The Transportation and Storage Conformity Evaluation of Hazardous and Toxic Waste of Fertilizer Production (A case Study in Industry X of West Indonesia)

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Abstract. Industry X is one of the sectors of the fertilizer and chemical industries that produce ammonia and urea. Their factory has a mass production that also makes them produce a huge amount of waste, especially Hazardous and Toxic Waste (B3 in Indonesian abbreviation). The resulting hazardous waste hereinafter referred to B3 Wastes, will then be managed under the applicable laws and regulations. The management of B3 wastes starts from the source and the producer of B3 wastes, temporary storage (TPS LB3 and TPS Fly Ash and Bottom Ash), waste labelling, and the generation of B3 wastes. This study aim (1) to recognize the condition of B3 in Industry X, (2) to identify kind of B3 waste in Industry X, and (3) to evaluate the operational of B3 packaging and labelling. The researchers will hold an observation, literature study, interview, and discussion as the data collection methods. Additionally, the analysis of the results and discussion of this study uses qualitative descriptions.

Keywords: Bottom Ash, Fly Ash, B3 Waste.
1. Introduction
The demand for fertilizer in Indonesia is very high and continues to increase year by year. Consequently, the increase in fertilizer production in Indonesia also leads to an increase in waste generation. This problem is also undertaken by one of the fertilizers producing companies in the west region of Indonesia [1]. The factory mass production certainly makes them generate a massive waste, especially Hazardous and Toxic Waste (B3 in Indonesian abbreviation). Thus, the management hazardous waste hereinafter referred to B3 Wastes needs to be controlled properly under the applicable laws and regulations [2].

The amount of generated waste must be supported by the availability of adequate storage capacity and done under B3 waste management standards. Therefore, as the background, this study aims to identify and evaluate the conformity of the application of B3 waste storage and management in the fertilizer industry.

2. Material and Method
This study was conducted in early 2020 in the transportation and storage sector of the national fertilizer factory waste represented by industry X, located in the west region of Indonesia. This study applies a field survey approach and a conformity evaluation study based on Ministerial Regulations and Environmental Impact Management Agency (BAPEDAL) Decree as well as the appropriate standards. Analysis and discussion of this study are presented in a descriptive qualitative method.

3. Results and Discussion
The observations on Work Safety aspects indicate that the efforts of the fertilizer industry X, in particular, can be said to be precise, since every employee and guest who enters the factory area must go through the following procedure: (1) Following the Personal Data Fill and Evaluation (PDPE) executed by the KAMTIB (security and (public) order) Department. (2) Following the direction of Occupational Safety and Health (K3) organized by the K3LH Bureau. (3) Have a red badge for the factory employee issued by the KAMTIB (security and (public) order) Department (4). Using safety equipment, including safety shoes, helmets, earplugs and earmuffs for noise levels > 90 dB (specifically in the area of the compressor house) [5].

One of the environmental activities carried out by the factory is to implement an ISO 14001/9002 Management System, which internally and externally audited to find a better way to control pollutants. Other activities are including routine monitoring to make sure that no pollutants flow into the sea. The results of marine monitoring in the waters of Industrial X are showing the same results as the previous marine monitoring activities. The evaluation of the obtained flue gas has also met the quality standard limits set by the Minister of the Environment. Further, the factory is also performed monthly monitoring evaluation of noise pollution to reach the tolerance limits.

3.1. The Identification of Solid and B3 Waste
The activities of the B3 waste dump site of Industry X are B3 waste management activities. The storage of B3 wastes is one of a series of B3 waste management activities undertaken by Industry X, including the packing, transporting, and storing of B3 waste. However, the coal ash waste will be stored and transported to the waste dumpsite hereinafter referred to as TPS, specifically for coal ash. The main activity in the B3 waste TPS is the storing of B3 waste with packing and transporting as its supporting activities. Yet, there is no coal ash packaging activity in coal ash TPS.

