

Redesign of the temporary storage facilities for hazardous and toxic waste at PT X

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Abstract. PT X is an industry engaged in the production of snacks. The processes and activities in the industry produce by-products, namely hazardous and toxic waste. All waste is stored in temporary storage, but based on observations, the extant temporary storage does not meet the government's requirements. Accordingly, PT X redesigned a temporary storage area following government requirements. This study aims to identify a temporary storage location that complies with government regulations for PT X. Recording the types, characteristics, and quantities produced by PT X, followed by existing observation, is followed by the calculation of facility needs according to SNI and individual calculations. This research analysis provides property and layout recommendations to enhance the condition of PT X's temporary storage for hazardous and toxic refuse.

Keywords: hazardous and toxic waste, temporary storage, redesign, waste management

1. Introduction

Industrial operations conducted to increase community prosperity and economic development may have an impact on the environment. Industrial activities generate a diversity of waste types [1]. Hazardous and toxic waste, hereinafter referred to as hazardous and toxic waste, is the residue of a business or activity that contains hazardous and toxic waste. Hazardous and toxic waste refers to waste materials that possess hazardous characteristics or have the potential to cause adverse effects on human health or the environment [2]. Indonesia encounters difficulties in effectively managing hazardous waste material, as a substantial proportion of this waste is consolidated under the control of a single entity, PT. PPLI (Prasada Pamunah Limbah Industri) [3], with a payback period of 0.69 years and a rate of return of 85%, the nation must construct additional treatment centers to manage the growing quantity of hazardous refuse [3]. According to Darmansyah et al., (2023), Indonesia utilizes only about 16 % or 5.5 million tons of co-fly ash from around 34.1 million tons of total co-fly ash production, so Indonesia needs to increase the utilization of by-products in the coming years. Another study conducted the rate at which electronic products become obsolete and degrade into hazardous waste is accelerating, contributing to the increasing concern about e-waste [5]. To increase waste management's transparency and accountability, measures have been taken to investigate the factors that influence the disclosure of hazardous toxic waste in Indonesia [6]. Hazardous and toxic waste has the potential to contaminate the immediate environment, including soil, water, and air, while also posing a risk of igniting fires and triggering explosions [7]. According to Aviana, (2020) hazardous and toxic waste management is a technique created to avoid contamination and damage to the environment and the safety of living things. Furthermore, complications have arisen regarding the application of fly ash due to its classification as a hazardous material, which necessitates authorizations from the Ministry of Environment and Forestry [9]. The management of hazardous and toxic waste is necessary in order to transform it into a valuable resource or reusable material, while simultaneously preventing any detrimental impacts on the environment. The objective of this study is to assess the attributes of hazardous and toxic waste and propose a redesign of the temporary storage facilities at PT X.

2. Materials and Methods

This research was conducted during August - September 2022 PT X, Pasuruan County. Kristanti, (2021) mentioned for data collection techniques are carried out by observing the management of hazardous and toxic waste, including the characteristics of hazardous and toxic waste, hazardous and toxic waste packaging and temporary storage of hazardous and toxic waste, interviews conducted with HSE staff at PT X, and take serveral documentation of hazardous and toxic waste and temporary storage of hazardous and toxic waste. Hazardous waste can be identified using a variety of methods, such as generator waste ID numbers, waste identification systems, written inventories and documentation, tracking by ID number, container marking, process, operation, and material reviews, and waste characterization and documentation. These techniques are also supported by department interviews and written records of system development. Data on the condition of existing hazardous waste management includes the type, packaging and management of hazardous and toxic waste that has been carried out. The identification of hazardous waste aims to ensure that hazardous and toxic waste management procedures can be implemented in accordance with applicable regulations.

3. Results and discussions

3.1 Identification of hazardous and toxic waste

The initial activity in identifying the characteristics of the waste generated by PT X, the identification process by reviewing the types of waste generated and then equating the types of waste with applicable regulations. The code and characteristics of the

waste generated can be found in Appendix IX of Government Regulation No. 22 of 2021 on the Implementation of Environmental Protection and Management [11] PT X's hazardous and toxic waste consists of solid waste and liquid waste. The types and characteristics of PT X's hazardous and toxic waste are shown in Table 1.

Table 1. Identification of hazardous and toxic waste in PT X

Type of hazardous and toxic waste	Waste code	Hazard category	Charecteristics
Chemicals packaging waste	B104d	2	Corrosive and toxic
Oil waste	B105d	2	Flammable liquid
Majun fabric	B110d	2	Flammable solid
Turbular lamp	B107d	2	Poisonous
Waste battery	A102d	1	Corrosive and toxic
Waste lab	A106d	1	Infectious
Sludge WWTP	B108d	2	Poisonous
Sludge FOG	NCR	NCR	NCR

NCR: No characteristic results

There are 8 types of hazardous and toxic waste generated from PT X's production process. The determination of hazardous and toxic waste consists of categories 1 and 2, where category 1 is acute hazardous and toxic waste in the sense that it has an immediate impact on humans and the environment, while category 2 has a delayed effect and has no immediate impact on humans or the environment. Waste that is identified as not included in the list of hazardous waste types can be carried out through characteristic and toxicology tests using the procedures for determining hazardous and toxic waste (**Permen LHK no. 55, 2015**).

