Hazardous Waste Management in the Cement Industry for Alternative Raw Material (ARM) or Alternative Fuel (AF)

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Abstract

Hazardous waste from the cement industry can pollute the environment and human health. The use of cement industry waste can be done to minimize this impact. This study aims to analyze the initial conditions of hazardous waste management in the cement industry and its potential utilization. This research was conducted by field observation through three stages, namely the stages of preparation, implementation, and preparation of reports. The XYZ cement industry has two procurement schemes, polutter payment and purchase. The XYZ cement industry permits hazardous waste as an alternative raw material (ARM) for fly ash, bottom ash, paper sludge, drilling cutting, crude oil, contaminated soil, and bleaching earth/eco oil, EAF (electric arc), and dust furnaces. Meanwhile, alternative fuel (AF) consists of used bag cloth, majun (contimated textile waste), used oil, kluber, used grease, resin, and pure SBE (spent bleaching earth).

Keywords: Hazardous Waste, Cement Industry, Potential Utilization, Alternative Raw Material, Alternative Fuel

I. INTRODUCTION

The cement industry is one of the essential industries in supporting the development of a country [1]–[3]. Cement consumption is an indicator of a country's economic growth. The high and low consumption of cement shows the country's infrastructure development level. Cement is a significant component in infrastructure development, such as buildings, toll roads, ports, airports, bridges, and other infrastructures [4]. As with other industries, the cement industry has the potential to generate waste. Waste in the form of fly ash, bottom ash, and several other types of waste is hazardous and toxic waste [5]. If this waste is not handled correctly and adequately, it is feared to harm industrial activities and the surrounding environment.

Cement is an essential adhesive agent for the construction industry and is produced in large quantities worldwide. The cement factory is an industry in most of its production in the form of size reduction and combustion (pyroprocessing). It is one of the major contributors of pollutants to air pollution, such as gas emissions and dust particles. In 2012 world cement production reached 3,600 million tons [6]. The cement production process is a process that requires a lot of thermal energy, up to 3.68 GJ/ton of clinker produced [7]. The high demand for cement and the increasingly limited non-renewable energy and natural raw materials encourage the cement industry to seek alternative sources of energy and raw materials. On the other hand, there is a need for proper and safe handling and management of waste in line with the increasing amount of waste due to increasing industrial and commercial activities and public demands for environmental quality [8]. One of the efforts to overcome these problems is to utilize waste as a source of energy or raw material for cement production through co-processing to assist waste management while securing fuel supply.

Meanwhile, what is meant by hazardous waste based on Government Regulation (PP) Number 101 of 2014 is the residue of a business or activity containing hazardous and toxic materials. Hazardous waste is waste or material that is hazardous because of its amount, concentration, or physical and chemical properties. This waste can cause or can significantly contribute to an increase in disease and death and be harmful to human health or the environment if not properly treated or managed, stored, carried, or thrown away. Based on this understanding, the difference between hazardous and hazardous waste can be seen. Suppose hazardous is a material that contains hazardous and toxic properties to be used for an activity. In that case, hazardous waste is a part of an activity containing hazardous and toxic materials. Hazardous management and hazardous waste management will be different. In this report, the scope used is limited to hazardous waste management.

With the increase in the production process in the industry, the raw materials used and needed are also increasing, and the waste generated is also increasing [9]. Waste containing hazardous and toxic (dangerous) materials can have a hazardous impact. Thus, it is necessary to manage hazardous waste based on the Government Regulation of the Republic of Indonesia Number 101 of 2014 concerning managing hazardous and toxic waste and obtaining permission from the local government to manage the waste produced. Not all industries can process the

waste they produce, especially hazardous waste because it requires separate management and the manager must have a permit according to applicable regulations. The cement industry is one of the companies that already has a permit to manage, process, and utilize hazardous waste. Hazardous wastes generated by the cement industry are used oil, rags, used batteries, filters, refractories [10], and other dangerous wastes. In addition, the cement industry produces products in the form of cement. Therefore, it obtains a permit to utilize the hazardous waste generated from other industries. Utilization of this hazardous waste is used as a mixture of cement and alternative fuels. Thus, this practical work is themed on the use of hazardous waste. In this way, the implementation can obtain directly applied information in the utilization of hazardous waste in the cement factory industry.

II. METHOD

The research was conducted through three stages, namely the stages of preparation, implementation, and preparation of reports. Primary data and secondary data are required in its preparation. The method used to find primary data is to collect data utilizing literature studies, field observations, interviews, and documentation. Meanwhile, collecting secondary data is done by collecting existing data in the form of documents from the company.