The B3 waste generates from the production process and the operational activities support of Industry X. The area of B3 waste TPS and coal ash TPS are 600 m2 and 0.19 Ha respectively for block A and 2.72 Ha for block B. The determination of TPS areas are based on the estimated B3 waste and coal ash generated by Industry X. The TPS building and its supporting facilities are made by referring to the KABAPEDAL decision No. Kep-01 / BAPEDAL / 09/1995. The activities carried out at the TPS are the temporary storage of B3 waste and coal ash before further management. The B3 waste TPS has separated into two different storage areas; the liquid waste storage area and the solid waste storage area. Yet, the TPS of coal ash is only designed to store coal ash (fly ash and bottom ash).
Fig. 1. Identification Result

The B3 waste storage repository is used to temporarily store B3 waste that has not been handled and utilized. Based on Government Regulation No. 101 of 2014 concerns with B3 waste management and Decree of the Head of Bapedal Number 01/ Bapedal / 09/1995 concerns with Procedures and Technical Requirements for B3 Waste Storage and Collection. Every person or B3 waste-generating company that performs the temporary storing must obey the applicable regulations. The size of the repository storage is 50m x 12m or 600m2 with a height of 5m and coordinates of N 00 ° 10 '40.7 "E 117 ° 29' '15.5". For the solid waste, the maximum capacity is 100 pallets or 100 bags of used waste insulation. The maximum capacity is 100 pallets with 4 drums or 4 jerry cans of used oil waste or laboratory waste per 1 pallet. The B3 waste TPS itself is equipped with fire fighting equipment, personal protective equipment (PPE), and first aid kits located near the control room and shower/eyewash.

The compliance with the requirements for the Temporary Storage of B3 Waste in Industry X with BAPEDAL No. 1 of 1995 and PP No. 101 of 2014 concerning Hazardous Waste Management explained as follows: (1) The condition of B3 waste packaging is rust free, neither leak nor overflow, but there is still some outside rust on the drums, but a replacement has been carried out. (2) The packages containing different B3 waste are stored separately, not in one block, nor in the same storage section. (3) The stacking of the B3 waste packaging based on the weight of the waste. (4) The storage of packaging has been made with a block system. Each block consists of 2 (two) x 2 (two) packages. (4) The width between blocks for the aisle is more than 60 cm [3].

3.2. The Evaluation of B3 Waste Storage Buildings

The evaluation of the B3 waste temporary storage building in Industry X consists of several types. The characterization and categorization are referring to the Decree of the Head of the Integrated Licensing and Investment Service Agency. Most of the B3 wastes in Industry X characterized as toxic B3 waste. Therefore, the contained waste in the temporary storage area of B3 waste does not need to be separated into different buildings. However, the toxic B3 waste must still be separated by using a wall with the other storage areas. The size of LB3 TPS for the solid and liquid waste is 50m x 12m with a capacity of 100 pallets each, with a pallet size of 1x1m.

B3 waste categorized as the first category if it is explosive, flammable, reactive, infectious, corrosive, toxic characteristics that have been through TCLP Test (if the pollutant concentration > the concentration of TCLP-A pollutant), and toxic that have been tested through the Lethal Dose Fifty LD50 Toxicology Test with LD50 ≤ 50 mg/kg of the weight of the guinea-pig. However, B3 waste categorized into the second category if it has toxic characteristics that have been through TCLP Test (if pollutant concentration > concentration of TCLP-B pollutant), toxic through the Lethal Dose Fifty Toxicology Test with LD50: 50-5000 mg/kg of the weight of the guinea-pig, and toxic through the Sub-Chronic Toxicology Test according to the test parameters.

