

Biological Risk Analysis in a Waste Treatment Company in Manaus-AM

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Abstract— *Biological Risks are defined by the existence of the probability of occupational exposure to Biological agents in functions that involve the use or manipulation of the biological agent as the main object of the work. This exposure without adequate protection causes health hazards, such as acquiring some occupational disease due to microorganisms present in the workplace. Thus, this work aims to conduct a descriptive research of the environment of the effluent treatment plant unit in Manaus-AM to verify which agents are present and which preventive measures are taken to eliminate or reduce these risks, ensuring a healthy environment to the employee. The obtained result fits within the acceptable standards, being in agreement with the theoretical reference present in this work, but it needs a deeper analysis in the subject to prove that these biological agents do not cause more serious health damages.*

Keywords— *Biological Hazards, Wastewater Treatment Plant, Biological Agents.*

I. INTRODUCTION

Work activities that involve the use or manipulation of biological agents as the main object of the work are considered biological risks, characterized as occupational exposure to biological agents. Microorganisms in an effluent treatment plant TEE are present in various sectors of the unit, these microorganisms are part of the acceleration of the effluent treatment process that operators are exposed to during the working period and may contract diseases caused by these agents. This exposure is known as deliberate intent, meaning that the presence of the agent is known and determined. In this way the risk recognition is simple and the handling and exposure procedure is well determined.

However, not all companies demonstrate proper importance for occupational exposure care, ignoring correct prophylaxis procedures, such as not using both collective and individual safety equipment or even not performing proper day-to-day inspections or training by putting in place. risk to workers' health.

According to [1] biological hazards are classified as occupational accidents, provided the respective causal link is established as allergic reactions, acute or chronic infections caused by bacteria, viruses, chlamydia, fungi, helminth and arthropod parasites and plant poisoning, or animals.

Senior management of a small industry or company should pay particular attention to biological hazards, even if the company has a low degree of risk, because when an operator is absent from work for a short time with respiratory, allergic, unwell among other reasons, the likelihood of being related to the work environment is high. These absences rarely generate CAT (occupational accident report), and consequently are not associated with biological agents. In addition to the lack of interest from employers and occupational safety professionals to do an in-depth investigation into the cause of leave so as not to generate the same or more aggravating cases, this fact increases the absenteeism rate in the establishments which represents a problem for workers, company or industry to the government segments, and causing financial losses, because they are repetitive facts [2].

Biological hazards are of most concern in the general health field. However, any professional category may be at this risk from the moment they have direct contact with potentially contaminated fluids, and may occur in different ways: Cutaneous or percutaneous route, with or without skin lesion; airway (aerosols) and oral [3].

As it is a problem for all categories of work, the biological risk, even with a low degree, should have its importance in relation to care, since they are transmitted in different ways, as [4] cited in this way. types of biological agents that are exposed to the operators at

Alpha Company who work with wastewater treatment in the aerobic biological process. Verify by document and on-site visit which standard procedure the company adopts to prevent its employees from occupational diseases caused by these agents.

II. LITERATURE REVIEW

In this topic, the concepts on Effluents, wastewater treatment, biological hazards, associated diseases and safety measures will be presented.

2.1. Effluents

Effluents and treatment are addressed by [5] define effluents as liquid discharges. Can be identified by industrial process derivatives, ie effluents from the production process and cleaning operation wash waters, including cooling waters, which are proven to be contaminated by products used or produced in the establishment; stormwater from storage or transshipment areas; domestic sewage resulting from physiological activities and hygienic habits originated from man; and sanitary sewage consisting of industrial, domestic sewage, sewage water and rainwater contribution.

Effluents, also called industrial discharges or wastewater, are defined as liquid streams or suspensions originating from processes, operations and utilities that may be accompanied by contaminated water from sanitary sewage. Emphasizing that industrial dumping has quite diverse biochemical and physicochemical characteristics [6]. And domestic waste is characterized by microbial activity factors and chemical reactions having a light gray to dark gray color, a strong odor due to hydrogen sulfide and other decomposing waste and its turbidity is caused by the high concentration of suspended solids [6].

2.2 Wastewater treatment

Based on [7], contaminants in water can be eliminated by physical, chemical and biological processes or by a combination thereof.

Wastewater treatment is basically classified into efficiency levels: Since primary and primary treatment refers to physical processes, secondary treatment is biological process and tertiary treatment concerns chemical processes [8]. The Ministry of Environment describes the processes

The purpose of wastewater treatment is the removal of pollutants which would cause a deterioration of the quality of water bodies. Hence the importance of an effluent treatment plant [9].

