

## Re-layout of Temporary Storage Area for Toxic and Hazardous Waste using 5S (Seiri, Seiton, Seiso, Seiketsu, Sitsuke)

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### Abstract

One of the industries that produces toxic and hazardous waste is rubber industry. This study was conducted in PT. Famili Raya. The problem was toxic and hazardous waste placed in an irregular placement and no follow the government regulations for storing and managing. This aims of this study were to redesign temporary storage area for hazardous waste based on 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke) and the regulation, Minister of Environment and Forestry No. 12/2020. The object of this study was temporary storage area for toxic and hazardous waste in PT. Famili Raya. The data used were current condition, actual dimensions of temporary storage area, dimensions of waste, input and output data, and dimensions of a forklift. The results obtained were the proposed layout using the 5S approach could be used to redesign the storage layout in the temporary storage area. Space utility could be reduced by 32,67%. The decrease in space utility did not reduce the maximum storage capacity for used batteries, used tubular lamp, used oil waste, and turpentine oil waste.

**Keywords:** temporary storage area, toxic and hazardous waste, 5S, rubber industry

### 1. Introduction

Industrial activities can produce toxic and hazardous waste materials whose properties and concentrations contain toxic and hazardous waste to damage the environment, interfere with health, and threaten the survival of humans and other organisms. Toxic and hazardous waste in industrial activities is a problem that needs attention—problems with Sandblasting Process toxic and hazardous waste at PT. Swadaya Graha related to the Sandblasting process was not by the prevailing regulations, namely PP. No. 101 of 2014, Kepka Bapedal No. 1 of 1995 and the Head of Bapedal No. 5 of 1995 (Murti and Ibrahim, 2018). Toxic and hazardous waste storage problems also occur in shipbuilding companies and maintenance workshops PT. Business Varia does not have a temporary storage area according to the established standards and needs to be planned and designed temporary storage area with a ventilation system, labeling, and symbols according to SNI 19-3964-1994 and the presence of lightning distributors, fire protection systems, lighting facilities, and ventilation systems according to standards PP No. 101 of 2014 and SNI 03-6572-2001 (Dewantara et al., 2018; Pratiwi et al., 2018).

In addition to companies, hospitals are places that produce toxic and hazardous waste. They must manage the toxic and hazardous waste by reducing, sorting, storing, transporting, processing, burying, and landfilling toxic and hazardous waste by Ministerial Regulation Number 56 of 2015 (Rachmawati et al., 2018; Pertiwi et al., 2017). In Clarisca and Samadikun's (2020) research, medical toxic and hazardous waste management is carried out at hospitals. Bhayangkara Tk. I Raden Said Sukanto where medical toxic and hazardous waste, such as infectious waste, sharp objects, chemicals, pharmaceuticals, and pathology, is

generated every day from medical activities carried out. Research conducted by Utami and Syafrudin (2018) related to toxic and hazardous waste management at PT. Holcim Indonesia Tbk. for Naronggong Plant refers to Government Regulation no. 101 of 2014. Managing toxic and hazardous waste includes identification and inventory, packaging, labeling and storage symbols, transportation by internal and third parties, and utilization.

PT. Famili Raya is a company that produces crumb rubber in the city of Padang. In its operational activities, the company produces toxic and hazardous waste, that it must provide a temporary storage area for the toxic and hazardous waste. Based on observations, the company has placed toxic and hazardous waste quite well on used tubular lamps and used batteries. However, used oil waste and turpentine oil waste are still placed without regular arrangement. It can reduce the smooth flow of waste at the time of receipt and delivery and harm the environment around the company. Based on the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 12 of 2020 concerning the area of toxic and hazardous waste, the impact of toxic and hazardous waste is hazardous for the environment. Companies must carry out proper preparation and placement by government regulations in storing toxic and hazardous waste (Ministry of Environment and Forestry of the Republic of Indonesia, 2020).

The arrangement and placement of storage warehouses have been carried out using a 5S approach. In previous research, the application of 5S can be used to redesign the layout and increase the utility of the warehouse space or storage space. A layout design with storage based on the popularity of raw materials can reduce the processing time by 34% and increase warehouse space utility by 13.22% (Widodo et al., 2013) and finished goods storage based on the frequency of movement into three storage classes (Kastoro and Nelfiyanthi, 2014). The application of 5S (Seiri, Seiton, Seiso, Seiketsu, Shitsuke) and safety can reduce waste in waiting time, delivery time, and time to find the required material (Kusnadi et al., 2018). Increased storage space capacity in the warehouse by 24.44%, sampling distance by 20.94%, and reducing the time and cost of finding samples by 63.81% with the concepts of similarity, popularity, and 5S (Maukar and Hakim, 2018).

