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REVIEW ARTICLE

Evaluation of the effectiveness of wastewater treatment methods: maintaining the quality of water bodies in Indonesia

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Abstract

Pollution in water bodies is an increasingly urgent problem and requires serious attention, this is due to poor waste management. In 2016, around 73.24% of 140 rivers from 34 provinces in Indonesia were in a polluted status. So that better management efforts and effective policies are needed to reduce river pollution. The use of water treatment technology consistently and sustainably is needed to overcome the challenges of water pollution and ensure that all levels of society have access to quality clean water, supporting public health and environmental sustainability.

Keywords: Water, Waste, Treatment.

INTRODUCTION

River water plays a very important role in human life and the ecosystem as a whole. Based on various studies published in journals, river water not only provides a source of clean water for daily needs, such as drinking, bathing, and washing, but also supports agricultural, fisheries, and industrial activities. However, over time the quality of river water continues to decline. Pollution in water bodies is an increasingly pressing problem that requires serious attention, especially in countries with poor waste management. Based on research published in the journal, many rivers in Indonesia experience significant pollution due to domestic, industrial, and agricultural waste. The water pollution index, which is measured by parameters such as BOD (Biochemical Oxygen Demand), COD (Chemical Oxygen Demand), and the number of coliforms, shows that most rivers are in the polluted category, with pollution status varying from light to heavy.

River pollution in Indonesia is a serious problem that has attracted the attention of many parties, including the government and the community. Based on data from the Ministry of Environment and Forestry (KLHK), in 2016, around 73.24% of the 140 rivers studied in 34 provinces were in polluted status, with only 2.01% meeting class 2 water quality standards (Firmansyah et al., 2021).

The main sources of this pollution come from domestic, industrial, and agricultural waste, which causes a significant decline in water quality. For example, along the Jenes River, pollution from batik industry waste has resulted in water quality being classified as heavily polluted (Safitri et al., 2023). This results in a reduction in the population of fish and other organisms that depend on the river ecosystem, and disrupts the natural balance.

This pollution not only impacts the aquatic ecosystem but also threatens public health, with increasing cases of waterborne diseases. For example, as a result of river pollution, people living on riverbanks often experience health problems. Diseases such as diarrhea, dermatitis, and skin irritation are some examples of common health problems. For example, in the Karang Mumus River, 23.44% of respondents suffered from diarrhea, 6.25% dysentery, and 70.31% skin irritation. Increased fecal coliform bacteria contamination due to human and animal waste also contributes to the spread of waterborne diseases (Pramaningsih et al., 2023). Therefore, better management efforts and effective policies are needed to reduce river pollution and protect water resources in Indonesia.

MATERIALS AND METHODS

This study adopts a literature review approach by collecting information from various previous studies to evaluate wastewater treatment to reduce river pollution. In this process, several relevant literature sources were used, including a search through Google Scholar, which is an effective platform for finding scientific articles and journals related to health and environmental issues. By utilizing this database, this study aims to present a comprehensive picture of the effectiveness of various types of wastewater treatment before being discharged into water bodies.

RESULTS AND DISCUSSION

Wastewater treatment is very important in maintaining public health and environmental sustainability, especially amidst the increasing amount of waste produced by various sectors, including industry and domestic (Sumiyati et al., 2023). Maintaining river water quality is very important for human health, considering the large number of people who depend on this water source for their daily needs. Based on research, river water pollution can cause various health problems, such as diarrhea, dysentery, and skin irritation (Pramaningsih et al., 2023). River pollution has a significant impact on public health. Polluted river water can be a breeding ground for bacteria and disease pathogens, increasing the risk of diseases such as diarrhea, cholera and skin infections for people who live near rivers and consume water from them. In addition, water contaminated with industrial and household waste can cause a variety of health problems, including upper respiratory tract infections (URTIs), gastrointestinal disorders (dyspepsia), and skin problems (dermatitis) (Ritiau, 2021). Polluted water can also contain harmful substances such as arsenic, nitrate, and chromium, which in the long run can increase the risk of stomach, kidney, and intestinal cancer.

The health impacts of river pollution can also affect the overall quality of life in a community. Water pollution can reduce the availability of clean water, which is essential for daily needs such as bathing, washing and food preparation. Lack of clean water can increase the risk of diarrheal and other infectious diseases, especially in children. In addition, river pollution can damage river ecosystems, causing the death of aquatic animals and reducing biodiversity. This can impact the food and economic resources of river-dependent communities.

As we know in Indonesia, some areas use river water for daily needs, such as the Surabaya River which is one of the sources of raw materials for PDAM to meet the water needs of the people of Surabaya City (Aufar and Muzayanah, 2019). Wastewater treatment before being discharged into the river body is a crucial step in maintaining environmental quality and public health. This process aims to remove hazardous contaminants contained in wastewater, so that it does not pollute the aquatic ecosystem. Various treatment methods, such as biological, physical, and chemical wastewater

treatment systems, have been evaluated to improve the quality of wastewater before being released into the River as in the following table.

