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B3 waste management through Rotary Kiln type incineration technology in construction activities in EPC projects

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ABSTRACT

PT. Rekind (Industrial engineering) engaged in construction on EPC (Engineering, Procurement, Construction) projects are activities ranging from civil and structural work, tank fabrication, piping work, electricity and instrument etc. From the work of each of these disciplines there are activities that require welding, sand blasting, painting and liquids to clean the outer rust (pickling), Majun that has been used, chemical liquids for internal cleaning of installed pipes, used lubricants. In this EPC, work causes waste, which cannot be allowed. In addition, if the company does not realize that the waste produced is simply thrown into the liquefaction system without any processing process. It will have a negative impact on the environment and human life. Given the magnitude of the risks and their impacts, efforts to manage B3 waste on construction activities are directly under the responsibility of the construction manager of PT Rekind and are coordinated by the HSE (Health, Safety, Environment). For this reason, we should know how to manage B3 waste in EPC activities at PT. Rekind through incinerator technology. So the study method carried out is an engineering research method or the method of management activities through the Type Rotary Kiln incinerator technology, where the management of B3 waste materials from the activity begins to mark the place where the B3 storage produces for a maximum of 90 days and transportation to treatment from the storage of B3 Waste. Rotary Kiln type incinerator technology is a two-stroke combustion process with various types of B3 waste materials, the first Combustion Chamber is for waste and the second Combustion Chamber is for the remnants of rudimentary gases burning in the Primary Chamber and lower temperatures are often needed to prevent the slagging of certain waste materials. The ash produced during the combustion process is discharged through the bottom of the second combustion chamber. So that the purpose of this study is to produce new material in the form of ash, which can be reused into fertilizer and others.

Keywords: Hazardous and Toxic Waste (B3), Management, Incinerator Technology, Rotary Kiln Type Incinerator, EPC Projects.
Article type: Review Article.

INTRODUCTION

Construction activities on EPC (Engineering, Procurement, Construction) projects (Bossik & Browers 2013; Rekind 2020), are activities ranging from civil &structural work, tank fabrication, piping work, electricity & instruments etc. from the work of each of these disciplines there are activities that require welding, sand blasting, painting and liquids to clean the outer rust (pickling). Majun that has been used, is a chemical liquid to clean the inside of the installed pipe, using lubricants. The presence of construction waste has a negative influence on the environment around the construction project (Oloruntade *et al.* 2013; Tavakoli *et al.* 2014; Bakhshipour *et al.* 2021). Construction waste that is partly an unused material resulting from the construction process, repair, alteration or any goods resulting from the process, or an unintentional one which cannot be directly used in that

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place without any more perpetrators. The company does not realize that the waste produced is simply disposed in the liquefaction system without a process. Even construction waste also has an impact on contractors, so that they suffer damage due to excess or wasted materials and require transportation costs to dispose waste from the project site. Hence the total project costs swell. The release of B3 waste into the environment can endanger life. B3 contaminants can be released into nature through manufacturing processes, product use, and waste treatment and disposal. After detaching into the environment, the B3 contaminants move and influencing environmental factors. B3 waste if not managed properly can pose a risk to the environment and human health. Love Canal, USA, which is a dumping ground for industrial waste neglected by thousands of other dumps, has taken its toll. In addition, akhimiya has become a milestone that gave birth to the local government's concern for B3 waste control. The Indonesian government began to pay great attention to B3 waste in the middle of the past. B3 waste control measures can include product change, control, source, reduction, recycle, reuse, and reclamation activities. The priority in control, including the minimization of B3 waste, is the reduction in the cost of procurement and operation of B3 waste treatment facilities. Another advantage is the creation of a safer and healthier environment, as well as reduced environmental risks. Institutions of the Ministry of Environment, according to Law No. 32/2009 on Environmental Protection and Management, PP No. 18/1999 on B3 Waste Management, PP No. 85/1999 on Amendments and PP No. 18/1999 PP RI No. 101/2014 on B3 Waste Management (Yulinah 2016) said that the guidelines should be implemented with a moderate level of law enforcement in the management of B3 waste. For this reason, we should find how to manage B3 waste in EPC activities at PT. Rekind through incinerator technology. So the study carried out is an engineering research method or the method of its management activities through the Type Rotary Kiln incinerator technology. Hence, the purpose of this study is to produce new materials that can be reused into fertilizers and others.

