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The Influence of Industrial Water Transportation System Management in Urban Areas

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A B S T R A C T

This study aims to examine the impact of wastewater treatment management on transportation management in modern industrial areas. Industrial areas are centralized areas for industrial activities, equipped with supporting infrastructure developed and managed by Industrial Estate Companies (IPCs) that have obtained business permits within the industrial area. The Medan Industrial Estate (KIM), with a total area of 514 hectares, is a State-Owned Enterprise (BUMN) managed by PT. Kawasan Industri Medan. With a water discharge capacity of 1,000 liters per second, the area can accommodate processing facilities well. Consequently, many companies are providing employment opportunities, leading to the continued development of the KIM area, as it accommodates workers close to their workplaces. In conclusion, wastewater treatment and transportation capacity can mitigate the negative impacts of industrial processes

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INTRODUCTION

Environmental issues have become crucial in today's modern era. Various efforts have been made to protect and preserve ecosystems and the sustainability of life from the environmental destruction caused by rapid technological and industrial development. These efforts have been undertaken by governments, the private sector, and communities themselves. These environmental preservation and protection efforts have also been carried out across countries through bilateral cooperation and international groups. A nation's progress is always accompanied by rapid industrial growth. Indonesia is also experiencing rapid industrial growth. This industrial development will have a significant impact on the government in terms of state revenue and job creation, ultimately contributing to the well-being of the community. However, on the other hand, industrial development can have negative impacts in the form of pollution from industrial waste, including liquid, solid, and gaseous waste. To ensure that the presence of industry in an area will not have a detrimental impact on the environment, the industry must implement proper waste management in accordance with standards stipulated in government regulation No. 14 of 2008, Ministry of Environment Regulation.

A modern industrial area is a centralized area for industrial activities, equipped with supporting infrastructure developed and managed by an Industrial Estate Company that holds a business permit within the industrial area. The existence of an industrial area in a region is inseparable from the natural potential of the area, such as good transportation routes, the availability of raw materials that are the main ingredients for industrial processing, and a geographic location that supports accessible marketing of the industrially processed products. An urban area or urban area is a settlement that includes a main city and areas of influence outside its administrative boundaries, such as the surrounding suburban areas. An urban area is an area with a primary activity other than agriculture, with the functional structure of the area being urban settlements, the concentration and distribution of government services, social services, and economic activities (Government Regulation No. 34 of 2009). According to Law No. 26 of 2007, Urban Areas are areas whose main activities are not agriculture, with the functional structure of the area as a place for urban settlements, concentration and distribution of government services, social services, and economic activities. The urban infrastructure is as follows (Tarigan, 2005):

- Trade centers
- Service centers
- Urban infrastructure centers
- Social facility provision centers
- Government centers
- Communication centers and transportation bases
- Well-organized residential areas

Proper waste management will prevent environmental pollution caused by industrial waste. The government has issued environmental management policies and regulations, as outlined in Article 7a of Ministerial Regulation No.

14 of 2008, which mandates that those responsible for meat processing businesses and/or activities must conduct wastewater treatment to ensure that the discharged wastewater quality does not exceed the wastewater quality standards set out in Appendix I. An environmental impact analysis (AMDAL) must be conducted before establishing an industry. Every industry is also required to provide waste collection and treatment facilities. However, given the significant costs incurred by companies for waste management, many industries do not implement waste management measures to the fullest extent, or even neglect the process.

LITERATURE REVIEW

Industrial Waste Management/Drainage

The construction of required facilities includes roads, parks, buildings, and offices, as well as other supporting utilities such as wastewater treatment plants (WWTP) and hazardous waste management. The utility unit, which generates electricity and water, consists of the construction of distribution networks, buildings, offices, and equipment foundations such as pumps and piping systems. Work carried out after the completion of building construction and mechanical equipment installation includes the installation of electrical, water, instrumentation, and sanitation facilities such as toilets, air conditioning, telephone networks, and computer networks, both within and between buildings.

To meet overall water supply needs, a clean water network is available and has reached the entire Medan Industrial Estate (KIM). This clean water facility is supplied by PDAM Tirtanadi in the KIM Phase I and KIM Phase II areas. The current clean water system is capable of supplying 300 liters per second, and the capacity to supply 25,000 m3 per day will be continuously increased in line with industrial growth. To this end, PT. KIM (Persero) is building a Water Treatment Plant (IPA) with a capacity of 1,000 liters per second, sourced from the Deli River, 6 km from the site. To ensure a smooth water supply and distribution, a piping network will be built for both clean water and wastewater. Meanwhile, a cable network will be installed for the electrical distribution system. The cables will be buried 80-100 cm below the ground surface and covered with bricks and gravel, in accordance with the standards for installing live cables issued by PLN. Electricity will be distributed to office buildings and operational units via grounding wire. The Liquid Waste Treatment Plant (WWTP) of KIM Phase I and KIM Phase II is equipped with a centralized WWTP with a biological treatment system in an aerated pond. Therefore, the parameters that can be reduced/treated in this WWTP unit include BOD (Biological Oxygen Demand), COD (Chemical Oxygen Demand), SS (Suspended Solids), and TDS (Total Suspended Solids).

