with a significant increase in the differential of auditory nerve tumors. The study added that the groups most vulnerable to these tumors are those whose owners are exposed to the noise of machines, electrical machines, construction equipment, and music, including those who work in the music industry. The study authors indicated that the possibility of infection related to exposure to noise was found in both men and women, but there was no risk of developing tumors in the auditory nerve, with exposure to loud noise when using means to protect hearing.

As for the effect of noise on heart disease, German researchers confirmed that exposure to loud noise in the street and the workplace can increase rates of heart disease. A research team from the University of Cariete Medical Center in Berlin conducted a study that showed that noise increases stress levels that can cause changes in the body. Researchers compared more than 2,000 patients who had heart attacks in 32 hospitals in Berlin between 1998 and 2001 and others who were hospitalized with injuries or injuries. To perform general surgeries. For his part, Stefan Wallach, Director of the Institute of Social Medicine, confirmed that the noise pollution caused by traffic and aviation increases the risk of a heart attack by about 50% for men and by a greater percentage for women. This is why the study team advises reducing

the permissible noise levels in the workplace to avoid the risk of noise pollution and the associated diseases. (Atmaca et al., 2005).

2.3 Types and Effects of Noise pollution (Arnaoot, 1999; Saber, 2000).

a) Chronic Pollution

It is continuous noise exposure, and it causes permanent hearing impairment.

b) Temporary Pollution with Physiological Damage

It is the exposure to noise source for limited periods like exposure to fireworks and it causes internal damage to the ear.

c) Temporary Pollution without Damage

It is an exposure to noise for limited periods like exposure to urban noise and workshops and it causes temporary hearing impairment which goes away after a short while.

Sound intensity is measured as we mentioned with the dB unit and as such all sounds, we hear daily are categorized according to main levels by use of the dB:

- I. **40-50 dB level:** This level causes reverse reactions like stress and anxiety as it affects the cortex, which leads to unrest and health disorders.
- II. **60-80 dB Level:** this level has negative effects on the nerve system and leads to severe headaches, bad work performance, and nightmares.
- III. **90-110 dB Level:** This level causes hearing impairment and disorders in the nerve and cardiac systems.
- IV. **Over 120 dB:** This level causes pain in the ears, severe cardiac disorder, and loss of sound recognition and direction.

3. Methodology

3.1 Study Area

Al-Hillah city is one of five big cities of Babylon Governorate and it is located on the bank of Shatt Al-Hillah River about 100 km to the south of the capital of Iraq (Baghdad) (<http://www.sctl-iq.com/language/en/about-us/>). The population of Al-Hillah city is around 910,000 inhabitants in 2017 (Iraqi Ministry of Planning, 2017), and its area is 860 km². Al-Hillah Textile Factory is situated at 3 km to the south of Al-Hillah city.

Al-Hillah Textile Factory is one of the formations of the State Company for Textile and Leather Industries-Iraqi Ministry of Industry and Minerals, and it was established in 1967 under the name of The State Company for Fine Fabric in Al-Hillah to produce 40 million meters of different types of textile, and its production began in 1970. Recently in 2015, the State Company for Textile Industries was merged with the State Company for Leather Industries under the name of the State Company for Textile and Leather Industries (<http://www.sctl-iq.com/language/en/about-us/>). Al-Hillah Textile Factory includes Administrative part, Al-Hillah Textile Factory, Babel Shamwa Factory, and woven and plastic bags factory. For the State Company for Textile Industries / Al-Hillah, it includes, in addition to the previous sections, Plastic Bags Factory/Al-Saddah-city, Diwaniyah Textile Factory, Medical Cotton Factory, and Medical Products, as well as Najaf Clothes Factory. The number of employees in the State Company for Textile Industries / Al-Hillah and the Al-Hillah Textile Factory are 4808 and 1536, respectively (<http://www.sctl-iq.com/language/en/about-us/>). **Figure 1** shows the organizational structure of the

Company for Textile Industries-Al-Hillah the workers' numbers at each factory (<http://www.sctl-iq.com/language/en/about-us/>).

Eleven rooms were selected within the Al-Hillah Textile Factory, Hillah city, Babylon, Iraq to represent all different stages of production. Samples were taken in every part of these rooms to measure noise level and to give a realistic view of the noise level that workers are exposed to. These rooms were weaving machines (stages 1 and 2), rotating machines, preparation machines, Roti-model machines, Techmash-model weaving machines, textile machines, Russian textile machines, Shamwa textile machines, operator machines.