B3 waste and B3 management through incinerator technology

B3 waste

Waste is the rest of business activities derived from production, both on a household, industrial, mining, and construction scale. This waste can be gaseous, liquid and solid. Based on Government Regulation No. 101 of 2014 concerning B3 waste management, hazardous and toxic materials, hereinafter abbreviated as B3, are substances, energy, and/or other components due to their nature. Its concentration, and/or amount, either directly or indirectly, may pollute and/or damage the environment, and/or endanger the environment, health, and survival of humans and other living things. Meanwhile, waste is the rest of a business and / or activity. B3 waste itself is the rest of a business and / or activity that contains B3. It is a hazardous waste or material, since its quantity or concentration can cause or can significantly contribute to an increase in disease, death and harm to human health or the environment if it is not actually processed or managed or disposed (Amalia, & Utami 2018). B3 is solid waste that is a potential threat to public health or the environment (VanGuilder *et al.* 2008). As for B3 waste, it is a hazardous and toxic waste, and it can pollute the environment and human health. Waste presence at some point and a certain place is not desired by the environment, since it has no economic value, while according to (Suparmoko 2000), Another definition, according to (Riyanto 2013) conveys that hazardous and toxic waste materials are hazardous substances /substances that have been disposed of, not ignored, released, or planned as waste materials, or something that can be associated with other substances becomes hazardous. Hazardous and toxic waste is the result of the residue of a production process activity containing B3, be it due to its nature, concentration or amount that can pollute the environment and endanger health. B3 waste in Indonesia every year continues to increase due to the increasing number of industries. Development in the industrial sector certainly produces a positive impact, namely producing a product that has many benefits, while its negative impacts will certainly produce waste (Ashari 2018).

Determination of B3 Waste

According to the determination of B3, waste is outside the list of B3 as stated in Appendix I PP 101/2014 which is indicated to have the characteristics of B3 waste. It is mandatory to conduct a characteristic test to identify waste as B3 one or non-B3 one which falls into several categories (PP No. 101 of 2014) as follows:

(1) Determination of B3 waste based on its Source: The B3 waste group will be divided into several parts, including (a) B3 waste from specific sources, namely remnants from process activities carried out by industry; (b) B3 waste from non-specific sources, including generally through activities such as equipment maintenance,

equipment washing etc.; (c) Chemical waste that has expired, spilled during use, used packaging or product residue.

(2) B3 Waste based on characteristics: B3 waste that falls into categories such as (a) is easily explosive if it reaches a temperature of 250 ºC, has a pressure of 760 mmHg and goes through chemical or physical reactions; (b) flammable in case of contact with the source of the flame, sparks at a pressure of 760 mmHg; (c) has reactive, unstable properties, and if mixed with water has the potential to cause an explosion; (d) Toxic B3 waste: It is very dangerous for living things and the environment, since it has deadly or killing properties; (e) B3 waste that can cause infection in parts of the human body. This waste usually comes from hospitals and laboratories; (F) rust on iron, irritation of the skin characterized by the presence of redness or swelling.

Table 1. Characteristics and criteria of B3 waste and Symbols of each type of waste as stated in Appendix II pp No.101/2014.

1. Explosive: Waste that at stander temperature and pressure (25°C, 760 mm Hg) can explode, or through chemical and/or physical reactions can produce gases with high temperatures and pressures, which can quickly damage the environment. 
2. Flammability: Wastes that have one of the following properties; • Waste in the form of liquids containing alcohol < 24% by volume and/or at the flash point < 60°C (140 °F) will ignite in case of contact with fire, sparks, or the source of the Jain flame at an air pressure of 760 mmHg. 
3. Reaktif: Waste that has one of the following properties: • Waste that under normal circumstances is unstable and can cause changes without detonation. This waste visually indicates the presence between Iain gas bubbles, smoke, and discoloration. 
4. Infectious: waste derived from the treatment of patients requiring isolation of renal diseases or intensive care and Jaboratorium waste. 
5. Toxin Test: Waste that has toxic characteristics based on toxic characteristics determination test through TCLP, LD50 toxicology test, and sub-chronic toxic test. 
6. Corrosive: Waste with a pH of < 2.0 for acidic waste, or a pH of > 12.5 for alkaline waste. The corrosive nature of solid waste is carried out by mixing waste with water in.