2.3 Biological Risks

According to [10] "biological risk is the probability of occupational exposure to biological agents". According to

[11] the biological agents consist of bacilli, fungi, bacteria, viruses, protozoa, parasites, among others. Regarding the effluent treatment unit the risks occur in the exposure to microorganisms present in the effluents that are generated from domestic and industrial sewage and especially when the aeration system treatment is used the microorganisms may be dispersed in the air representing source of contamination and cause acute or chronic diseases in exposed operators.

According to [12] the term microorganism congregates varied taxa of microscopic unicellular organisms that live as isolated or aggregated cells. Since these microorganisms have two types of lives: aerobic, that is, they need oxygen to breathe consequently, proliferate and anaerobic proliferate in environments with little or no oxygen.

2.4 Associated Diseases

In the secondary treatment process live microorganisms are used. Therefore, the operator who is exercising some degree of control is exposed to these pathogenic organisms such as bacteria, viruses and protozoa, being the main causes of waterborne diseases and appearing in water, usually in low concentration and intermittently [13].

Treatment plant workers are potentially exposed to a wide variety of pollutants and may contain biological agents. In addition, these workers may develop respiratory, gastrointestinal, flu, and other symptoms that may be associated with exposure to non-infectious microorganisms and specific microbial toxins [14].

2.5 Safety Measures

According to [15] the safety measures for the operator are: always use appropriate PPE's for each activity to be performed; wear boots and uniform in effluent management areas; In tasks that require contact or handling with sewers, always wear appropriate mask and impervious gloves; in the interval between risky activities, wash gloves with detergent, remove them and wash hands; Always wash your hands with detergent before eating or handling food; never leave dirty or watery soap, which represents a focus of contamination; All PPE, other equipment, tools and materials used at the stations should be washed with detergent after use and kept strictly clean. do not reuse PPE that is already contaminated, especially gloves; Every work environment should have an absorbent paper towel and liquid hand wash; All employees should take over activities only after training. Employees must undergo periodic and admission medical examinations; Company employees dealing with effluent should be immunized as recommended by the

company's Social Work and Occupational Safety and Health Management.

[16] recommends that a shower be installed for every ten workers in unhealthy operations or activities, or work that has exposure to infectious, toxic, allergenizing, irritating, dusty or dirty substances, and where exposed in intense heat. In establishments and workplaces with less than thirty workers, at the discretion of the competent authority, in matters of occupational safety and medicine, workers should be provided with sufficient comfort for meals in a place that meets the requirements of cleaning, aeration, lighting and drinking water supply.

According to [17] should identify the risks of the work process, and prepare the risk map, with the participation of the largest number of workers, with advice from SESMT, where there is; developing a work plan that enables preventive action to solve occupational safety and health problems; participate in the implementation and quality control of the necessary preventive measures, as well as in the evaluation of action priorities in the workplace in order to identify situations that may bring risks to the safety and health of workers; Conduct at each meeting an assessment of the achievement of the goals set in its work plan and discuss the risk situations that have been identified.

According to [11] on the Environmental Risk Prevention Program - PPRA preventive measures eliminate or reduce the use or formation of agents harmful to health. These measures prevent the release or spread of agents in the workplace, reducing levels or concentration. The implementation of collective measures should be presented in the training of workers and how the PPE should be used.

III. STUDY METHODOLOGY

Data collection was performed at Alpha Company to obtain information on what type of process is used in the treatment unit, which effluents are treated and the biological agents that operators are exposed to.

It was adopted in the methodology four types of research to elaborate the work, following exactly this order: bibliographic research, documentary research and field research along with descriptive research.

In the bibliographic research were analyzed books, scientific article, manuals, guides, theses and monographs. This stage of the research aimed to make a comparison between companies that were studied in relation to biological risks and the company Alpha.

The second step was an analysis of the Environmental Risk Prevention Program (PPRA) and the PCMSO Occupational Health Medical Control Program to verify

what degree of biological risk workers are exposed to, what procedures are taken to eliminate or eliminate reduce these risks, and preventive measures for health promotion of operators.

In the on-site research the objective was to learn about the station's operation by collecting information about the problem in question and describing the facts without interfering with the process, the field research served to make the records just describing the situations. Observe how operators behave without the supervision of a work safety technologist if PPE is used in accordance with the establishment rule. Analysis of the treatment plant.

An analysis was made, through observation and photographic record, in the structures of the treatment plant during the field visit.