In the development of the KIM Phase III area, a WWTP with a capacity of 3,600 m3/day is planned, with the same treatment system as that of the KIM I WWTP. The treated wastewater is expected to comply with applicable regulations, namely Regulation of the Minister of Environment Number 03 of 2010 concerning Wastewater Quality Standards for Industrial Areas.

Hazardous and Toxic Waste Management Facilities In the development of the KIM Phase III area, one of the planned business units will be a Hazardous and Toxic Waste Management Unit, which will be managed and constructed by a third party. The location of the B3 Waste Management Unit is planned to be in the KIM 1 and KIM II areas. During the construction phase of the Medan Industrial Estate development facilities and infrastructure, it is estimated that there will be potential impacts on air and dust quality parameters, noise, groundwater, and public attitudes and perceptions.

METHODOLOGY

This research is a quasi-qualitative study. It focuses on the partial relationship between waste management and the succession of water transportation management in industrial areas. This research was conducted in the odd semester of 2025. Data for this study were sourced from several media sources and literature studies.

RESULT

Number of Companies

The definition of an Industrial Estate, according to Law No. 3 of 2014, defines an Industrial Estate as "an area where industrial activities are concentrated, equipped with supporting facilities and infrastructure developed and managed by an Industrial Estate Company." Government Regulation No. 142 of 2015 defines an Industrial Estate as "an area where industrial activities are concentrated, equipped with supporting facilities and infrastructure developed and managed by an Industrial Estate Company."

Industrial wastewater is water originating from a series of industrial production processes. Therefore, this wastewater may contain components derived from these production processes. If discharged into the environment without proper management, it can disrupt receiving water bodies. The impact of industrial wastewater pollution on the quality of receiving water bodies varies depending on the nature and type of waste, as well as the volume and frequency of wastewater discharged by each industry (Benefield D & Clifford, 1980).

Waste is a serious problem in Indonesia, which is increasing over time. The waste problem originates from various sectors, particularly industry. Industrial waste is a significant concern for industry players and the government, as it can cause various hazards and environmental damage that impact living things if not managed properly. Industrial waste is the residue or waste produced during industrial production processes. Different types of waste are generated depending on the industrial product being produced. For example, the textile industry produces not only food waste but also waste from the textile dyes used. Industrial waste is divided into four groups: liquid waste, solid waste, gas waste, and hazardous and toxic waste (B3). Liquid waste, as the name suggests, is the liquid waste produced during industrial production activities.

Amount of Waste

The Medan Industrial Estate (KIM), which covers a total area of 514 hectares, is a State-Owned Enterprise (BUMN) managed by PT. Kawasan Industri Medan. The numerous companies providing employment opportunities have led to the development of the KIM area, necessitating housing in the form of flats to accommodate workers close to their workplaces.There are 500 industries located in the Medan Industrial Estate (KIM), consisting of foreign and domestic companies, including 300 manufacturing companies and 200 industrial companies. This can undoubtedly lead to environmental damage, particularly for residents living in the Medan Industrial Estate, in the form of air and water pollution. Therefore, environmental pollution management in the Medan Industrial Estate is necessary in accordance with government regulations. Medan Deli District, as planned in the 1995 Regional Development Plan (RUUTRK), is located in the Northern Region, with easy access to the toll road and port areas. Based on the 2008 Medan in Figures statistical data, it is known that the concentration of industrial locations is in Deli District, this is due to the large number of industries in this district, namely 75 company units with a high population density which has the potential to become a slum area.

DISCUSSION

The urgency of handling and managing industrial waste is that production generates environmentally sensitive waste, whether in the form of liquid, solid, or other forms. Therefore, educating small-scale industrial businesses regarding the problems of handling and managing waste is crucial (Nasir and Fatkhurohman, 2010). The fundamental problem with waste management and handling is the lack of knowledge among business owners, particularly those in small-scale industrial groups. This then justifies the low awareness of waste management among small-scale industrial owners.

Wastewater Quality Standards Wastewater quality standards are the limits or levels of pollutants and/or the amount of pollutants that are tolerable in wastewater to be discharged or released into the water environment by a business and/or activity (Minister of Environment Regulation No. 5 of 2014).
Waste management in the Medan Industrial Estate combines waste generated by tenants within the area, including production industries, warehouses, canteens, and depots, and is referred to as communal wastewater treatment. Industrial waste management begins at the companies (factories) located in the Medan Industrial Area. The waste generated by these companies (factories) is first treated according to wastewater quality standards stipulated in Minister of Environment Regulation No. 5 of 2014 concerning Wastewater Quality Standards.