Table 1. Previous research related to the wastewater treatment methods

Type Of Waste	Method	Results	Reference
Domestic Wastewater	Biosand Filter	The efficiency of reducing BOD and TSS concentrations in reactor 1 with a media arrangement of gravel, coarse sand, fine sand, and activated carbon in a ratio of (10:10:30:10) cm was 62.92% and 78.40%, respectively. Meanwhile, in reactor 2 using a media arrangement of gravel, coarse sand, fine sand, and activated carbon with a ratio of (10:10:15:25) cm, the efficiency values of reducing BOD and TSS concentrations reached 67.01% and 81.99%, respectively.	Ratnawati and Ulfah, 2020
Tempeh Wastewater	Seeding and Acclimatization	The percentage removal for COD reached 87.89%, BOD5 reached 86.91%, TSS reached 85.63%, reached 87.98%, PO4 reached 82.93% at a sampling time of 8 hours.	Alisa and Purnomo, 2020
Batik Wastewater	Filtration and Photocatalysis of TiO2	Filtration and Eco-Photocatalysis of TiO2 showed promising results in batik wastewater treatment. In this method, the pH was neutral, reducing the TSS concentration, and reducing the color intensity.	Suzana et al., 2024
Textile Wastewater	Geotextile, Hibiscus sabdariffa seeds, activated carbon, and clinoptilolite	The results obtained were a color change from deep red to almost colorless (1249 TCU to 82 TCU), a decrease in the amount of dissolved solids from 800 mg/L to 270 mg/L , a decrease in the content of dissolved hexavalent chromium to very small from <0.04 mg/L to <0.01 mg/L and the content of lead from dissolved cadmium from 0.06 and 0.003 mg/L to undetectable.	Kristiani et al., 2022
Laundry Waste Water	Adoption Using Egg Shells	The optimum COD and BOD levels reduction was at 90 minutes which could reduce BOD levels by 80% and COD levels by 74.5% and 120 minutes which could reduce LAS levels by 35.67%.	Fasihah et al., 2022

Based on the table above, various methods have proven effective in wastewater treatment. The improvement of water quality shows effectiveness from 60 to 90%. In addition, water quality is also monitored automatically because there is a process of measuring water quality at the beginning and end of treatment. Wastewater treatment is always monitored by meeting the established quality standards before being discharged into the river. Regular monitoring and supervision of water quality is also very important to ensure that the discharged water does not contain hazardous substances. With the application of appropriate technology and routine monitoring, wastewater treatment not only contributes to environmental protection but also to public health by reducing the risk of water body pollution that can have a negative impact on aquatic ecosystems and daily life.

Wastewater treatment requires different approaches, depending on the type and concentration of contaminants contained in it. Broadly speaking, we can divide wastewater treatment into three levels based on its complexity: simple, intermediate, and complex. Simple treatment is generally aimed at removing suspended solids (TSS) through sedimentation or filtration, as well as neutralizing the pH of the water so that it is not too acidic or alkaline. The main objective is to reduce turbidity and ensure the wastewater has an appropriate acidity level before it goes to the next treatment process or is discharged into the environment.

Intermediate treatment focuses on the reduction of organic matter as measured through BOD (Biochemical Oxygen Demand) and COD (Chemical Oxygen Demand), as well as the removal of oil and grease (Sulistia and Septisya, 2019). Biological processes such as the use of stabilization ponds or biological reactors are commonly used to break down organic matter, while flotation or grease trap methods are effective for oil and grease removal. With intermediate treatment, the organic pollution

load of wastewater can be significantly reduced, reducing the potential for water quality degradation and disturbance to aquatic life.

Complex treatment is required to deal with more difficult to remove contaminants, such as ammonia, heavy metals, and pathogenic bacteria. Nitrification/denitrification or ion exchange processes are used to remove ammonia, while heavy metals can be removed through chemical precipitation, adsorption, or membrane technologies such as reverse osmosis. Disinfection with chlorine, ozone, or ultraviolet (UV) radiation is effective to kill pathogenic bacteria. Complex treatment ensures that the discharged wastewater meets strict quality standards and is safe for the environment. The parameters used are based on PERMEN LHK RI No. 68 of 2016 concerning domestic wastewater quality (Sulistia and Septisya, 2019).

CONCLUSIONS

All of this shows that the development and application of water treatment technologies not only improve public health but also contribute to environmental sustainability and better water resource management in the future. With the various water treatment technologies and methods available, it is important for governments and stakeholders to implement solutions that are appropriate to local conditions and community needs. Public education on the importance of water resource management and the implementation of conservation practices are also key to ensuring the sustainability of clean water use. By utilizing water treatment technologies consistently and sustainably, we can overcome the challenges of water pollution and ensure that all levels of society have access to quality clean water, supporting public health and environmental sustainability.

Author contributions

Nur Salsabila Kamarudin: Conceptualization, analysis, draft writing, and editing.

Conflict of Interest

There is no conflict of interest in this study.

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Data availability

Data related to the findings of this study are available at the corresponding author.

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