Al-Hillah district occupies an area of 860 km², which constitutes 16.1% of the total area of Babylon Governorate. In 2017, the official population of Al-Hillah district was approximately 909,000 inhabitants (Iraqi Ministry of Planning, 2017).

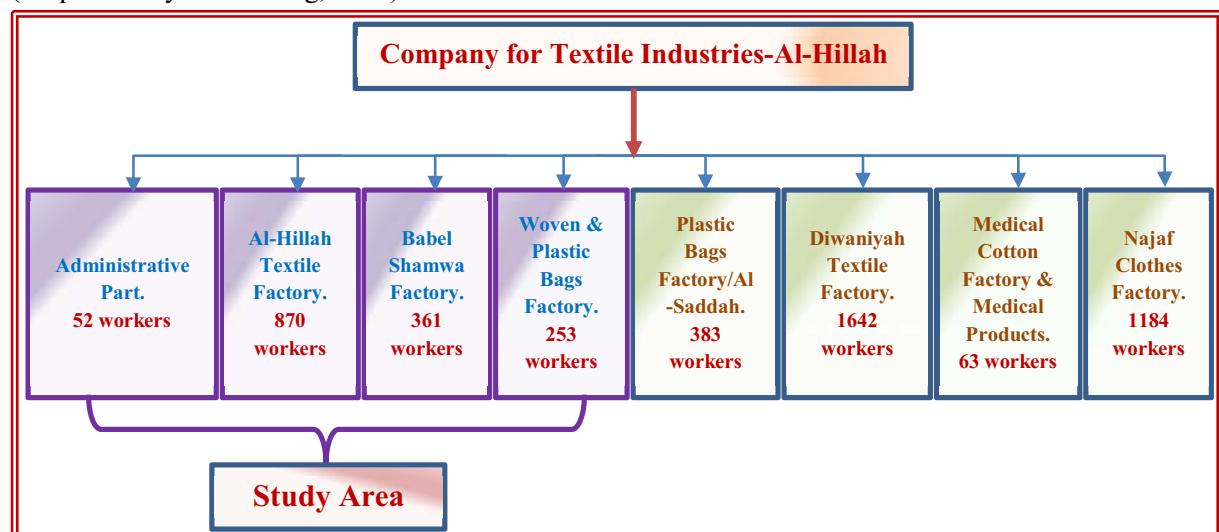


Figure 1. Organizational structure of Company for Textile Industries-Al-Hillah the workers' numbers at each factory (<http://www.sctl-iq.com/language/en/about-us/>).

3.2 Apparatus

The study used two Fulfici-2237-model devices to measure noise intensity (**Figure 2**).



Figure 2. The device of measuring noise intensity (Fulfici-2237-model).

4. Results and Discussion

For Eleven rooms in the State Textile Company in Hillah city, forty readings were taken in each room (a total of 440 readings) throughout the company and during the entire official working hours, i.e., between 7 AM and 1 PM.

shows that the highest reading was recorded in the Roti textile machines (118dB), which exceeded the EPA limits (85dB) and also exceeded the time of exposure of the worker to noise according to OSHA (87dB) considering that working time is 6 hours (**Figure 3**). This is due to these types of machines are ancient.

Figure 3 shows the highest readings recorded in the production rooms were (91dB) in spinning machinery stage-1 and stage-2, (97dB) in rotating machinery, (90dB) in preparation machinery, (96dB) in Techmash- machinery, (94dB) in textile machinery, (93dB) in Russian textile machinery, (91dB) in Shamwa machinery. All machinery types were exceeded the EPA limits (85dB) and also exceeded OSHA exposure time for workers (87dB) in a working time of 6 hours.

The highest reading recorded in the operator's machine room was (78dB), which is within the permissible limits because these machines generate low noise intensity and have low capacity compared to other machines used in large-capacity production.