Currently, no research discusses the layout design of toxic and hazardous waste temporary storage areas using the 5S approach. Research related to temporary storage area layout design, which refers to the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 12 of 2020, also does not exist. This research aims to redesign the layout of the temporary storage area for toxic and hazardous waste at PT. Famili Raya with a 5S approach and by the provisions of the regulation. This research is expected to contribute to toxic and hazardous waste layout design with a 5S system. The issuance of these regulations, the previous rules related to the storage of toxic and hazardous waste, namely Kepka Bapedal No. 1 of 1995, Decree of the Head of Bapedal No. 355 of 1996, and the Regulation of the Minister of the Environment Number 30 of 2009 is no longer valid. All companies and commercial sectors that carry out toxic and hazardous waste storage should follow these regulations.

## **2. Methods**

The type of research used is descriptive qualitative research. Qualitative descriptive research is a study to provide a systematic and accurate description of the situation that is the object of research (Fauzy, 2020). The object of research is the temporary storage area of toxic and hazardous waste owned by PT. Famili Raya. The primary data collected is the current condition of the temporary storage area, the actual dimensions of the temporary storage area, the dimensions of toxic and hazardous waste, data on receipt and delivery of waste, and the measurements of the material handling equipment. The method used is 5S to redesign the hazardous temporary storage area layout. Calculations of space utility and maximum storage capacity were calculated and compared before and after the temporary storage area layout redesign.

Room utility is the ratio between the total block area used and the total temporary storage area. This space utility aims to maximize the utilization of building space in the storage and operational processes. The utilization of space properly can facilitate the process of activities and support the optimal use of facilities (Kastoro and Nelfiyanthi, 2014, Kusuma, 2017). The calculation of space utility can be seen in equation 1

(Stephens and Meyers, 2013). Maximum storage capacity is calculated based on the dimensions of the waste and the area of the block used.

$$\text{Space Utilization} = \frac{\text{Storage space occupied}}{\text{Total available storage space}} \quad (1)$$

### 3. Results and Discussion

#### 3.1. Dimensions of Material Handling

Material handling used for temporary storage of used oil toxic and hazardous waste by PT. The CRF Famili Raya is Forklifts. This tool is used to transport used oil waste from several used oil-producing areas to temporary storage areas. The dimensions of the device are 266 x 120 x 232 cm. The weight of the load that can be transported is 3,000 kg in one transport (Table 1). With these dimensions, the tool can enter the temporary storage area and store the toxic and hazardous waste that the company produces.

**Table 1.** Forklift dimension

No	Type of Material Handling	Dimensions (cm)			Transportable Weight (kg)
		P	L	T	
1	<i>Forklift</i>	266	120	232	3.000

Source: PT. Famili Raya, 2020

#### 3.2. Layout of the Initial Hazardous Temporary Storage Waste

Dimensions of temporary storage area owned by PT. The Famili Raya is 3 x 3.5 x 3 m<sup>3</sup>. This toxic and hazardous waste temporary storage area consists of used oil waste, turpentine oil waste, operated tubular lamps, and used batteries with temporary storage area dimensions. The condition of the initial temporary storage area is the placement of used oil waste, and turpentine oil waste is irregular and tends to be placed in an area that is still empty. The available temporary storage area has also not been used optimally. It has not been grouped according to the latest regulation, Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 12 of 2020. The packaging for the storage of used oil waste and turpentine oil waste uses drum packaging. Still, it has not included the label and symbol for toxic and hazardous waste characteristics on the drum. The inside of the room has the emblem for toxic and hazardous waste written on, but there is no symbol for the toxic and hazardous waste stored in the building on the outside of the building. Light fire extinguishers or fire-fighting equipment are also unavailable, either outside or inside the temporary storage area (Figure 1).

