



Microbiology of Industrial, Textile, Domestic and Fish Liquid Waste Treatment (Literature Review)

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Abstract. Microbiological research on waste treatment has been conducted to reduce the concentration of waste pollutants, such as ammonia, nitrites, and sulfide acids. Treatment of Fish Washing Waste with Microorganisms *Rhodopseudomonas* sp., *Lactobacillus* sp., *Aspergillus* sp., *Penicilium* sp., *Sacharomyces* sp., and *Actinomycets* sp. to reduce contaminants from cod fish washing waste. The addition of microorganisms can decrease the concentration of ammonia, nitrite, and sulfic acid. Research on the Identification of Organic Pollutant Decomposing Bacteria in Domestic Wastewater found *Eschericia coli*, *Acinetobacter iwoffii*, *Acinetobacter haemolyticus*, *Proteus mirabilis*, and *Pseudomonas* sp. The Role of Aerobic Microbes in Liquid Waste Treatment in textile waste treatment, especially in the process of activated sludge ponds found that microbes can reduce the concentration of BOD parameters in textile waste. Bioremediation methods that use microorganism agents can be used to degrade organic materials in waste. Microorganisms have been used to reduce the concentration of waste pollutants, such as ammonia, nitrite, and sulfide acid and microorganisms can be effective in reducing the concentration of waste pollutants.

Keywords: processing, waste, microorganisms, fish, textiles

INTRODUCTION

Waste treatment has become an important issue in efforts to preserve the environment. One of the methods that is increasingly in demand is the use of microorganisms to treat waste. These microorganisms include different types, such as bacteria, fungi, and algae, each of which has a specific role in the process of decomposing waste. Types of microorganisms used in waste treatment include bacteria, fungi, and algae. Bacteria are the most commonly used microorganisms in waste treatment. They play a role in breaking down organic matter into simpler forms, such as carbon dioxide, methane, hydrogen, and water. Bacteria can also be divided based on their oxygen needs into aerobic, anaerobic, and facultative. In addition, bacteria can produce energy as a side effect of waste treatment, such as methane and hydrogen gases that can be used to generate electrical energy (biogas). Fungi play an important role in the process of decomposing

lignocellulosic waste, such as wood and plant fibers. They help break down ingredients that are difficult for bacteria to break down. Algae are used to treat waste that contains excess nutrients, such as waste from the agricultural industry or aquariums. They are able to absorb excess nutrients and help reduce environmental pollution

Microorganisms in waste treatment work through several key mechanisms, such as the decomposition of organic matter and the biogeochemical cycle. They convert important elements such as carbon, nitrogen, and phosphorus from one form to another, which supports the survival of life on earth. The use of microorganisms to treat waste offers a number of advantages, including being environmentally friendly, reducing pollution, improving water quality, and producing alternative energy. In addition, microorganisms can be a large enough source of biomass to be used as fuel for PLTBiomass. Despite its many advantages, the use of microorganisms to treat waste also faces a number of challenges, such as cleanliness and safety. However, there are several interesting innovations in the development of waste processing microorganisms, such as microorganism genetic engineering and Microbial Fuel Cell (MFC) technology that is able to convert chemical energy into electrical energy. The application of microorganisms that can treat waste has been applied in various industrial sectors, including agricultural waste treatment and other industries that are rich in organic materials. In Indonesia, liquid waste treatment technology that utilizes bacteria has been applied in various locations, providing tangible evidence of its benefits in sustainable waste management. The use of microorganisms in sewage treatment offers an environmentally friendly and efficient solution to address the pollution problem. With different types of microorganisms that have specific roles, as well as technological innovations that continue to develop, this method has great potential to be widely applied in various industrial sectors. However, challenges in terms of hygiene and safety still need to be considered to ensure the effectiveness and sustainability of these methods.

