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3 Hazardous waste minimization challenge in autocomponent industry, West Java, Indonesia

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Abstract. Modern industries have managed their hazardous waste through hazardous waste management with End of Pipe approach. As part of the most robust industry, autocomponent industry have to manage their hazardous waste from production process. To meet sustainable manufacturing, waste minimization is required. Hazardous waste minimization in practice is relatively difficult to implemented. This paper explore hazardous waste management and waste minimization activity in one of autocomponent industry in Indonesia. Hazardous waste minimization regulation also explain in this paper. Regarding waste minimization implementation there were some obstacle such as lack of awareness and knowledge, lack of time and economic factor

1. Introduction

The Automotive sector is one of the most robust industries in Indonesia and the country ranks 15th in world in term of sales. The industry has steady domestic growth averaging 15% in 2010 as is projected to continue to growth till the end of decade [1]. This industry growth is parallel autocomponent industry development. Autocomponent industry in its production plant process uses raw material and chemicals component that generated hazardous waste. Hazardous waste burden give impact to water and soil that potentially harmful to human health. Modern industries have managed their hazardous waste through hazardous waste management with *End of Pipe* approaching at end of the process stage. This approach tends to ignore various kinds of environmental problem that appeared during operational process. On the other hand, this methode is not effectively implemented by the manufacturing industry [2].

To meet the sustainable manufacturing, waste minimization is one of the best technique in the industry through efficiency of raw material, energy and natural resource in process. Some automotive industries has waste minimization program but there were some industries more focused in delivery, quality and cost. According to the Environment Protection Agency waste minimization refers to strategies that are aiming to prevent waste at source through upstream interventions [3]. Waste minimization program in the industry affected by government regulation, industrial behavior and strategy related with awareness of the benefits from waste minimization program [4].

The concept of waste minimization look easy, but in practice is relatively difficult due to factors not directly related such as government regulation, quality human resources from various disciplines and the most important is the strong commitment from top management [5]. Availability of technology and facility for waste minimization can affect the social behavior as well as pro environmental attitudes [6]. Nevertheless waste management behavior might have been motivated to avoid the cost for waste



disposal, not due to the proenvironmental attitude. Assem and Karima revealed that indirect causes of waste were found to be the lack of legal and contractual incentives [7]. The ability of operative contribute to a waste reduction in industry as good as level of management support offered[8].

Some research of waste minimization in Indonesia has been conducted in Pharmaceutal industry. Waste minimization effort could be implemented by reduction of waste at source, modification of raw material and process, and water saving during production process [9]. Waste minimization in paint industry applied by housekeeping, reused of used water and segregation of waste contaminated and uncontaminated[10].

In this paper, we discuss current status of hazardous waste management and implementation of waste minimization in autocomponent industry, in one of autocomponent Industry in Indonesia. We summarize the role of government regulation in hazardous waste management in autocompanent industry. We also represent barrier of waste minimization implementation in industry.

2. Methode

Hazardous waste minimization data in Autocomponent Industry obtained through observation in industry. The hazardous waste management implementation reviewed based on Indonesia government regulation. Information about barrier of hazardous waste minimization come from structured questionnaire collected from employees in indutry and semi dept interview toward middle management in industry.

3. Discussion

3.1 *Minimization hazardous waste regulation*

Indonesia has Government Regulation number 101 year 2014 regarding Hazardous Waste Management. Based on article 1 in this regulation definition of hazardous waste is residue of a business activity that contain hazardous and toxic substance. In article 3, any person who generates hazardous waste will be required to manage the hazardous waste generated. In other hand, waste reduction is obligated for every person who generates hazardous waste. Waste reduction conducted through material substitution, process modification, and environmental friendly technology. Material substitution implemented by eliminated toxic material. For process modification set up through implementation of more efficiency production process. This hazardous waste reduction mechanism revealed in article 10 about Hazardous waste reduction

Hazardous waste that generated collect in hazardous storage. Guideline for storage and collection of hazardous waste revealed in this regulation, however detail explanation about this guidance exist in Decree of Head of BAPEDAL: 01/BAPEDAL/09/1995. Duration of hazardous storage in this store not more than 90 days. For treating hazardous waste, in case every body or organization industry being incapable of treating hazardous waste individually the treatment shall be entrusted to other party. Treatment of hazardous waste shall secure license from Environemental Minister. Hazardous waste transport from waste producer to treatment using manifest. Regarding manifest system of hazardous waste, the regulation noted in Decree of Head of BAPEDAL:2/BAPEDAL/09/1995. The transporter of hazardous waste needed licence to transfer hazardous waste from its source to treatment and disposal facilities.