Source: Permen LH No. 14 of 2013 [13].

(3) The TCLP test of B3: TCLP (Toxicity Characteristic Leaching Procedure) is carried out to test the waste whether it falls into category 1 if the concentration of pollutants is greater than TCLP-A or the waste belongs to category 2 if TCLP-B is less than the concentration of pollutants and less than equal to TCLP-A.

(4) Toxicology test of B3 waste is identified as B3 Waste in placed in category 1, if it has a value equal to or less than the LD toxicology test of 50 mg kg^{-1}; and category 2 of B3 waste, if it has a value greater than the LD_{50} toxicology test with a value smaller than or equal to 50 mg kg^{-1}.

(5) The sub-chronic assay of waste is identified as category 2 of B3, if the test shows sub-chronic toxicity properties.

B3 Waste Management

B3 waste management is one of a series of activities that include producer/storage, collection, utilization, transportation, utilization, processing/hoarding. Waste management with techniques to minimize waste, as shown in Fig. 3 (Environment Agency, 2019 & PP No: 32/Year 2009) as follow (Fig. 10):

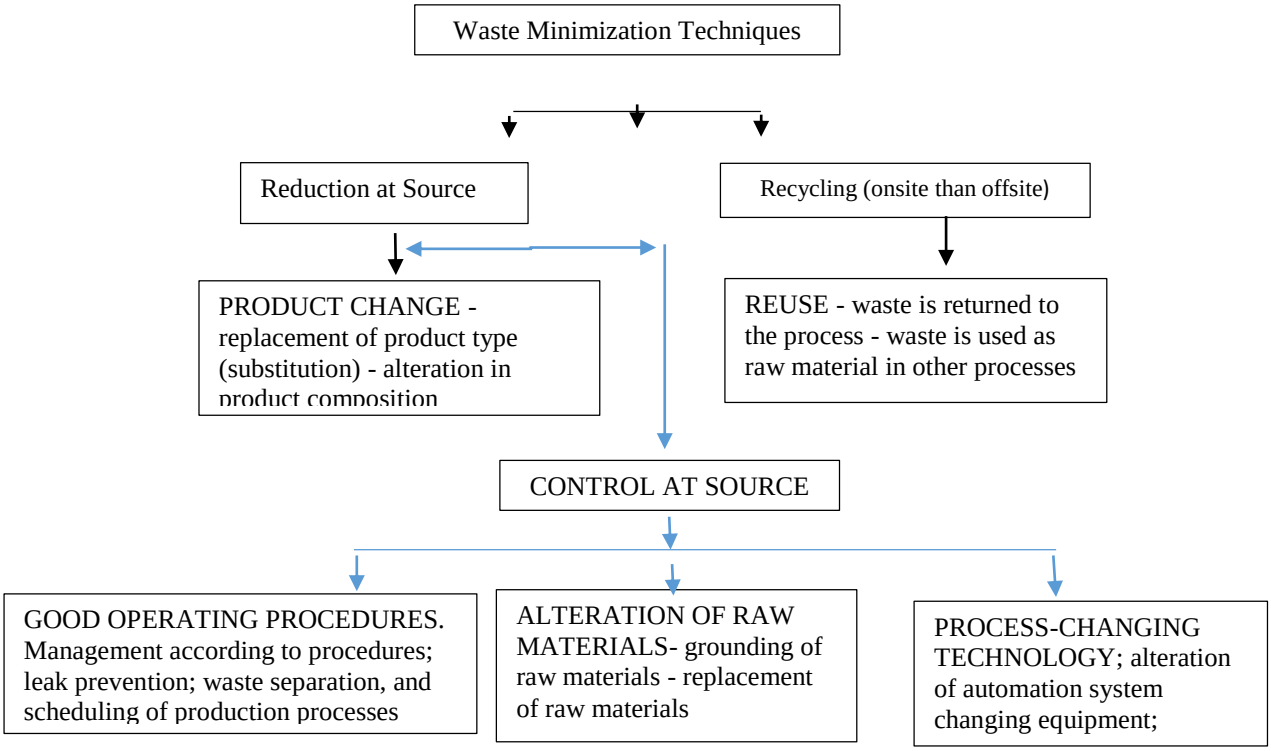

Fig. 1. Waste minimization techniques (Source: Blackman 2001).