METHOD

The method used in presenting the ideas in this article is a literature review. Literature is all written works that can be used as reference materials or references in conducting various research or scientific papers. In Indonesian, literature is better known as literature. In the Great Dictionary of Indonesian Language (KBBI), literature is reading material used in various intellectual and recreational activities. Systematic mapping study is a literature review method in which the writing is carried out systematically and using

predetermined steps. Choosing a research paper cannot be done subjectively with this literature review method, so it must be done objectively. Researchers using this method in literature reviews usually collect various papers. After collecting the papers, the researcher will read them one by one, reviewing or analyzing them and adjusting them to the topic of discussion to be researched.

DISCUSSION

1. Waste Treatment Microorganisms

Waste treatment has become an important issue in efforts to preserve the environment. With the growth of the human population and industry development, waste is a serious problem that needs to be dealt with wisely. One promising solution in waste treatment is using microorganisms that can decompose waste. In this article, we will explore in more depth waste processing microorganisms, their working mechanisms, the advantages of their use, and their applications in industry and the natural environment.

Microorganisms used as waste treatment include various types, but the most common are:

- 1. Organic Waste Decomposing Bacteria.** So, Bacteria is one of the most widely used organic waste decomposing agents. These bacteria are able to decompose organic materials into simpler compounds, such as carbon dioxide and water. This process helps reduce the density of organic waste, thereby minimizing its negative environmental impact.
- 2. Lignocellulose Waste Decomposing Fungi.** Fungi play an important role in decomposing lignocellulosic waste, such as wood and plant fibers. They produce ligninolytic enzymes capable of digesting complex compounds in lignocellulose. The use of this decomposing fungus has shown beneficial results in treating organic waste that is difficult to decompose.
- 3. Nutrient Waste Processing Algae.** Algae is one of the microorganisms used to process waste that contains excess nutrients, such as waste from the agricultural industry or aquariums. Algae use the nutrients in waste as an energy source for their growth, thus helping to reduce the amount of excess nutrients that pollute the water.

Working Mechanism of Microorganisms in Waste Treatment

Microorganisms in waste treatment work through several main mechanisms:

1. **Decomposition of Organic Matter.** Bacteria and fungi help the decomposition process of organic matter by decomposing complex compounds into simpler molecules. This reduces the volume of waste and speeds up the natural process of decomposition.
2. **Fermentation Process.** Some microorganisms can ferment organic waste, which can produce renewable energy and various useful by-products, such as biogas.
3. **Manufacture of Degrading Enzymes.** Microorganisms can also produce effective degrading enzymes. These enzymes can be used in the waste treatment industry to help decompose waste more efficiently.

The use of microorganisms that can treat waste offers a number of advantages, including:

1. **Environmentally friendly.** Microorganisms naturally work to decompose waste, so using it will be more environmentally friendly compared to chemical technology that tends to pollute.
2. **Efficient in Waste Treatment.** Microorganisms can work efficiently in breaking down organic waste, helping to reduce the amount of waste that must be disposed of.
3. **Reduction of Dependence on Chemicals.** Microorganisms can reduce dependence on harmful chemicals, making waste treatment safer and more sustainable.

The application of microorganisms that can treat waste has been applied in various industrial sectors, including:

1. **Agricultural Waste Treatment.** Microorganisms can be used to treat agricultural waste, such as organic fertilizers, to increase soil fertility and reduce environmental pollution.
2. **Food Industry Waste Treatment.** Microorganisms have been used to reduce the environmental impact of such waste from the food industry, which often produces organic waste.
3. **Textile Industry Waste Treatment.** The textile industry produces hazardous waste, and the use of microorganisms has helped reduce its toxicity and create more sustainable treatment methods.

Microorganisms also play an important role in the treatment of waste in the natural environment, including:

1. **The Role of Microorganisms in the Biogeochemical Cycle.** Microorganisms engage themselves in biogeochemical cycles, transforming essential elements such as carbon, nitrogen, and phosphorus from one form into another, supporting life's survival on Earth.
2. **Impact of Microorganisms on Ecosystem Sustainability.** The presence of microorganisms in ecosystems supports the balance of the natural environment, such as in the recovery of nutrient recycling and the decomposition of organic materials.