The architecture and area of the storage are builds based on the type, quantity, and characteristics of the B3 waste. The size of TPS block A is 19.9 m x 99 m with a capacity of 7,500 tons, while TPS block B has 220.6 m x 123.24 m size with a greater capacity of 54,750 tons. Both TPS blocks are coated with a 1.5 mm thick geo membrane. From the observations that have been executed in the temporary storage area of Fly Ash and Bottom Ash of coal boilers, generally, the storage has met the applicable provisions under the Decree of the Head of the Integrated Licensing and Investment Service Agency Number 14 of 2015 concerning B3 waste management permits for B3 waste storage activities in the form of Fly Ash and Bottom Ash of Industry X's Coal Boiler. It recognized matches the provisions since the storage area is coated with a geo membrane, has fire fighting equipment, personal protective equipment (PPE), as well as the first aid kit located near the control room and shower/eyewash. Furthermore, the tarpaulin as the cap/protector of coal ash waste is available in the temporary storage of fly ash and bottom ash of Industry X's coal boiler. According to the Minister of Environment Regulation Republic of Indonesia No. 14 of 2013 concerning the symbol and labelling of B3 waste [4] and the Decree of the Environmental Impact Management Agency (BAPEDAL) No. 1 of 1995 concerning the procedures and technical requirements for the storage and collection of B3 waste, the symbol in the storage of B3 waste in the TPS of Industry X has been following and met the applicable requirements.

According to the Regulation of the Minister of Environment Republic of Indonesia No. 14 of 2013 concerning the symbol and labelling of B3 waste as well as the Decree of the Environmental Impact Management Agency (BAPEDAL) No. 1 of 1995 concerning the procedures and technical requirements for the storage and collection of B3 waste [6]. The storage of B3 waste in Industry X requires symbols and warning signs. This warning sign
aims to provide an identity for B3 waste that makes them easily recognized. Through this warning sign, the managers, supervisors, and people around the storage can easily identify the type and characteristics of B3 waste in the storage. The process of B3 Waste Storage Activities by Industry X performed through the following stages:

![Diagram](Fig. 2. The storage of B3 waste)

The longest storage of B3 waste at the TPS explained as follows:

1. 90 days since the B3 waste generated, for the production of 50 kg B3 waste per day or more.
2. 180 days since the B3 waste generated, for the production of less than 50 kg category I of B3 waste per day.
3. 365 days after the B3 waste generated, for the production of less than 50 kg per day of the category II of B3 waste generated from unspecified sources and general specific sources.

The process of coal ash management by Industry X performed through the following stages:

![Diagram](Fig. 3. The management of coal ash)

In compliance with the requirements of Decree of the Head of Bapedal Number: 01 / Bapedal / 09/1995 concerning Procedures for the Storage and Collection of B3 Waste, the longest storage of B3 waste at the TPS described as follows [7]:

1. 365 days after the B3 waste generated, for the production of less than 50 kg per day of the category II of B3 waste generated from unspecified sources and general specific sources.

The obligations to fulfil the provisions apply in the implementation of B3 waste temporary storage described as follows:

1. Managing all the stored B3 waste based on its type, characteristics, as well as the category of B3 waste at the designated place.
2. Avoiding spills of stored B3 waste, especially flammable or explosive waste, as well as implementing good housekeeping procedures.
3. Recording the flow of the amount of B3 waste that enters and leaves the storage based on the type and volume into the B3 Waste Balance Sheets.
4. Carrying out run-off management of the Fly Ash and Bottom Ash Coal Boiler Storage Activities.
5. Conducting regular checks on Geo membrane that capped the temporary storage area and making an immediate repair once damage occurs.
6. Capping the stored fly ash and bottom ash waste with tarpaulin and/or watering the stored fly ash and bottom ash waste regularly.
7. Watering and/or capping the fly ash and bottom ash waste with a tarpaulin during the transport from the boiler to the B3 waste TPS as well as during the off-taker (handover to the third parties)

According to the survey conducted at the Industry X's B3 waste TPS, resulted that the building of B3 Waste Temporary Storage, the drum storage, is a flood-free area with a minimum distance of 50 meters to public facilities. Furthermore, the location has also in compliance with the requirements of Government Regulation No. 101 of 2014 concerning B3 waste management and Decree of the Environmental Impact Management Agency (BAPEDAL) No. 1 of 1995 concerning the procedures and technical requirements for the storage and collection of B3 waste [8].