Based on Government Regulation No. 101 of 2014 concerning B3 Waste Management (Riyanto 2013), Hazardous and Toxic Materials (B3) are substances, energy, and/or other components that due to their nature, concentration, and/or quantity, either directly or indirectly, can pollute and/or damage the environment, and/or endanger the environment, health, and the survival of humans and other living things. B3 Waste Management is an activity that includes the reduction, storage, collection, transportation, utilization, processing and/or hoarding of B3 waste (Government Regulation 2014, Article 1 Number 11; Ashari 2018). B3 Waste Management is an activity of understanding the use of technology and interpreting regulations in handling B3 waste (Suparmoko 2000). One of the management is processing, according to PP Number 101 of 2014 concerning Hazardous and Toxic Waste Treatment (B3; PP No. 101 of 2014) is a substance, energy, and/or its amount, either directly or indirectly, can pollute and/or damage the environment, and/or endanger the environment, health, and survival of humans and other living things. In relation to the type of B3 waste for EPC construction activities, the appropriate is the Rotary Kiln type incinerator waste technology. Rotary Kiln incinerator theology is able to destroy liquid waste and solid waste with a combustion heat of 550-8300 kcal / kg. Solid waste packed in drums is carried into the furnace with a conveyer, while the detached/unpackaged solid waste is fed into the furnace with a bucket elevator or crane. Liquid waste and sludge are injected into the furnace with a nozzle. Combustion temperatures range from 810-1600°C. RKI is usually equipped with a lime or base injection system to neutralize acidic gases and other combustion products (Permen 2013).

Incinerator type of waste treatment

(1) Incineration: Incineration or combustion at high temperatures, with sufficient air supply is a safe way to destroy organic B3 waste that cannot be disposed safely by other methods. Organic waste is of an infectious and toxic nature, both flammable and non-combustible, in addition to all kinds of organic waste that are liquid, solid, or semi-solid. Incineration tests at the pilot plant show the need for temperatures above 1000 °C to destroy this type of waste. However, this method has the disadvantage of expensive equipment procurement costs and operating costs, in addition to the need for permits that are difficult to obtain.

Types of incinerators: in determining the right type of incinerator, it is necessary to consider several criteria: They should be able to destroy organochlorine B3 waste, hence it should be able to reach a temperature of 1200°C with a gas retention time of 2 seconds. The incinerator should be able to burn containers that vary from aerosol bottles to 200 liter drums, be able to destroy the types of paint and resin waste that are semi-solid, have a feeding system capable of allowing the combustion of various types of waste with various calorific values. Ash from the furnace should come out in solid form, since it will be more resistant to leaching in the landfill. Residues from toxic materials should contain hazardous materials as minimally as possible, and the waste mixing system should be as good as possible, especially when the waste consists of various types and shapes (Yulina Trihadiningrum 2016; Environment Agency, 2019 and PP No: 32/Year 2009). The types of incinerators that are widely used for the destruction of B3 waste are liquid injection incinerator (LII), rotary kiln incinerator (RKI), fluidized bed incinerator (FBI), and multiple hearth furnace (MHF).

Liquid injection incinerator (LII) can be used to destroy all types of flammable liquid waste, the viscosity of which < 2.2 × 103 poise. The viscosity of the waste can be lowered by heating using additional heating devices. If it is not possible, preheating can be replaced by the addition of liquid with a lower viscosity, which can mix well, simpler when compared to rotary kiln incinerator (RKI). The main part of LII is an atomization device or nozzle that serves to automate waste, as well as mix it with air. The atomization process takes place in the combustion chamber. Atomization is carried out mechanically with a rotating saucer or with a high-pressure nozzle. Additional fuel is not required to reach and maintain a temperature of 1250°C when the waste fuel heat > 5000 Btu/lb. Liquid injection incinerator is widely used mainly due to the relatively low price of the equipment, operating costs, as well as the relatively low maintenance costs. Incineration systems with LII are generally equipped with exhaust gas cleaning equipment in the form of wet electrostatic precipitators to overcome gas and particulate emissions.