Challenges and Obstacles in the Use of Waste Treatment Microorganisms include:

1. **Cleanliness and Safety.** The use of microorganisms must pay attention to standards to ensure cleanliness and safety, especially in the food and pharmaceutical industries.
2. **Environmental Suitability for Microorganisms.** Because microorganisms have different living environments, carefully choose the type of microorganism to be used according to environmental conditions.
3. **Availability of Technology.** The limitations of the available microorganism processing technology require further innovations and research in this field.

Latest Innovations in the Development of Waste Processing Microorganisms. In recent years, there have been several interesting innovations in the development of waste treatment microorganisms, such as:

1. **Genetic Engineering of Microorganisms.** Genetic engineering allows for the creation of microorganisms that are more efficient and have specific properties in decomposing particular wastes.
2. **Use of Artificial Intelligence Technology.** Artificial intelligence technology can be used to optimize the waste decomposition process and improve the performance of microorganisms in waste treatment.

Using Waste Treatment Microorganisms is one of the environmentally friendly solutions to overcome the waste problem. Microorganisms work efficiently in decomposing organic waste and reducing its negative environmental impact. The application of microorganisms in industry and the natural environment has shown favorable and promising results for a more sustainable future.

Industrial Liquid Waste Treatment

Industrial liquid waste treatment involves several processes that aim to reduce the pollutant content in liquid waste so that it does not damage the environment. Here are some commonly used industrial liquid waste treatment methods:

1. Liquid Waste Treatment Physically:

- Filtration: Separates suspended particles from water using filtration or filtration.
- Flotation: Separating particles that float on the surface of the water.
- Sedimentation: Using electrolytes to separate insoluble materials from water.

2. Chemical Treatment of Liquid Waste:

- Coagulation: Using chemicals to precipitate impurities in liquid waste.
- Oxidation: Oxidizes liquid waste to remove toxic substances.
- Exclusion: Removing organic materials and toxic substances by oxidizing liquid waste.

3. Biological Treatment of Liquid Waste:

- Use of Microorganisms: Microorganisms such as activated sludge are used to decompose the content of organic substances in liquid waste.
- Oxidation Pond: Using an oxidation pond to biologically decompose liquid waste.

4. Exclusion of Disease-Causing Microorganisms:

- Using UV light or adding chlorine to eliminate disease-causing microorganisms.

5. Reduction of the Amount of Liquid Waste:

- Streamline the production process to reduce the amount of liquid waste produced.

Using a combination of the above processes, industrial liquid waste treatment can be effectively carried out to reduce negative environmental impacts. Treatment of Tofu Industrial Liquid Waste by Using Biofilters to Reduce Levels of Pollutants such as BOD, COD, and TSS in the wastewater of the Tofu Bunga Indah Industry, Banda Aceh City. The liquid waste produced contains pollutant levels such as BOD, COD, and TSS that exceed the quality standards set by the Regulation of the Minister of Environment No. 5 of 2014 concerning Quality Standards for the Tofu Industry, so it has the potential to pollute the waters; therefore the form of tofu industry liquid waste treatment must be carried out to reduce pollutant levels before being discharged into the waters. One effort can be made to treat the waste of the Tofu Industry using a biofilter reactor. This study is quantitative research that is conducted by conducting experiments to treat tofu industry wastewater. It aims to determine the reduction of BOD, COD, and TSS pollutant levels of tofu

wastewater by using biofilter treatment. The results of the study showed a decrease in tofu waste levels by biofilter treatment with BOD-5 values of 725.43mg/L, COD 1,648.32mg/L, TSS 73 mg/L, and pH (6-7) (Anwar, 2020).

Textile Liquid Waste Treatment

Liquid waste generated from the textile industry includes the following types:

1. Waste Water from the Dyeing Process:
 - This waste comes from the process of coloring fabrics using harmful chemicals such as dyes, starch removers, and others. If not managed properly, these dyes and chemicals can contaminate groundwater and damage ecosystems.
2. Waste Water from the Washing Process:
 - This waste is produced from the washing process of fabrics after the dyeing process. This waste can contain detergents, solid particles, and other chemicals potentially damaging the environment.
3. Waste Water from the Finishing Process:
 - Finishing is a final process in textile production involving chemicals to exert a specific effect on the fabric. This waste can also contain harmful chemicals that can pollute the environment.
4. Waste Water from the Starch Removal Process:
 - The starch removal process is an essential step in textile production to remove unwanted starch residues. This waste can contain chemicals that have the potential to damage the environment.