3.2 Packaging and storage of hazardous and toxic waste

Hazardous and toxic waste packaging is carried out so that each type of waste before being stored has been marked with a labeling system that is in accordance with the type and characteristics of the waste. Packaging of hazardous and toxic waste is carried out in accordance with the characteristics of the waste concerned [13].

Good and proper packaging will also facilitate supervision by the responsible officer. PT X's hazardous and toxic waste packaging and labeling standards are in accordance with the Indonesian packaging and labeling standards set out in the legislation on hazardous and toxic waste symbols and labels [14]. The following table shows the packaging and labeling of B3 waste at PT X:

Table 2. Packaging and storage of hazardous and toxic waste

Hazardous and toxic waste	Packaging and storage	Description
Chemicals packaging waste		Storage of chemical packaging waste in one place with waste lab
Oil waste		Packaging in good condition: no leaks, no rust and no damage (white jerry cans)
Majun fabric		Packaging in drum containers

Hazardous and toxic waste	Packaging and storage	Description
Tubular lamp and waste battery		• Tubular lamps are packed using cardboard boxes in a vertical position • Waste battery are packed using cardboard boxes in a vertical position
Sludge WWTP		Packaging in good condition: no leaks, no rust and no damage
Sludge FOG		Packaging in good condition: no leaks, no rust and no damage (blue jerry cans)

Based on table 2. there are some packaging / storage that does not have a cover, especially in chemical packaging waste and cloth. Therefore, a cover is needed to reduce the risk of harm to the environment and human health.

3.3 Temporary storage of hazardous and toxic waste

Storage activities must be carried out by every person who produces hazardous and toxic waste. Temporary storage place or commonly called TPS. Temporary storage of hazardous and toxic waste has a construction design and storage area that is in accordance with the type, characteristics and amount of waste stored, is able to protect hazardous and toxic waste from rainwater and direct sunlight, has adequate lighting and air ventilation. The floor of the building is made watertight, not strongly corrugated, not easily damaged, and has an embankment to localize splashes/spills. The inner floor is sloped towards maximum containment with a slope of 1%. Temporary storage is equipped with adequate facilities and infrastructure in accordance with OHS regulations.

3.3.1 Current conditions

Hazardous and toxic waste will be packaged in different drums or bags according to the type of waste, after packaging or packaging, hazardous and toxic waste waste needs to be stored in the temporary storage of hazardous and toxic waste. PT X must comply with several laws and regulations as well as government regulations and regulations of the Ministry of Environment, including laws that discuss temporary storage of hazardous and toxic waste which must meet the requirements [15]. Based on the field survey, overall, the existing labeling must be updated because it appears that some of the labeling has begun to fade in color. Some of the storage in the temporary storage of hazardous and toxic waste is not in accordance with existing regulations, especially in the chemicals packaging waste and majun fabric does not have a cover in their top of packaging and it can also be seen that the tubular lamp and waste battery storage boxes are not properly covered.

3.3.2 Redesign of temporary storage of hazardous and toxic waste

The temporary storage of hazardous and toxic waste land area provided is $4 \text{ m}^2 \times 3 \text{ m}^2$. Waste arrangement must pay attention to the characteristics of the waste. Figure 1 shows the recommended plan of PT X's temporary storage of hazardous and toxic waste.