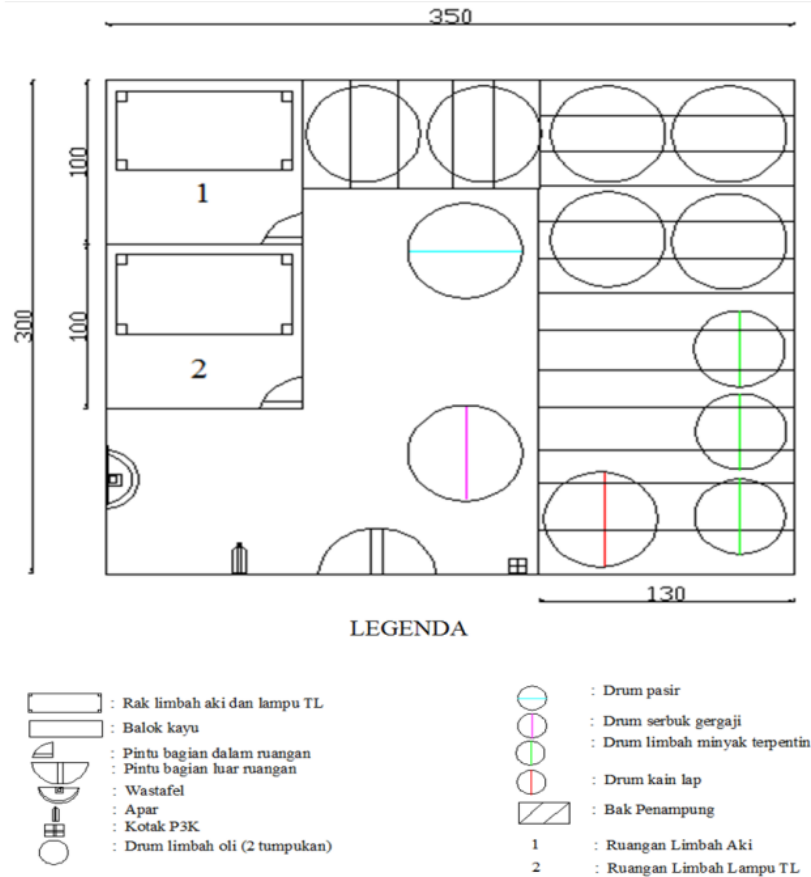


**Figure 1.** Indoor and outdoor conditions of PT. Famili Raya  
 (Source: Personal Documentation, 2020)

#### 3.3. Calculation of Space Capacity and Utility in Initial Layout

Based on Figure 2, the area of the temporary storage area is 10.5 m<sup>2</sup>, with the block area used being 8.26 m<sup>2</sup>. The calculation of the block area used consists of the site for placing used oil waste and turpentine oil waste (3 x 1.3 m and 1.16 x 0.58 m) and the storage area for used batteries and used tubular lamps (2 x 1 m). The storage of used oil waste and turpentine oil waste is carried out in one pile. For used batteries measuring 11.3 x 7 x 10.5

m and used tubular lamps measuring 60 cm and 90 cm, storage is carried out using two-level shelves. Based on the storage area, the space utility in the initial layout is 78.67%. The room capacity that can be used is 20 used batteries, 24 used tubular lamps, and 14 drums with a total of 200 l for waste oil and waste turpentine oil. With used oil waste and turpentine oil waste produced as much as 6-12 drums per quarter (table 2), the temporary storage area can accommodate the amount of toxic and hazardous waste. The time the toxic and hazardous waste is stored is three months before being handed over to a third party.



**Figure 2.** Initial layout of toxic and hazardous waste temporary storage area  
 (Source: Personal Documentation, 2020)

**Table 2.** Receipt and delivery of used oil waste and turpentine oil waste pt. famili raya

Month	Reception	Submitted	Number of Drums
Jan	533		
Feb	429	1600	8
Mar	638		
Apr	793		
Mei	831	2400	12
Jun	776		
Jul	620		
Agu	582	1800	9
Sep	598		
Okt	473		
Nov	410	1200	6
Des	317		

Source: PT. Famili Raya, 2020

### 3.4. Provisions for Temporary Storage Places by the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia No. 12 the year 2020

Hazardous waste storage can be in buildings equipped with first aid facilities, handling of spills from toxic and hazardous waste, and according to the type, characteristics, and storage space area. The building structure has a windward ventilation system for air circulation. Storage areas in the form of buildings must protect from rain and sunlight, and the roof is not flammable. The compatibility of hazardous waste characteristics also needs to be considered. The attributes of used batteries are corrosive and used tubular lamps have harmful parts to the environment. The characteristics of used oil waste and turpentine oil waste have flammable elements. Based on these regulations, the compatibility of B<sub>3</sub> waste in the form of flammable liquids is compatible with corrosive B<sub>3</sub> waste. Still, it is limited by the characteristics of being hazardous to the environment.