3.1 Data Collection

Alpha has been operating in seven Brazilian states for three years and has the competence and differential for complete solutions in the treatment of domestic and industrial wastewater. As a result of the data collection it was observed that, according to the PPRA, the activities performed are in open and closed places with natural and artificial light, the analysis to make the risk recognition was qualitative, the risk classification is class 2, that is, the risk is easily controlled. Danger of contamination may occur at the time the operator performs wastewater collection tasks for analysis, inspection, tank cleaning through treatment aeration, airway and epidermis.

The PCMSO provides data on the exams that are taken for employees and the training offered by the company.

IV. STUDY APPLICATION

The study application will be presented, showing the analysis of the treatment station, identification of biological agents and the preventive measures.

4.1 Treatment Plant Analysis

At the Manaus treatment plant branch, effluents are treated in the batch aerobic biological process. In this process a certain volume is treated in a certain period of time, for example, 14 m³ of effluent is treated in approximately 10 to 12 hours of continuous aeration in the biological reactor.

After this time the aeration is turned off and decantation occurs and then the semi-treated effluent is directed to the tertiary treatment where it will receive chlorination and then destined to the recipient body.

The effluents arrive separately in the treatment unit, where there are two pipes of domestic effluent and industrial effluent, in this step is performed the operation of separation of fat Figure 1.



Fig. 1: Separation Railing

Subsequently, they form a mixture, following the grating process at this stage. The effluent passes through two grids of different particle size.

Grating: Large solid waste is retained by grids with spacings of five to ten centimeters, serving as a first filtration to facilitate the conduction of sewage through pumps and pipes.

Desaneration: It is the separation of smaller organisms from larger organisms. The sand goes to the bottom of a tank and the organic material remains on the surface.

Primary decanter: These are tanks that mix solid organic material to settle it to the bottom of the tank until it takes the form of sludge.

Rotary Sieve: Solid material is subjected to a sort of sieve that serves as a new filtration and separation so that the liquid is stored in buckets.

Aeration Tank: This is where matter is fed to microorganisms through a chemical process that converts organic waste into carbon dioxide.

Secondary Decanter: Tanks separate suspended solids through sedimentation and reduce more sludge solids.

Sludge Density: Sludge is filtered to reduce the volume of water to show solid material, which in turn undergoes other filtering processes.

Anaerobic Digestion: All sludge-shaped matter is stabilized by chemical process, including the elimination of harmful bacteria and gases, and is also reused as fertilizer.

Chemical Sludge Conditioning: The matter goes through a process of coagulation and dehydration.

Plate Press Filter: The sludge is filtered through pressed plates which cause all remaining liquid to be removed.

Thermal Dryer: Finally, the remaining sludge is evaporated at high temperatures, eliminating significantly more liquid.

Subsequently they form a mixture, following the grating process at this stage the effluent passes through two grids of different particle sizes shown in Figure 2.



Fig. 2: Separation Boxes

After the removal of all pollutants through a chemical, physical and biological process, treated water can finally be reused for industrial or agricultural purposes and is not yet potable water.

Thus removing the thick solids and follow the parchall gutter Figure 3, where it is possible to perform the volume measurement.



Fig. 3: Parchall trough with volume meter

Still in the preliminary treatment the effluent falls in a lift where it is pumped to a static sieve Figure 4 of smaller particle size to remove fine solids and then go to receiving tanks where they receive aeration.



Fig. 4: Static sieve

Then begins the primary treatment or physicochemical treatment, the effluent receives chemicals to remove solids, these solids clump together forming denser flakes, allowing the effluent to decant and clear, which proceed to a decantate where the separation of the effluent occurs. clarified effluent and sludge resulting from the physical chemical process.

This sludge resulting from the physicochemical process goes to a device called filter press that has the purpose of removing the liquid existing in the sludge and thus reducing its volume. This liquid returns to the process and the dried sludge is removed by trucks and composted to produce organic fertilizers.

The clarified effluent goes to equalizing tanks where they receive aeration, pass a rotary filter and go to the secondary treatment that is performed by the activated sludge. In this stage, biological reactors that control aeration mechanically by blowers are used so that the bacteria perform their process, they feed on organic matter excreting water and carbon dioxide.



Fig. 5: Effluent analysis and treated effluent discharge

Finally the effluent goes to the tertiary treatment or polishing, where it will receive chlorination and then after analysis Figure 5 to verify if its characteristics are suitable to be released to the receiving body.