III. RESULT AND DISCUSSION

In maintaining the quality of the products produced and supporting the clean process system, the XYZ cement industry cooperates with several companies, such as companies in steel, paper, steam power plant, and so on. To treat some of the company's hazardous wastes, which can be used as additional raw materials for cement production. XYZ cement industry already has a permit to utilize and process hazardous waste produced by the company, hazardous waste originating from outside companies is called external hazardous waste. External hazardous waste utilized by PT Semen Indonesia is divided into two uses, namely for alternative raw materials (ARM) and alternative fuel (AF). Hazardous waste used for alternative raw materials (ARM) are fly ash, bottom ash, paper sludge, spent bleaching earth/eco oil, activated carbon, contaminated gypsum, dust EAF (Electric Arc Furnace), and resin. As for Alternative Fuel (AF), namely rags, used oil, rejected paper, spent earth, and low-grade gypsum. The XYZ cement industry has two procurement schemes in procuring external hazardous waste: Polutter Payment and Purchase. Types of hazardous waste included in the polluter payment procurement scheme are fly ash, bottom ash, paper sludge, EAF dust, spent bleaching earth/eco oil, activated carbon, etc.

Meanwhile, the procurement scheme includes husks, cocopeat, blast furnace slag, and trass. Furthermore, in the utilization of hazardous waste, XYZ cement industry produces cement products where the composition of hazardous waste is a maximum of 50% of the raw material for making cement. The cement products produced are OPC, PPC, and PCC.

The XYZ cement industry has a permit to utilize hazardous waste as alternative raw material (ARM) and alternative fuel (AF) from the Ministry of Environment and Forestry as stated in Decree No. 281 of 2016. For hazardous waste used as an alternative raw material (ARM) such as fly ash, bottom ash, copper slag, paper sludge, used refractories, etc. Meanwhile, those used as an alternative fuel (AF) are sludge oil, wastewater treatment plant (WWTP) sludge, used Majun, and so on. In addition, the XYZ cement industry has a permit to utilize hazardous waste as stated in the Decree of the Ministry of the Environment Number 308 of 2017.

XYZ cement industry has a team to conduct surveys of hazardous waste producers, to see visually. As well as taking samples of hazardous waste for testing in the laboratory. Then the sample is taken to a laboratory owned by the XYZ Cement Industry for testing. After the sample test results are complete, the laboratory assistant will notify the survey team regarding whether the content follows the standards applied and set by the XYZ cement industry. Then, if appropriate, the material will be sent to the shipping process. Before the delivery process, the hazardous waste producer prepares the total amount of material to be shipped according to the agreement. The material will be sent by truck if it is by land and if it is by sea it will be sent by barge. After the material arrives, every truck at the cement factory is weighed to determine the tonnage, specifically for sea routes using barges. Only one weighing is carried out when the barge rests in the port. After that, laboratory testing was carried out again for land delivery. Retesting is done by taking a sample of the material at each arrival or truck, while the sea route is sampled once when the barge rests at the port. After that, coordination with the waste management team is carried out to unload the material and determine the location for storing hazardous waste materials.

After determining the location for storing hazardous waste materials, the truck goes to the storage location and unloads it at the hazardous waste material storage area. Then the truck goes back to the scales for weighing to find out the exact tonnage of the material from the calculation of the difference in the scales between the load weight and the empty weight. After that, the samples that have been taken are taken to the laboratory cement factory to

ensure that the materials sent follow the XYZ cement industry standards. In storing hazardous waste materials, it is not allowed to store materials for more than 90 days. Therefore, a plan to enter the material into the raw material for making cement is carried out to avoid this. The types of external hazardous waste used by the XYZ cement industry can be seen in Table I.

TABLE I. UTILIZATION OF HAZARDOUS WASTE IN XYZ CEMENT INDUSTRY

Utilization	Material	Utilization Points
Alternative Raw Material (ARM)	Fly ash	Mix Pile Crusher
	Bottom ash	
	Paper sludge	
	Drilling cutting	
	Crude oil and contaminated soil	
	Spent bleaching earth/ Eco oil	
	Debu EAF (Electric Arc Furnace)	
Alternative Fuel (AF)	Bag cloth bekas	Calciner SLC
	Majun (textile waste)	
	Oli bekas	Calciner SLC
	Kluber	
	Grease bekas	
	Resin, SBE (Spent Bleaching Earth)	Mix with Raw Coal

External hazardous waste received by the XYZ cement industry and used as an alternative raw material (ARM) in July 2021 was 39,851.30 tons, and in August 2021, it was 39,163.16 tons. Meanwhile, what is used as an alternative fuel (AF) is 7,192.05 tons in July 2021 and 9,078.94 tons in August 2021 (Figure 1).