Rotary Kiln Incinerator (RKI): This incinerator has a main part in the form of a rotating cylinder which is the combustion chamber. The cylinder is located with a certain slope position. The slope of the combustion chamber is intended to facilitate the mixing waste with circulated air. RKI can destroy liquid waste and solid waste with a combustion heat of 550-8300 kcal kg^{-1}. Solid waste packed in drums is taken to the furnace with a conveyer, while the solid waste that is released /not packaged is put into the furnace with a bucket elevator or crane. Liquid waste and sludge are injected into the furnace with a nozzle. The combustion temperature ranges from 810 °C to 1600 °C. RKI is usually equipped with a lime or alkaline injection system to neutralize acidic gases and other combustion products. The ratio between the length and diameter of the RKI is 10:2. Rotational speed is 5-25 mm s^{-1}. Both the ratio of length and diameter and the speed of rotation are largely determined by the type of waste being incinerated. High length and diameter comparisons and low rotation rates are usually required to destroy waste that requires a long residence time for combustion to take place completely. The advantages are that it can be used to exterminate various types of wastes. It can be operated at high temperatures and exhibits a good ability to mix waste continuously. Its disadvantages are high procurement and operation costs. It takes a truly trained manpower for operation. The liner layer on the furnace must be replaced frequently when the tool is used to destroy corrosive waste, producing a lot of particulate matter during the combustion process. The residence time for burning solid waste is controlled by regulating the speed of rotation of the cylinder and its slope, while the residence time to burn liquid waste is determined by regulating the speed of gas flow. RKI generally has a second combustion chamber located next to the main combustion chamber. The second combustion chamber serves to encourage waste incineration. Under certain conditions, liquid waste is sprayed on the second combustion chamber. The ash produced during the combustion process is discharged through the bottom of the second combustion chamber. Combustion products in the form of gases move outwards through the second combustion chamber where the addition of oxygen and combustible waste is carried out. RKI can also be operated by pyrolysis, where waste can be decomposed in a limited oxygen atmosphere. The gases formed are subsequently burned back in the second combustion chamber. This operating model is advantageous, since it can reduce the amount of particulates from the combustion process. Fan Ash has suction gate. Types of waste that can be incinerated with RKI include: PCBs contained in capacitors, nitrochlorobenzene waste, lubricating oil, waste from chloroplastyluene production, phenylamine, alkylated phenols, epiclorohydrin and acryloniterite.

Fluidized Bed Incinerator (FBI): The FBI is often used to destroy waste from petroleum, paper, sawmill, and sludge industries from municipal sewage WWTP. The FBI is equipped with additional equipment certified over fuel-incendiary systems, air supply systems, and liquid waste as well as solid waste feeding systems. The incendiary chamber contains a grainy medium, which consists of a non-reactive layer of sand. Such combustion chambers are equipped with a stirring system for mixing oxidants. Stirring proceeds so quickly, that the sand medium expands and has the property of being a fluid. Liquid or gaseous waste is passed into the sand medium, where an efficient oxidation and combustion process takes place on an evenly distributed waste. The FBI is designed so that combustion in sand media can take place at a temperature of 450-980 °C. For the combustion temperature to be maintained above 850°C, the waste must at least have a calorific value above 4500 BTU lb^{-1}. In the latest FBI models, the air supplied for combustion is preheated, to temperatures between 425 °C and 650 °C. This can reduce the need for waste with high calorific value. Fluidized bed incinerator advantage are: (a) it exhibits high combustion efficiency; (b) the maintenance cost is relatively low due to the simple design; (c) the low probability of nitrogen oxide formation due to the relatively low gas temperature and high air requirements; (d) the sand media can neutralize combustion products; (e) the sand media has a high surface area, thus guaranteeing proper combustion; (f) an even temperature on the entire surface of the sand media can burn sewage sludge and be tolerant of the feeding rate; and (g) if the waste has sufficient calorific value, no additional fuel is required. The weakness of the FBI is that the diameter and height of the bed are highly dependent on the capabilities of the design technology; the separation of ash from the sand medium is often a problem; operation at low temperatures can result in the accumulation of charcoal on the sand medium; and high operating costs. The types of waste that can be incinerated are limited.