Drum packs with a capacity of 200 l can be stacked on two levels using pallets as a separator between the lower and upper stacks, or they can be stacked on four levels using racks. The distance between the top pile and the roof or ceiling is 1 m. The hazardous waste storage drum must be equipped with symbols and labels on the packaging—the height of the temporary storage area building owned by PT. Famili Raya is 3 m. The distance between one storage block and another is 60 cm. To anticipate spills of hazardous waste mixed with each other, the storage section must be separated by making a dividing boundary in the form of a dike as drainage and connected to a holding tank with a maximum slope of 1% on the inner floor.

### 3.5. Usulan Proposed Improvement of the Layout of the Temporary Storage Area for Hazardous Waste

The proposed layout improvement at the toxic and hazardous waste temporary storage area uses the 5S approach. The 5S principles that can be applied are as follows:

1. *Seiri (Sort)*

Sort or distinguish between what is needed and what is not needed. Please get rid of what is not required and look for the causes and eliminate the cause so that it does not cause problems again. In the previous layout, the drums have not been grouped, where the sand drum is still in the oil drum area, and the distance of the storage block between toxic and hazardous waste is still not by the regulations. The sorting of goods carried out is by classifying waste according to the toxic and hazardous waste type and characteristics.

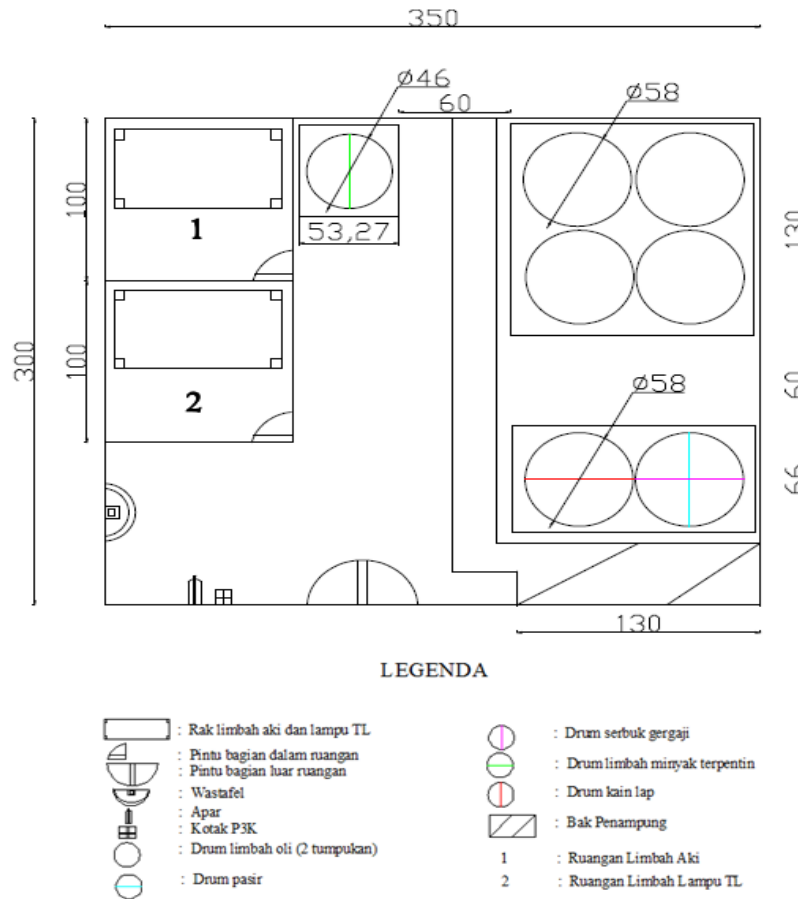
2. *Seiton (Set in Order)*

At this stage, it can be done by placing toxic and hazardous waste and storage packaging in the right place. In its design, used batteries and used tubular lamps have not changed the layout and are still by their storage provisions. Storage for waste used oil and turpentine oil is made in two piles using pallets with a thickness of 15 cm as a separator between stacks. The maximum pile height produced is 1.87 m and still leaves 1.13 m from the roof. The arrangement for storing used oil waste and