Figure 6 shows the whole process in the step-by-step flowchart as outlined above:

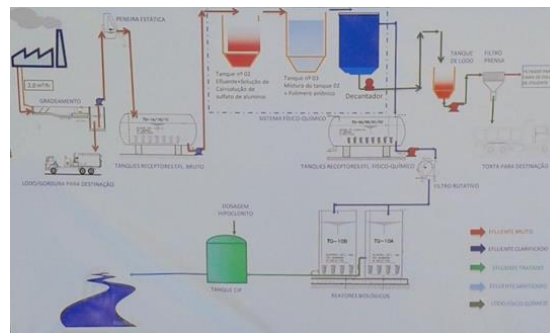


Fig. 5: Effluent Treatment Flowchart in the company

In short, industry-supplied effluent arrives at the station and undergoes preliminary operation separating greases, greases, oils in order not to damage any apparatus, after which the coarse and fine solids are removed from the liquid surface and deposited in a truck after that. Step o A physical - chemical process is carried out in order to remove as much liquid as possible from the sludge for volume reduction and to be taken together with the solids for proper disposal as preparation for composting. The biological process is initiated by blowers. In order for the bacteria to work to accelerate the treatment process, the chemical-analytical process is finally performed and as the results are treated effluents return to the receiving body.

4.2 Identification of biological agents

Through the risk map it can be observed that the biological risks are in every season, with more evidence in the effluent analysis laboratory, the biological agents present are fungi, viruses, parasites, bacteria, protozoa and bacilli. These microorganisms originate mainly from the aeration process, where biological treatment occurs, each tank has a nameplate and each sector of the unit has a specific risk map.

The identification of biological agents, specifically fungi and heterotrophic bacteria can be compared in the paper by [18]. According to the author, analyzes were performed to identify airborne microorganisms in the following locations: Outside (administrative sector, near aeration tanks, kitchen, panel room, solids laboratories, physicochemical laboratories, equipment room) indoors (engine control center, near the aeration tank).

To perform the analyzes [18] used the following method: Samplings were performed in triplicate using a Millipore Figure M Air T Microbiological Air Monitor

Figure 6, with an active air sampling rate of 1 m³ / 7 min, which was coupled to a 44 cm² cassette. area containing specific culture medium Figure 7. Above this was added the M67 T perforated plate with 967 holes to optimize colony distribution and reduce overlap.



Fig. 7: Portable air monitor

The table in figure 8 shows the result of the analysis performed with the samples.

Grupo	Meio de cultura	T (°C)
1. Fungos		
Fungos Mesofílicos	Ágar Saboroud Dextrose Clorafenicol	25,0
2. Bactérias		
Estafilococos	Ágar Baird-Parker Base	35,0
Coliformes fecais	Ec Broth	35,5
<i>Pseudomonas aeruginosa</i>	Ágar Cetrimide Base	35,0
Bactérias heterotróficas	Casein-peptone Dextrose Yeast Agar	35,0

Fig. 8: Analyzed microorganisms and culture media

According to the author, the presence of mesophilic fungi (MF), fecal coliforms (FC), staphylococci (EF) and *Pseudomonas aeruginosa* (PA), as well as heterotrophic bacteria (HB) were found in the samples.

4.3 Preventive Measures

The procedures adopted by the company to prevent biological risks depend on each activity performed. Therefore, for each activity there is a preventive measure that is included in the JSA - Job Safety Analysis. In the area of the effluent treatment station, the use of boots, goggles and helmet is mandatory, and for activities where the effluent handling is required, the use of a procedure glove is indispensable, as well as the other mentioned PPE's.

It is essential to wash your hands thoroughly with soap and water, and the use of alcohol gel after each activity performed, because microorganisms are present in all parts of the TEE.

The use of other PPE, such as safety masks, is required when preparing chemical solutions.

In some situations where an intervention of cleaning of tanks or equipment where the presence of microorganisms is present, a disposable coverall is used.

Inside the laboratory the analyst should always wear a safety boot, safety goggles, procedure glove and lab coat. It is strictly forbidden to feed on the premises of the wastewater treatment plant. Other preventive measures are vaccines, especially for hepatitis A and B. Care and attention in all activities are part of prevention measures.

V. CONCLUSION

According to research and document analysis of the company Alpha, conducted in the city of Manaus-AM, about biological risks found that the degree of risk is 2, considered low. This conclusion makes the workers not aware of the danger they are in, because when a disease associated with viruses, bacteria, protozoa do not associate with the work environment.

Finally, the study needs to have more analysis regarding worker exposure, since the literature is very poor in information about this area. And the committee that looks after employee health promotion should promote lectures to show what these dangers are, train them on the use of appropriate PPE's and make everyone aware of their use even if enforcement is not around.

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