Multiple Hearth Furnace (MHF): This type of incinerator was originally widely used to exterminate sludge from domestic discharges. MHF equipment is equipped with a steel liner system, a rotating air regulator, a series of flat furnaces, an air blower (blower), a series of burners on the walls of the furnace, an ash waster system, and a sewage feeding system. There is also an MHF equipped with an injection and incendiary facility for liquid waste as well as a second combustion furnace. Waste of various types can be put into the incinerator at the desired furnace layer. The waste is agitated/stirred with rotating stalks contained in each furnace. The mud-shaped limbati enters the furnace through the top and moves down through the existing series of furnaces. Tar and lubricating oil are burned at the edge of the furnace, while gas and liquid waste are burned first in the bottom furnace. Particulate combustion products are ejected through the lower-side of the incinerator, carried by conveyor and bucket elevator to the ash storage container. Meanwhile, the exhaust gas flows upwards through the coolant, towards the exhaust gas cleaning facility. There are 3 kinds of combustion temperatures in MHF, namely 300-550 °C in the upper furnace, 750-1000 °C in the middle, and 200-300 °C in the bottom one. The types of waste that can be incinerated with MHF are sludge, tar, and lubricating oils. The advantage of MHF is that it does not require a large area of land. Its disadvantage is that the combustion process goes slowly. The exhaust gases formed require expensive processing equipment, cannot be used to burn halogenated hydrocarbon waste. Co-incineration: It is a combination of the B3 waste incineration system of an industry with the process of incineration of waste from other sources for energy saving purposes, or to produce additional energy.

MATERIALS AND METHODS

Engineering and theoretical research methods

The study methods used in this study are engineering (technological activities and calculations) and theoretical research methods (implementing according to theory / science) including Field study (3P), Preparation/data collection and Sorting. Before conducting the study, it is necessary to conduct a preliminary study (3P) namely paper, person and place. Furthermore, preparation or data collection is carried out, namely hazardous and toxic material waste from EPC construction activities at the project site of PT, REKIND (Rekind 2020) waste storage on site within 60 to 90 working days. The storage process is borne by the construction manager, with the aim of ensuring that waste is managed and disposed in accordance with applicable regulations and B3 waste from EPC activities, as shown in Table 2 (Chaib *et al.* 2014).

Data processing

Rotary Kiln Type Incinerator Technology: The combustion system of the rotary kiln incinerator generally adopts the process of rotary kiln initial combustion, equipped with its equipment. High-temperature secondary

combustion chamber and exhaust gas purification. It is composed of kiln body, support, transmission, sealing and other components. The main part is a horizontal cylinder and can be rotated. The waste to be treated enters the kiln from the upper end (kiln head), and moved slowly to the tail of the kiln as the cylinder rotated. The rotation of the furnace makes the material fully in contact with the combustion air during the combustion process, and the drying is completed. The whole process of burning takes place, and finally the burning slag is removed from the tail. Unique material and structure of the guide material are used in the kiln. The material is a parabolic speed and is not the same in the kiln, which improves heat exchange and makes the working conditions more stable. In order to ensure the operation of the kiln under micro-negative pressure and reduce the influence of equipment leakage on the system, the combined seals are designed at both ends of the kiln to reduce the air leakage rate of the rotary furnace and improve the pyrolysis effect. The kiln body is generally frequency controlled, which can meet the requirements of various incineration materials in the kiln. The second combustion chamber is a cylinder perpendicular to the ground, and its main function is to further destroy harmful substances that do not burn in rotary kilns.

Table 2. Waste type.