3.3. The Evaluation of Fly Ash and Bottom Ash TPS

According to the decision of the Head of the Integrated Licensing and Investment Services Agency of Institution Government Number 14 of 2015 concerning B3 waste management permits for B3 waste storage activities in the form of Fly Ash and Bottom Ash of Industry X's Coal Boiler, the Integrated Licensing and Investment Services Agency of Bontang have granted permits for the temporary storage of Fly Ash and Bottom Ash of Coal Boilers to the Industry X.

3.4. The Evaluation of B3 Waste Transportation in Industry X

According to PP No.101 of 2014 concerning the management of B3 waste, the transportation of
Industry X’s B3 waste has met the requirements under the applicable regulations since the waste transported by using a closed conveyance. The transportation uses a 20x8x8 feet container, by land, sea, and air. The maximum transportation under the applicable regulations is 24 tons. However, Industry X transports only 20 tons, concerning safety reasons as agreed with the 3rd party. The transportation scheduled every 3 months, at the end of the quarter. The waste from B3 waste TPS was taken out on December 5, 6, and 7, 2019 with a total of 30,553 tons of solid waste, 1.96 tons of liquid waste, 7.023 tons of used oil, and 1,087 tons of used lamps. The total amount of waste taken out from the B3 waste TPS in the fourth quarter was 40,623 tons, proposed to be handed to PT PPLi. Besides, the coal ash at FABA TPS was taken out on 16, 17, 18, 19, 20, and 21 December 2019, with the amount of 24090,6311 tons of Fly Ash and 751.65 tons of Bottom Ash. Further, the total fly ash and bottom ash that is taken out in the fourth quarter is 24842.2811 tons to be handed over to PT KIE. However, each transportation done by Industry X has a permit and has been listed by the government agency.

3.5. The Evaluation of B3 Waste Utilization
1. Before B3 waste used as a substitution of raw materials for making bricks and paving blocks, it must meet the following criteria: a. The total content of SiO2, Al2O3, Fe2O3 and CaO oxides is at least 50% (fifty percent); and b. The value of Loss of Ignition (LOI) is not more than 10% (ten percent);
2. The utilization of B3 waste performed through the following stages: a. B3 waste that meets the criteria test will be mixed with the other raw materials using a mixer with a composition of B3 waste at most 30% (thirty percent) and added water until it is homogeneous; b. The results of the B3 Waste mixing and stirring process are then printed using a printing press into a brick and/or paving block; and c. The molds are arranged in an open room, doused with water, and left until perfectly dry;
3. The equipment used in B3 Waste Utilization activities consists of: a. 1 (one) unit of mixer with a capacity of 15 tons/day (fifteen tons per day); and b. 2 (two) printing machines with a capacity of up to 1000 pieces/day (one thousand pieces per day).

The holistic result of evaluation indicates that Industry X meet all the regulation criteria. The summary of evaluation graph can be seen below.

![Holistic Evaluation](image)

Fig. 4. Holistic Evaluation Result

The graph describes that Industry X meet all the entire criteria as the achievement of the corporate’s effort to government regulation B3 Waste Management. Industry X get the best score 8.5/7.5 in label and symbol conformity due to easiest to control.

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4. Conclusions
1. The TPS buildings and B3 waste management permits are already performed under the applicable terms and conditions, whether the location as well as the temporary storage building.
2. The B3 waste in Industry X generated from JPP, factories, labs, and offices. After that, it stored in the B3 waste TPS. Furthermore, the temporary storage is already under SOP. The waste then partly utilized, and some of it handed over to the licensed third parties for subsequent management. In coal ash waste, plant 6/boiler produces fly ash and bottom ash. Then the waste stored in the FABA B3 waste TPS and some other utilized. After that, the waste transported to dock 8 (port) by the transporters and finally submitted to the third party.
3. There are several symbols and labels on every container/packaging in Industry X that must be completed. For example, B3 waste in the storages
only has 1 (one) symbol, while the waste has 2 characteristics.

References