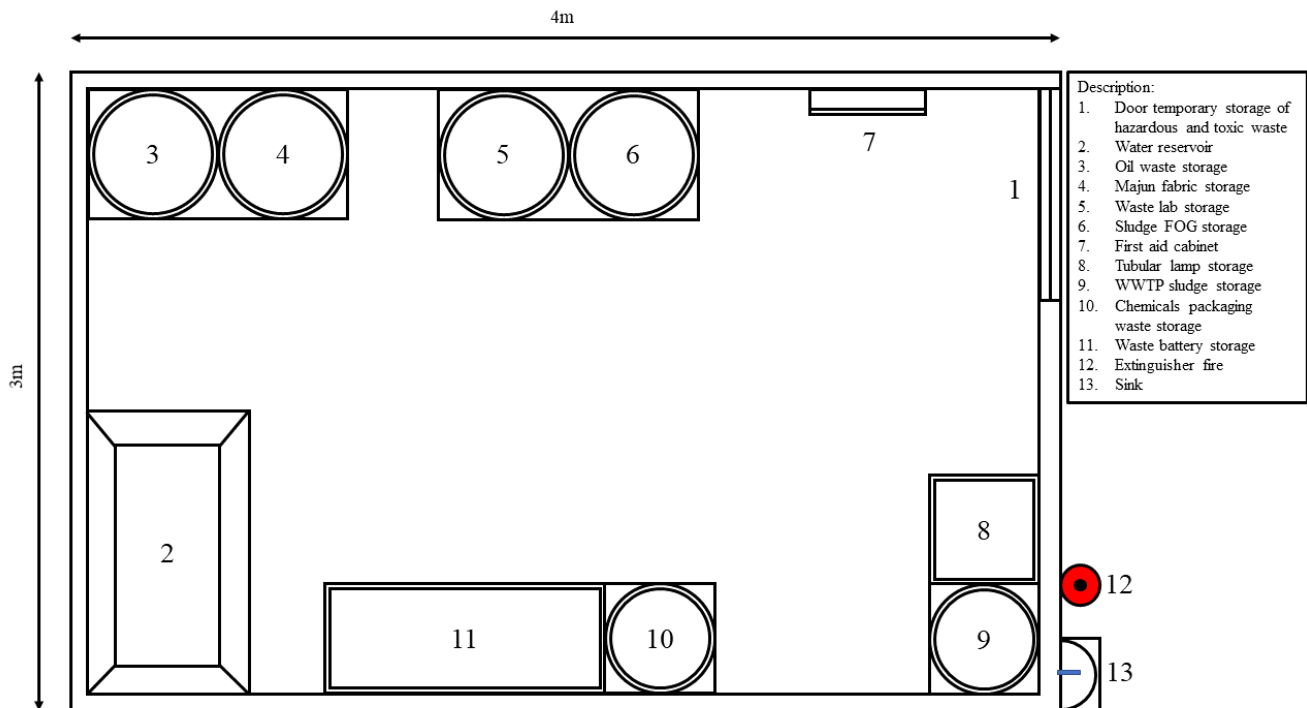


Fig 1. Layout recommendation temporary storage of hazardous and toxic waste in PT X

Based on Figure 1. layout and storage of hazardous waste, there are several recommendations that must be made such as separating the storage of tubular lamps and waste batteries because they have different characteristics. The addition of a sink and fire extinguisher is placed outside the building which aims to make it easier when there is an accident such as a fire in hazardous and toxic waste.

3.3.3 Property recommendations

Property recommendations aim to minimize work accidents during storage and transportation. Here are 2 property recommendations for temporary storage of hazardous and toxic waste at PT X:

1. Assessment of lighting requirements

Hazardous and toxic waste materials can be stored and transported more efficiently in a temporary storage area when adequate illumination is present. Existing comfort and safety regulations are outlined in SNI 03-6575-2001 and must be adhered to by the lighting system [16]. The lamp that will be used is a 1500-lumen LED lamp that uses 15 watts of power [17]. Therefore the results are obtained:

$$N = \frac{E \times L \times W}{\phi \times LLF \times Cu \times n} \quad (1)$$

$$N = \frac{1500 \times 0.7 \times 0.5 \times 1}{100 \times 4 \times 3}$$

$$N = 2.28 \approx 3$$

The result obtained is a temporary storage of hazardous and toxic waste requiring 3 lamps to illuminate the room.

2. Assessment of ventilation requirements

Proper air circulation is essential for the temporary containment of hazardous and toxic waste in order to mitigate the risk of gas condensation and subsequent chemical reactions with the waste. Construction apertures and ventilation significantly influence endeavors to implement wind energy for room conditioning [17]. The intended temporary storage facility in this instance is 4 m × 3 m in size, giving it a 12 m² floor area. The ventilation area should not be less than 10% of the room's floor area [17]. The ventilation area is obtained as follows:

$$\text{Minimum ventilation area} = \text{Room floor area} \times 10\% \quad (2)$$

$$\text{Minimum ventilation area} = 12 \text{ m}^2 \times 10\%$$

$$\text{Minimum ventilation area} = 1.2 \text{ m}^2$$

Minimum Ventilation Area of the room is 1.2 m², therefore, at least 1.2 m² of designed ventilation space is required. Ventilation is planned to have a size of 0.5 m × 0.5 m, and 5 ventilations will be made. It is mean, with 5 vents it has an area of 1.25 m².

4. Conclusion

Hazardous waste management in Indonesia is a critical issue that requires immediate attention and comprehensive solutions. The country faces significant challenges in handling and disposing of hazardous waste, leading to environmental and public health risks. To address this, it is essential for the government to enforce strict regulations, invest in proper infrastructure, and promote sustainable waste management practices. In this study hazardous and toxic waste comes from the production and operational processes of PT X. The management of hazardous and toxic waste carried out by PT X is the identification, packaging and storage of hazardous and toxic waste in the temporary storage. Transportation and utilization of hazardous and toxic waste is submitted to third parties. PT X produces 8 types of hazardous and toxic waste, namely chemicals packaging waste (B104d), oil waste (B105d), majun fabric (B110d), tubular lamp (B107d), waste battery (A102d), waste lab (A106d), WWTP Sludge (B108d) and FOG Sludge. Layout recommendation and property recommendations are the results of this research analysis which aims to improve the condition of temporary storage of hazardous and toxic waste in PT X.

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