The wastewater, which has been processed internally within each industry, is then transported to the Medan Industrial Area Wastewater Treatment Plant (WWTP) through pipes or culverts provided in accordance with the limits set by PT KIM's WWTP, as shown in Table 2. The delivered liquid waste is then treated according to the wastewater quality standards stipulated in Minister of Environment Regulation No. 3 of 2010 concerning Area Wastewater

Quality Standards. After being processed according to the established quality standards, the liquid waste can be discharged into ditches or public drains (public media). The wastewater parameters that can be discharged to the WWTP are as shown in the table below.

The realization of the 2019 Wastewater Treatment Sector project activities reached Rp 8,523,028,500, compared to the 2019 Work Plan and Budget (RKAP) target of Rp 10,048,288, or 84.82%. The following is the capacity of the wastewater treatment plant at PT KIM Medan.

Table 2. The Capacity of the Wastewater Treatment Plant at PT KIM Medan

No	**IPAL Installation**	**Volume/Capacity**
1	Capacity	1.000 liter/sec
2	Mixing Chamber	48,245 m^3
3	Clarifier	794,112 m^3
4	Filter Tank	662,57 m^3
5	Clean Water Tank	427,65 m^3
6	Pempipaan	
7	MSCL	ø 60 - 15 cm
8	Upvc	25 - 40 cm
9	Pomp	Pompa
10	Distribution pumps	2 unit @500 lt/dt 1.000 lt/dt
11	Backwash water pumps	15 m^3 2 unit
12	Dosing pumps	11 unit
13	Air Blower	3 unit
14	Dosing Tank	
15	Caustic (kapur) storage tank	2 m^3
16	- Alum preparation tank	0,50 m^3

With the construction of a wastewater treatment installation system in the area By managing industrial wastewater, the impact of damage caused by factory wastewater can be minimized and prevented. Processing by collecting wastewater can also reduce the impact of hazardous waste disposal into the surrounding environment, including residential areas. Improper wastewater treatment can damage the environment and negatively impact the company's operations. Proper wastewater treatment can reduce negative environmental impacts while saving resources and costs. Water transportation management influences the wastewater treatment support system, ultimately ensuring that industrial areas maintain a good urban environment, in accordance with the law.

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impacts while saving resources and costs. Water transportation management influences the wastewater treatment support system, ultimately ensuring that industrial areas maintain a good urban environment, in accordance with the law.

A modern industrial estate is a centralized area for industrial activities, equipped with supporting infrastructure developed and managed by an Industrial Estate Company (IPC) that holds a business permit. The existence of an industrial estate in a region is inseparable from the impacts of industrial processes, such as industrial waste and air pollution. Industrial estates must be areas that support urban areas. They must be areas that support the structure of urban life, including employment, social, and environmental aspects. The Medan Industrial Estate (KIM), with a total area of 514 hectares, is a State-Owned Enterprise (BUMN) managed by PT. Kawasan Industri Medan.

The numerous companies providing employment opportunities have led to the development of the KIM area, leading to the need for housing in the form of flats to accommodate workers close to their workplaces. In conclusion, wastewater treatment capacity and transportation can mitigate the negative impacts of industrial processes.

CONCLUSIONS AND RECOMMENDATIONS

The urgency of handling and managing industrial waste is that production generates environmentally sensitive waste, whether in the form of liquid, solid, or other forms. Therefore, educating small-scale industrial businesses regarding the problems of handling and managing waste is crucial (Nasir and Fatkhurohman, 2010). The fundamental problem with waste management and handling is the lack of knowledge among business owners, particularly those in small-scale industrial groups. This then justifies the low awareness of waste management among small-scale industrial owners.

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standards, the liquid waste can be discharged into ditches or public drains (public media). The wastewater parameters that can be discharged to the WWTP are as shown in the table below.

Table 2. The Limits for Parameters Permitted to be Discharged to the PT KIM from the Company

No	Parameter	Unit	Limitation
1	Ph		6-9
2	Temperatur	^{o}C	25 – 40
3	COD	Mg/l	900
4	BOD	Mg/l	600
5	SS	Mg/l	1.000
6	TDS	Mg/l	4.000
7	Cl2	Mg/l	2
8	Lemak / minyak	Mg/l	10
9	NH3	Mg/l	25

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ADVANCED RESEARCH

Research in industrial management has a broad scope. This research focuses on the relationship between air handling and transportation management, which are partial components of holistic industrial management. Suggestions for future researchers include how to link financial policy to industrial management.

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