turpentine oil waste is 2 x 2 and 4 x 4. To facilitate the movement of toxic and hazardous waste material using a forklift, the aisle width between blocks is 60 cm. In addition, a light fire extinguisher is placed on the left side of the door and adjacent to the first aid kit and sink. The area can be used as an area for temporary storage area support facilities. On the right side of the entrance, placed a reservoir. This tub is used to accommodate spills of used oil waste and turpentine oil waste as one of the initial facilities for emergency conditions in toxic and hazardous waste storage so that toxic and hazardous waste does not flow out of the toxic and hazardous waste temporary storage area, by running this stage, the design of the temporary storage area layout at PT. The Famili Raya is arranged as shown in Figure 3.

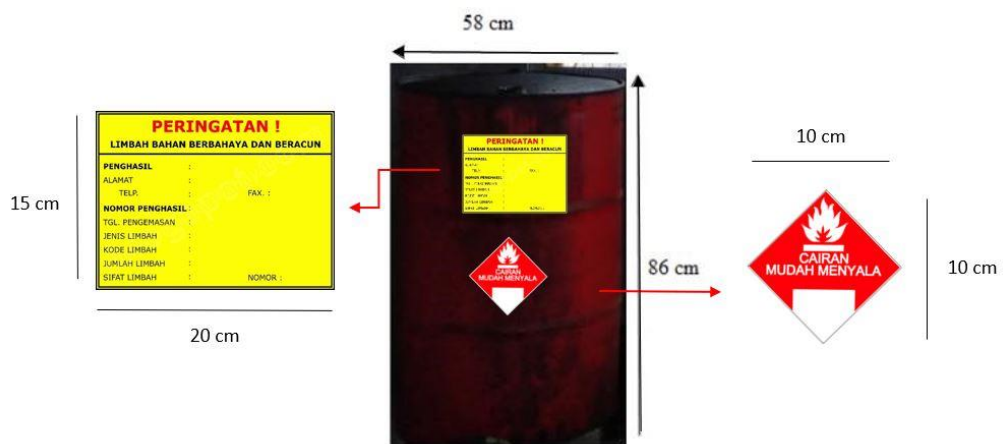
3. *Seiso (Shine)*

The essence of this stage is cleansing. Workers carry out this application after carrying out activities in the temporary storage of B<sub>3</sub> waste. This cleaning must be done on the floor by spilled oil, which can cause the floor to become slippery and dangerous for other employees. The spaces between the beams and the dust in the room are also cleaned, and toxic and hazardous waste symbols and labels are

attached. This design is carried out by making symbols and labels for drum packaging and displaying signs outside the TPS room. The flammable liquid symbol with 10 x 10 cm and a label measuring 20 x 15 cm is affixed to the drum packaging of used oil waste and turpentine oil waste (figure 4). Symbols of dangerous to the environment, flammable liquids, and toxic are also affixed to the outer wall of the temporary storage area building with a size of 25 x 25 cm, as shown in figure 5.

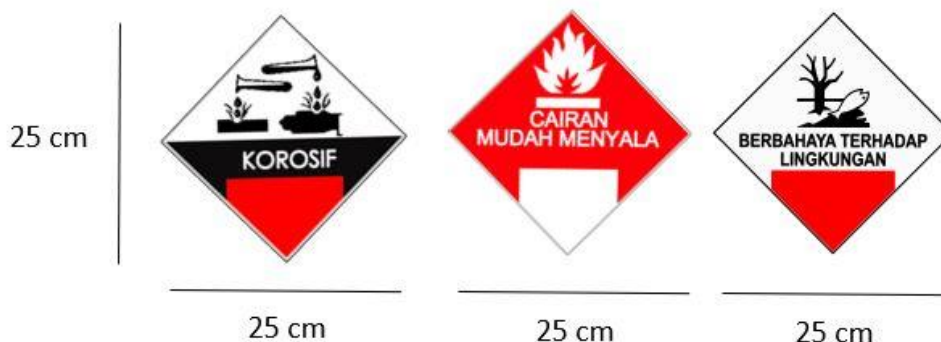


**Figure 3.** Layout of the proposed hazardous waste temporary storage area  
 (Source: Personal documentation, 2020)



**Figure 4.** Symbols and labels on used oil waste storage packaging and waste oil turpentine  
 (Source: Minister of Environment Regulation No. 14 of 2013)