3.2 *Hazardous waste management in autocomponent industry*

Autocomponent industry located in West Java Province, Indonesia. Industry has been implemented Environmental Management System (ISO 14001) and has Environmental Management and Monitoring Document license from Local Environmental Authority. Based on production activity industry generated various hazardous waste such as Scale quenching, Shotpeen Ash, Painting Sludge, Saw Contaminated, WWTP Sludge.

Hazardous waste from process collected using drum 200 litre (52 gallon). Hazardous waste then store in safe storage including in this store is fire extinguishers, secondary containment, eye wash, hazardous waste management standart. Duration of hazardous waste storage is 90 days. There is operator who

has task for storage container and storage are inspection. Description of hazardous waste from autocomponent industry could be seen in Table 1

Table 1. Hazardous Waste from Autocomponet Industry

Type	Description	Hazard Category	Waste Code*
Scale Quenching	Steel material heated in tempering process then dipped in quenching oil	Explosive	A 323-3
Shotpeen Ash	Residue from shotpeen process,	Flammable	B323-1
Painting Sludge	Residue from paint spray mixed with water wall	Flammable	B323-2
Saw Contaminated	Absorbent of oil spill, chemical spill	Explosive	A108d
WWTP Sludge	Residue from Wastewater Treatment Plant process	Flammable	B323-5

*Categories and coding based on Government Regulation of The Republic Indonesia Numb. 101 year 2014 on Hazardous and Toxic Waste Management

Hazardous waste transportation and treatment facilities conducted off site using manifest system. Lack of inspection did by autocomponent industry during transport, treatment, and disposal due to it belief that private companies has permit that they must be complying with regulation from Environmental Ministry. Limited time and personil become barrier in hazardous waste transport, treatment and control. This uncontrol activity lead to release of hazardous waste dumping in environment. However number of hazardous waste in a year could be seen in Table 2.

Table 2. Number of Hazardous Waste from Autocomponent Industry in A year (2014-2015)

Type	Sceal Quenching	Shotpeen Ash	Painting Sludge	Chemical absorben	WWTP Sludge
Volume (tonnase)	69,84	10,8	44,95	0,475	12,8

Based on Table 2. Total all of hazardous waste generated from Autocomponent industry were 138,865 Ton in a year. The most dominant hazardous waste generated was scale quenching with a composition of 50%, then followed by 33% of painting sludge volume

3.3 Waste Minimization Implementation

Waste minimization includes source reduction and recycling. Source reduction is defined as any activity that reduces or eliminates the generation of waste at the source, usually within a process. Recycling is defined not only as recovery and or reuse of what would otherwise be a waste material but also quality improvements [11],[12].

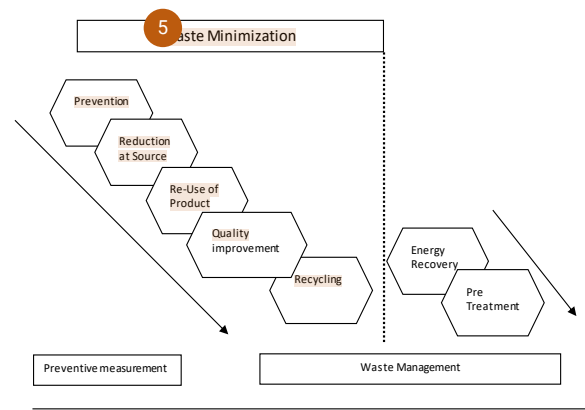


Figure 1. Graphic Representation of Waste Minimization

In production process, waste minimization strategy focuses on optimization of raw material, energy use and reduction chemical material usage. In general, primary route of waste reduction from its source are [13]:

1. Decreasing or eliminating the amount or toxicity of material used in the manufacture and packaging of product
2. Redesigning products for increased life span, reusability, and repairability
3. Changing purchasing decisions to favor those products that have minimized residual toxicity and waste associated with them
4. Modifying patterns of consumption and material use in a way that reduces the amount and toxicity of waste generated

Hazardous waste reduction from source has been implemented on production process with various approaches. Hazardous waste minimization implementation in autocomponent industry could be seen in Table 3

Table 3. Hazardous Waste Type and Its Waste Minimization Approach

Methode	Waste Type				
	Chemical Absorbant	Painting sludge	Sceale Quenching	Shotpeen Ash	WWTP Sludge
Raw Material Management	X	X	X	X	X
Setting Process Condition	X	O	O	O	X
Technology Modification	X	X	X	X	X
Good Housekeeping	O	X	X	X	X
Off site Treatment	O	O	O	O	O

X : Not Implemented O : Implemented

Based on hazardous waste minimization observation in industry, there were some technique with process approach such as setting process condition for painting sludge, sceal quenching, and shotpeen ash and good housekeeping for saw contaminated. However, this waste minimization strategy not measure effectively. Based on interview with production manager, methode in setting process and good housekeeping only generated minimizing hazardous waste about 10% from total. Minimum result from waste minimization implementation due to setting process modification conducted based on improvement suggestion from employees who were not expert waste minimization knowledge. Good house keeping also set up based on routine activity, there was no Plan Do Check Action in this

program. All hazardous waste such as saw contaminated, painting sludge, scale quenching, shotpeen ash, and WWTP sludge after collected on-site and stored in a segregation area based on their characteristic. Then transported off-site by a licensed regulated waste transporter, to a licensed facility for treatment and disposal.

Autocomponent industry has been implemented Environmental Management System (EMS), it can be verified that EMS System contributes to made environmental management in industry better however hazardous waste still be managed by the end stage of production process. This condition relevant with research conducted by Cervelini and Souza that Environmental Management System certified does not establish conditions to minimize the use of *End of Pipe* technique [14]. In research ISO 14001 and waste minimization in metallurgy industry state that implementing EMS clearly brings positive changes in waste treatment, however it is insufficient to bring forth waste prevention [15].

3.4 Waste minimization obstacle

Previous studies have been conducted regarding waste minimization implementation issue, there are common issue highlight among industrial sectors such as lack of awareness and knowledge, lack of time, and economic factor.

3.4.1 Lack of awareness and knowledge

Employees awareness in waste minimization implementation are still lack due to respondents stated that waste minimization can run if carried out by certain employees who has task control the waste. This perception is consistent with research in Construction Industry that most workers assumed that the reduction of waste are not part of their regular duties and responsibilities. Based on management statement, waste reduction activity has not been implemented properly and was not specific due to limited knowledge of employees [16]. This result in line with research measurement of waste preventive that calculation of waste minimization is complex process due to needed quality of human resources from multidiciplines and require strong commitment from top management [12].

3.4.2 Lack of time

Waste minimization implementation has not been effective due to unoptimal attention from management. Most of the industry's attention more focused on development of projects for new products based on consumer demands. Through interviews with the management, information was obtained that problems were found in the implementation of waste minimization activities were cost, time, labor constraints in an effort to conduct improvement ideas, and lack of support from the top management. This is consistent with studies that have been done in the implementation of waste minimization in various sectors of the industry that found a similar problem are the lack of awareness, not understand how to implemented it, no time [17][18].

3.4.3 Economic factor

Great motivation of Autocomponent Industry in waste reduction are cost savings however there was no budget allocation to run this program. Waste management efforts based on the cost savings also in line with the idea of waste management and recycling research in Korea in which the waste management activities over the background by the motivation to avoid the cost of elimination disposal [6]. In addition, research on some industrial contractors in the United Arab Emirates that the main benefits obtained by the industry in the application of waste minimization is to increase profits while benefiting environmental protection finished last [7].

1. Conclusion

Based on study result it can be concluded hazardous waste minimization well not developed, however regulation for industry to reduce hazardous waste generation exist. Government regulation about

hazardous waste management required industry to eliminated toxicity material and modify production process to made activity more efficient. There were some barriers in hazardous waste implementation such as lack of awareness and knowledge, lack of time, and economic factor.

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