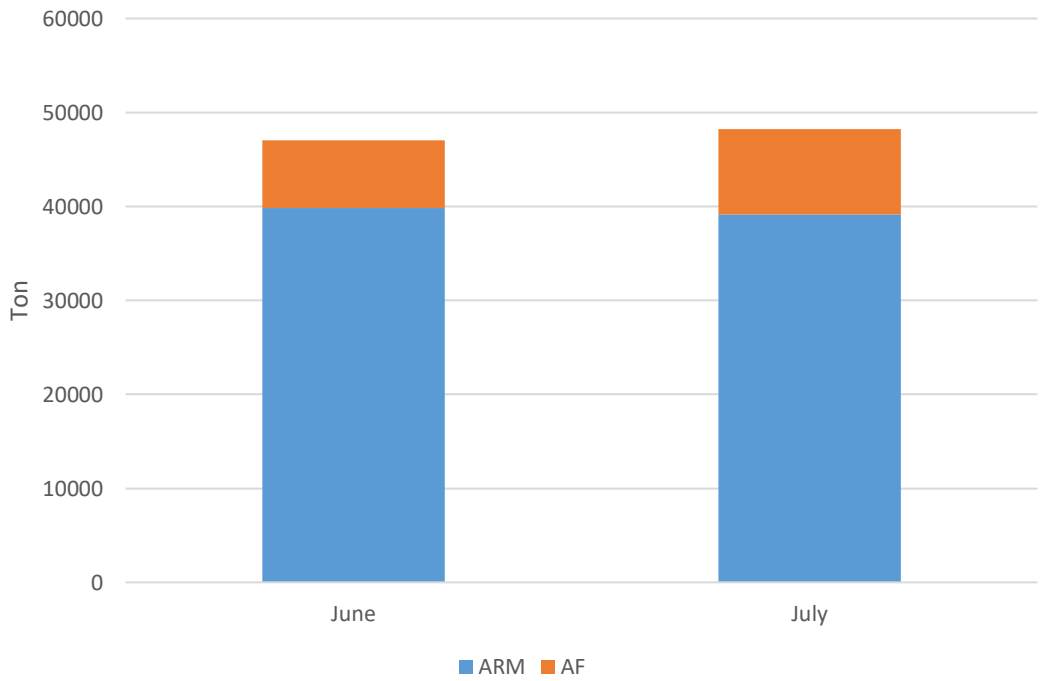

Fig. 1. Hazardous Waste Generation and Composition in XYZ cement industry

The XYZ cement industry utilizes external hazardous waste, namely by using the Co-Processing method. Co-processing is a controlled combustion method in waste destruction that can increase the added value of waste in energy recovery and materials used as raw materials for the production process [11]–[13]. This method utilizes the energy from combustion and utilizes the components contained in the waste as raw materials for the production process [14]. Based on PP No. 101 of 2014 concerning the Management of Hazardous and Toxic Waste, Article 1, paragraph 17 states that the beneficiaries of hazardous waste are business entities that carry out hazardous waste utilization activities. Then in article 54, the use of hazardous waste includes:

a. Utilization of hazardous waste as a substitute for raw materials
b. Utilization of hazardous waste as a substitute for energy sources
c. Utilization of hazardous waste as raw material; and
d. Utilization of hazardous waste following the development of science and technology.
e.

IV. CONCLUSION

It can be concluded that the XYZ cement industry is one of the companies in Indonesia that is engaged in cement. In the manufacture of cement products, XYZ cement industry utilizes hazardous waste, hazardous waste generated and hazardous waste from other companies. Utilization of hazardous waste is used as an alternative raw material (ARM) and alternative fuel (AF). The process of utilizing external hazardous waste as an alternative fuel (AF) in the kilnker area, using the CoProcessing method with several stages.

The high demand for cement, limited non-renewable energy, and the occurrence of global warming due to greenhouse gases encourage the cement industry to look for an alternative, environmentally friendly energy sources. More in-depth research is needed for further utilization of hazardous waste to produce zero waste from the cement industry, especially for the use of alternative raw materials (ARM) and alternative fuel (AF).

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