Thus, liquid waste from the textile industry can pollute the environment and harm human health if not managed properly. Therefore, it is essential to carry out adequate and environmentally friendly waste treatment to reduce the negative impact of this liquid waste.

Domestic Liquid Waste Treatment

Domestic liquid waste treatment is an important process to reduce environmental pollution and potential negative impacts on health. Here are some of the main methods in domestic liquid waste treatment:

Physical Processing Methods

1. Filtration is a process that separates suspended particles from wastewater using a filter medium such as sand, gravel, or activated carbon. It is effective for removing solids and improving water quality.
2. Deposition: This method separates particles that are not easily soluble by precipitating them. The electrolyte is usually added to aid the sedimentation process.
3. Biological Processing Methods. The aeration process adds oxygen to the wastewater to support the activity of aerobic bacteria that decompose organic matter. Aeration for 72 hours can significantly reduce COD content.
4. Oxidation Pond. An open pond can be used as a place for biological treatment of liquid waste.

Utilization of Aquatic Plants

1. Aquatic plants such as water hyacinth can be used as a pollutant-absorbing medium in domestic liquid waste.
2. Chemical Processing Methods. Disinfection is the process of removing pathogenic microorganisms, usually using UV light or chlorine.
3. Absorption. It uses activated carbon to absorb and separate unwanted particles from water.
4. Integrated Processing System. The combination of several processing methods can provide more optimal results. Examples:
 - a. Aeration for three days
 - b. Followed by filtration
 - c. Finally, disinfection with UV light

This system has been proven to be effective in reducing COD, TSS, and Total Coliform levels in domestic liquid waste.

Simple Technology

For household scales, simple processing systems can be used, such as:

- a. Multi-level filter tub/tube with coconut palm media, sand, zeolite stone, and activated carbon.
- b. Infiltration wells to return water to the soil and reduce groundwater pollution.

Proper domestic liquid waste treatment can provide two main benefits: addressing environmental pollution issues and providing an alternative source of clean water through wastewater recycling. By applying appropriate processing methods, we can contribute to preserving the environment and public health.

Domestic liquid waste treatment will produce two benefits, namely overcoming the problem of environmental pollution, while promoting the use of household liquid waste as a new source of clean water for the community. The purpose of this study is to obtain a laboratory-scale liquid waste treatment system that can be used to treat domestic liquid waste and produce effluent that can meet the requirements of water quality standards that are suitable for reuse. Liquid waste samples are put into plastic bucket containers as reactors. The reactor is left open and equipped with an aerator. After that, the effluent liquid waste from the reactor is flowed to the filtration or filtration device and finally flowed to the disinfection tank to kill or reduce pathogenic microorganisms by using disinfection by UV light from the sun. Changes in COD, TSS and Total Koliform content of household liquid waste have been reduced after going through an aerobic processing process for 3 days followed by filtration and disinfection with UV light, where the initial COD content of waste is 257.5 mg/L and after treatment is 21 mg/L., the initial TSS of waste is 372.5 mg/L and after treatment is 2 mg/L and the initial total coliform content of waste is 110x10⁴ MPN/100 ml and after treatment is HPN (MULYANA, et.al, 2011).

Fish Waste Treatment

For liquid waste from fish washing and processing, several methods can be used:

- a. Sedimentation in a settling pond
- b. Filter filtering
- c. Biological processing using microorganisms
- d. Phytoremediation using aquatic plants such as *Scirpus gross*

Sidoarjo is one of the largest fish-producing districts in East Java. The high productivity of fisheries is in line with the increase in the amount of waste produced. Both solid waste and liquid waste. Liquid waste generally comes from used fish washing water, usually brownish, cloudy, and fishy smelling. In addition, the concentration of organic matter in the waste is very high. The purpose of this study is to determine the decrease in the levels of Total Suspended Solid (TSS), Total Dissolved Solid (TDS), and Biochemical Oxygen Demand (BOD) in these wastes using *Scirpus grossus*. The independent variable used is the variation in the number of plants (without (zero) plants, 5 plants and 10 plants). The waste used comes from the Regency Fish Market Depot. The research began with an acclimatization process, followed by phytoremediation tests. Based on laboratory analysis, it is known that the best reductions in TSS, TDS and BOD were obtained from reactors with 10 plants (Widiyanti and Hamidah, 2021).