No	Waste Type	Method	
		Observation	**Check List**
1	Used Chemical Drums Used / Contaminated Rags	Sub- Chronicle C	85 %
2	Contaminated Soil / Materials (907.3 kg)	1-(TCPL-A)	40 %
3	Used Thinner / Solvents	Sub- Chronicle C	40 %
4	Used Chemical/ waste residual chemical liquid rust cleaning stainless steel pipe for the outside (pickling; 239.3 kg)	Sub- Chronicle C	40 %
5	Contaminated containers (paint cans, thinner cans, coolant packaging, grease packaging, diesel fuel waste (packaging) 710 kg	Sub- Chronicle C	85 %
6	Used Lube Oil (oil bekas; 2930 kg)	1-(TCPL-B)	85 %
7	Used Insulation Materials	Sub- Chronicle C	40 %
8	Used Filters	40 %	
9	Used TL Lights	1-(TCPL-A)	40 %
10	Waste of welding sticks	1-(TCPL-A)	40 %
11	Sand blasting waste/ Paint cans and toner waste/sand blasting waste, paint cans waste and toner blasting waste, paint cans waste and toner	Sub- Chronicle	
12	Liquid Sludge Oil (residual solvent, used diesel, used gasoline, etc.)	1-(TCPL-A)	80 %
13	Spill kit bekas (Used spill kits (cloth, absorber, etc.)	1-(TCPL-A)	85 %
14	Toner print	Sub- Chronicle C	40 %
15	Used Batteries (Battery) / used waste that has been used	Sub- Chronicle C	85 %
16	Water mixed with diesel fuel (295.2 kg)	A-307.3	
17	Fixer and developer (100 kg) Average sub chronic-C Waste Type	A-339.1 61,875 %	

The second combustion chamber is equipped with an auxiliary burner and a tangential secondary air supply device to ensure that the exhaust gases are in full contact with oxygen at high temperatures and the stay time of the exhaust gases in the second combustion chamber is not less than 2 seconds. The amount of air supply in the second combustion chamber is small. It can be adjusted according to the oxygen content of its outlet exhaust gases, effectively removing dioxins. The upper part of the second combustion chamber is the exhaust gas combustion zone, equipped with additional auxiliary tools, a fire pit and an inspection door hole. The thermocouple controls the burner at the top and is equipped with an emergency explosion-proof chimney to ensure the safety of personnel and equipment in case of an accident. The lower part of the second combustion chamber is the ash burning area, which is sealed by the water cooler, and the burnt ash is cooled by the water and removed from the furnace through the slag discharge slag machine. In order to curb the re-synthesis of Erying ying in the tail, high-temperature exhaust gases (about 1000 °C) out of the second combustion chamber enter the cooling tower, and are cooled by

the atomization of the water spray, then the temperature is lowered to 200 °C in a very short time. Thereby leapfrogging the temperature zone formed by Erying Yingyi, effectively preventing the re-synthesis of Er-Ying. The nozzle is used in the cooling tower, the water spray is fully customized, and it is evaporated at high temperature, and no waste is discharged. The extinguished exhaust gases enter the dry de-acidification absorption tower. Slaked lime powder is sprayed onto the absorption tower through the ejector, and chemical reactions with acidic gases such as sulfur dioxide or hydrogen chloride in the exhaust gases occur in the absorption tower to remove acidic gases such as sulfur dioxide and hydrogen chloride. Activated carbon powder enters the filter bag before the absorption tower is injected into the chimney, evenly dispersed in the chimney gas, which has a good adsorption effect on dioxins and fine particles, and reducing emissions of harmful substances in chimney gases. Then the exhaust gas enters the bag filter to remove most of the fly ash. So that the exhaust gas reaches the national exhaust standard, and as cleaned after treatment, is exhausted by the fan induced through the chimney. The slag disposed after the combustion of the second combustion chamber can be sent back to the furnace for re-incineration or directly sent to the landfill. Then the bottom slag and fly ash removed from the cooling tower, absorption tower and settling device are disposed in the landfill.

RESULTS AND DISCUSSION

Fifteen types of toxic hazardous material waste in EPC construction activities are based on the results of observations. The type of B3 waste from EPC construction activities produces from 15 types of waste with greater category C (Sub-Chronicle-C) waste.