**Figure 5.** Symbol of hazardous waste for outside temporary storage area pt. famili raya  
(Source: Minister of Environment Regulation No. 14 of 2013)

4. *Seiketsu (Standardize)*

After the previous three steps have been carried out, the next step is the implementation of standardization. The logbook needs to be filled in on an ongoing basis by the employee assigned to find out information on the amount and date of receipt and delivery of toxic and hazardous waste. A toxic and hazardous waste balance must also be provided and filled in regularly. The placement of the Standard Operating Procedure is affixed to the temporary storage area wall as information for employees to store in the temporary storage area and submit toxic and hazardous waste to third parties.

5. *Shitsuke (Sustain)*

At this stage, the company will try to find out how this suitable procedure will continue to run stably and consistently in the temporary storage area for toxic and hazardous waste. Implementation of 5S will not succeed without awareness and consistency. In addition, a high commitment is needed in the performance of 5S where the widespread attention of every employee is required, which ultimately becomes a good culture. The habit of 5S procedures provides duties and responsibilities for every worker who will carry out activities to temporary storage area toxic and hazardous waste PT. Famili Raya and has a continuous standard of work system.

### 3.6. Calculation of Space Capacity and Utility in the Proposed Layout

In the proposed layout design, the storage of used oil waste and turpentine oil waste is carried out in two piles. The applicable height of two piles is 1.87 m (including 15 cm pallet thickness). The storage area for used batteries and used tubular lamps has not changed, which is 2 m<sup>2</sup>. The storage area for used oil waste and turpentine oil waste is 4.83 m<sup>2</sup>. The area consists of 1.3 x 0.66 m<sup>2</sup>, 1.3 x 1.3 m<sup>2</sup>, and 0.53 x 0.53 m<sup>2</sup>. Space utility can be reduced from 78.67% to 46% or decreased by 32.67%. Despite the decrease in space utility, the maximum storage capacity has not changed. The room's capacity is 20 used batteries, 24 used tubular lamps, 12 drums with a capacity of 200 liters for used oil waste, and two special drums for storing turpentine oil waste.

### 3.7. Discussions

The realization made by PT. Famili Raya in storing toxic and hazardous waste has not been by applicable regulations. That is in line with the results of research conducted by Dewantara et al. (2018) and Clarisca and Samadikun (2020), where toxic and hazardous waste storage is still found that is not accompanied by toxic and hazardous waste labels and symbols in storage containers and TPS buildings that it is necessary to design toxic and hazardous waste labels and signs. As a step or action that can be taken referring to the applicable regulations. The design of the toxic and hazardous waste temporary storage area with the 5S approach can reduce space utility but not change storage capacity. This reduced space utility also occurs in the research of Kusnadi et al. (2018) and Maukar and Hakim (2018). Still, in Kastoro and Nelfiyanthi's (2014) study, the application of 5S can increase its storage capacity. Based on the results obtained, the storage of toxic and hazardous waste that is not by the regulations needs to be redesigned by the regulations still in force. The

redesign of toxic and hazardous waste TPS using the 5S approach can reduce space utility and maintain its storage capacity.

#### 4. Conclusions

Based on the research results, the 5S approach can rearrange the layout of the toxic and hazardous waste temporary storage area. The proposal based on the 5S method is to separate and sort goods in the temporary storage area, group toxic and hazardous waste according to the characteristics and provisions in the regulations, carry out cleaning, arrange symbols and labels for toxic and hazardous waste, determine standardization of reception and delivery of toxic and hazardous waste. And habituation of 5S procedures. Toxic and hazardous waste storage layout at PT. Famili Raya experienced changes in the storage of used oil and turpentine oil, but there was no change in the storage of used batteries and used tubular lamps. Space utility can be reduced by 32.67%, with the maximum storage capacity unchanged compared to the initial layout. This research is limited to the design of toxic and hazardous waste storage by the provisions of the latest Ministerial regulations and has not discussed the amount of toxic and hazardous waste and efforts that can be made to minimize the amount of toxic and hazardous waste generated by the company.

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