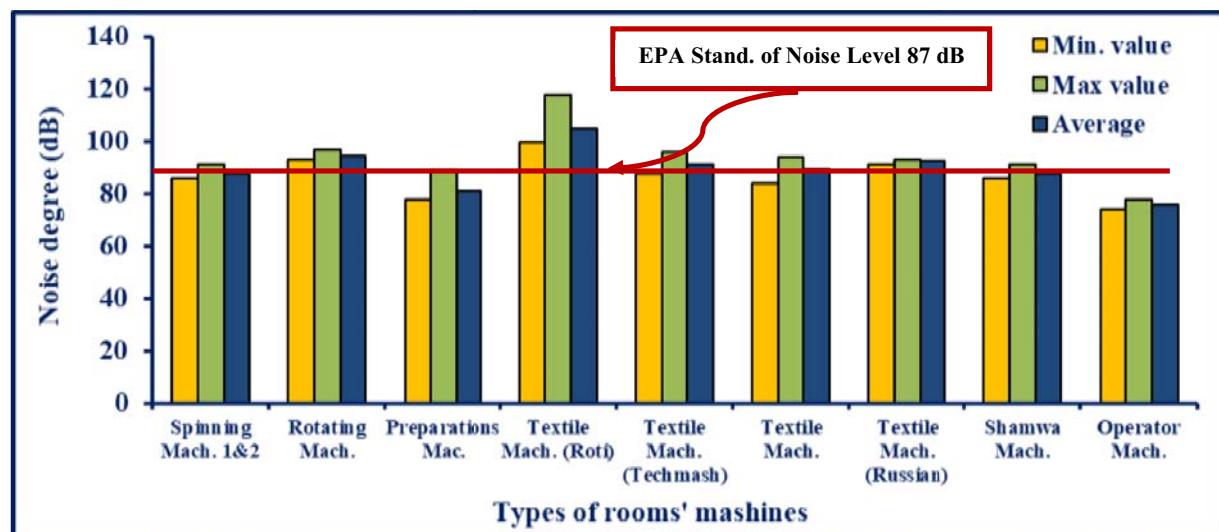


Figure 3: Noise intensity values (lowest, highest, and average) at production rooms in Al-Hillah Textile Factory.

Table 4 shows that noise intensity levels in the production rooms have exceeded EPA permissible limits (85dB) and OSHA requirements (87dB) for exposure time in 6 hours of the workday. The reason is that the machines used in the production in this company are obsolete and causing high noise, therefore, impairing the psychological and physiological wellbeing of the workers. Reading recorded in the preparation room (81.2dB) was within the permissible limits since the readings were taken away from the machines and it was relatively low (78dB), compared to the readings that were taken near the machines (90dB), while the readings in the operator machine room (76dB) were within the permissible limits.

The results show that the lowest noise readings were recorded in the production rooms (rotating machines (93dB), Roti machine (100dB), Techmash textile machines (88dB)). The Russian textile machinery room (91dB) has exceeded the permissible limits, and this shows the intensity of the noise in these rooms.

Production rooms (rotating machinery 86dB, textile machinery 84dB, Shamwa machinery 86dB) were within the highest rate of the permissible limit (87dB).

Table 4: Lowest, highest, and average noise readings (dB) at production rooms in Al-Hillah Textile Factory.

Values	Spinning Machines (stages 1&2)	Rotating Machines	Preparations Machines	Textile machines (Roti)	Textile Machines (Techmash)	Textile Machines	Textile Machines (Russia n)	Shamwa Machines	Operator Machines
Lowest	86	93	78	100	88	84	91	86	74
Highest	91	97	90	118	96	94	93	91	78
average	88	94.4	81.2	105.2	91.2	89.2	92.4	88	76

5. Conclusions

This study, through which the level of noise intensity is measured in the production rooms of Al-Hillah Textile Factory-Hillah City, showed the following:

- 1- Most of the readings showed an increase in the noise level beyond the permissible limits in most of the production rooms.
- 2- Most of the machines used in production are obsolete or exceeding the design's useful life.
- 3- The machines violate the environmental specifications and cause high noise levels and thus their effect on the workers in terms of psychological and physiological terms, besides noise from the proximity of the building to the street linking the university entrance to many colleges and other buildings and the traffic.
- 4- Workers complain from noise especially in the rooms where the level of noise intensity is higher than the permissible rate, and this affects the flow of work and thus low production rates due to psychological and health pressure.
- 5- environmental culture of the necessity of using the appropriate equipment is absent.

The duty of the concerned ministries (Iraqi Ministry of Industry and Minerals, Iraqi Ministry of Environment and Health) to monitor these important industrial establishments in our country because workers in all industrial establishments are national wealth, as it is through them that this important industrial sector is promoted and therefore increasing revenues of the economic level of the country. The high level of noise intensity in these industrial production sites has psychological and physiological effects, and this leads to a lack of focus and complaining about work, so it must be a priority to reduce this influencing environmental pollution. Noise can be reduced by the combination of several factors:

- 1- The use of new machines in the production process with specifications that observe the permissible environmental limits.
- 2- Developing guide signs that increase the environmental awareness of the employees.
- 3- Mandating all workers to use safety requirements, especially those that maintain the safety of workers against high noise levels.
- 4- The facility should improve the monitoring role through the use of reward and punishment in the use of full safety and prevention means at work.

5- Holding educational courses in the field of industrial safety, to show the extent of the danger of not using protective measures on the psychological and physiological health of workers.

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