CONCLUSION

Microbiological research on waste treatment has been conducted to reduce the concentration of waste pollutants. Fish Washing Waste Treatment with Microorganisms. This study used microorganisms such as *Rhodopseudomonas* sp., *Lactobacillus* sp., *Aspergillus* sp., *Penicillium* sp., *Saccharomyces* sp., and *Actinomyces* sp. to reduce contaminants from cod fish washing waste. Treatment with adding microorganisms can reduce the concentration of ammonia, nitrite, and sulfuric acid. The study on the Identification of Bacteria Decomposing Organic Pollutants in Domestic Wastewater identified the types of bacteria that are able to decompose organic pollutants in domestic wastewater on Kodingareng Island. The bacteria found include *Escherichia coli*, *Acinetobacter iwoffii*, *Acinetobacter haemolyticus*, *Proteus mirabilis*, and *Pseudomonas* sp. The Role of Aerobic Microbes in Liquid Waste Treatment of textile waste treatment, especially in the process of activated sludge ponds. The study found that microbes can reduce the concentration of BOD parameters in textile waste. Microbiological waste management requires attention to the types of waste and environmental factors. Bioremediation methods that use microorganism agents can be used to degrade organic materials in waste. In some studies, microorganisms have been used to reduce the concentration of waste pollutants, such as ammonia, nitrites, and sulfuric acid. The results of the study show that microorganisms can be effective in reducing the concentration of waste pollutants.

BIBLIOGRAPHY

- Auliya Anwar. (2020). Tofu Industrial Waste Treatment Using Biofilters. Thesis. Science and Technology. Faculty of Environmental Engineering. Ar Raniry State Islamic University. Banda Aceh.
- Fitriadi, R., Haeruddin, H., & Ain, C. (2016). Effectiveness of Microorganisms as Bioremediation Materials in Cod Fish Washing Waste (*Auxis thazard*) (Laboratory Scale) Microorganism Effectiveness as Bioremediation of Cod (*Auxis thazard*) Wahery Waste (Laboratory Scale). *Fisheries Science: Indonesian Journal of Fisheries Science and Technology*, 12(1), 52-59.
- Komarawidjaja, W. (2007). The Role of Aerobic Microbes in Textile Liquid Waste Treatment. *Journal of Environmental Technology*, 8(3).
- Maufilda, D. (2015). Content of BOD, COD, TSS, pH, and Oil or Fat in Wastewater in Inlets and Outlets of Shrimp Cold Storage Industry (Study at PT. Panca Mitra Multi Perdana Kapongan-Situbondo).
- Mulyana, Y., & Purnaini, R. (2011). Domestic Liquid Waste Treatment for Reuse (Water Reuse). *Journal of Wetland Environmental Technology*, 1(1).

- Mustamin, H. A., Larasati, R. P., & Sumada, K. (2020). Study on the suitability of microorganisms in industrial liquid waste treatment. *Chempro*, 1(2), 45-52.
- Sila, N. (2021). *Identification of Organic Pollutant Decomposing Bacteria in Domestic Wastewater of Kodingareng Lompo Island* (Doctoral dissertation, Hasanuddin University).
- Widiyanti, A., & Hamidah, L. N. (2021). Treatment of Liquid Waste Used for Fish Washing Using *Scirpus grossus*. *Journal of Research and Technology*, 7(1), 61-70.
- Yunita Mulyana¹, Rizki Purnaini², Berlian Sitorus (). Domestic Liquid Waste Treatment for Reuse (Water Reuse). Study Program: Environmental Engineering, Tanjungpura University, Pontianak.