Table 1 depicts that the majority of observation results of 8 types of Sub-Chronicle C waste, namely Used Thinner / Solvents, Used Chemical / waste residual chemical liquid rust cleaning stainless steel pipe for the outside (pickling) = 239.3 kg; Contaminated containers (paint cans, thinner cans, coolant packaging, grease packaging, diesel fuel waste packaging) = 710 kg; Used Insulation Materials Sand blasting Waste/ Paint Cans and Toner waste/sand blasting waste, paint cans waste and toner, Toner print Used Batteries (Battery) / used waste that has been used with an average number = 61.875 %; and 7 types of category 1-(TCPL-A) an average of 40.71 %. Standardization of waste type, with Industry code A -108 d is the type of contaminated waste so as to indicate hazard category 1, material code B104 d indicates having pollutants from used packaging B3 with hazard category 2 and industrial code A 310-1, industrial activities for steel refining operations, sources of waste from steel refining and processing. So that the description of the waste from the acid-alkali solution used and its residues, indicates the hazard category of: (1) Code B-105 and Used lubricating oils include used lubricating oils for hydraulics, engines, gears, lubrication, insulation, heat transmission, grit chamber, separator and/or mixture, with hazard category; (2) Industry Code A.339.1 is in the photography industry. Sources of waste manufacturing, formulation, production and distribution (MFPD) are in the field of photography and waste description. Developer solutions, fixers, and bleachers are used. So it shows hazard category 1. Industry code A-307-3: in the industrial activities of oil and gas refineries, the source of waste from the process of manufacturing lubricating oils, oils and greases based on oil; oils and fats based on oils. Description of waste Slop oil emulsion solids from the petroleum refining industry, thus indicating hazard category 1.

Management of Rotary Kiln Type Incinerator Technology

Based on information from HSE personnel at the project site and head office (HO), it shows that B3 waste of 15 types has explosive characteristics, flammable, reactive, toxic, infectious, and corrosive. So that the person in charge of handling hazardous waste is the project manager of the construction site who conveys to the head of the agency responsible for the management of toxic hazardous material waste. B3 waste producing contractors are required to report on the realization of B3 waste TPS activities periodically and be monitored by the K-3 committee to ensure that the B3 waste is managed in accordance with existing regulations. Management of B3 waste materials as a result of EPC construction activities at PT. Rekind started for it is necessary to mark the place of storage, collection, transportation, processing of vehicles with the aim of being in by technology. B3 waste producers (site projects) can store the B3 waste produced for a maximum of 90 days before being handed over to collectors or utilization or processing or hoarding of B3 waste. Then manufacturers and management of B3 waste need to take preventive measures to avoid unwanted things from happening, such as poisoning, fire, explosion, irritation, etc. Hierarchical principles (reduction and accumulation) and stakeholder involvement in the preparation of the program plan include the B3 waste expert team, the principle of hierarchical management charts

with the reduction and hoarding of the need for prudence (pre-cautionary). Absolute responsibility (strict responsibility), responsible polluter (polluter pays), 3R + R (reduce, reuse, recycle + recovery), global polluters (cross-border polluters) and good environmental governance. In addition, the application of the principles of management is based on that all waste must be managed, the risk to health and the environment is carried out thoroughly (from the cradle to the grave). However, from the temporary storage area, the transportation process from the project site for all types of B3 materials above is continued. Solid waste as well as liquid waste generated by industry is destroyed by rotary kiln incinerator systems in commercial premises and sites. Rotary kilns are cylindrical flame retardant coated shells that are rotated to provide falling and lifting action to solid waste materials. It exposes the surface of the waste to the fire from the combustion of fuel as well as the incineration of liquid waste in the rotating kiln. Fire will also be generated above the surface of solids waste exposed to heat and incoming air. The sludge and pumpable slurry are injected into the kiln through the nozzles. The temperature for combustion varies from 700 °C to 1300 °C. Lower temperatures are often necessary to prevent slagging certain waste materials. Rotary kilns provide excellent mixing through a swirling-falling action that evenly distributes heat over all waste materials contained in them. A kiln is a primary combustion chamber (PCC) in which the organic compounds in the waste evaporate and oxidize as air is introduced into the kiln. Unburned volatiles enter the secondary combustion chamber (SCC) along with the heat-of-combustion products from the PCC where additional oxygen is introduced and liquid waste or ignitable fuel can be burned. Total incineration of volatized waste from PCC, liquid waste and fuel occurs in the SCC with the aim of obtaining an even incineration of waste throughout the entire section. The combustion process is the same as the static type. There are two combustion in combustion chamber 1 (primary chamber) for waste and combustion chamber 2 (secondary chamber) for the remains of rudimentary gases burned in the primary chamber. Incinerator processing or combustion with Rotary Kiln type is in accordance with B3 material waste construction activities. This type can be used to destroy various types of B3 waste operating at high temperatures and exhibits a good ability to mix waste continuously. Fire will also be generated above the surface of solids waste exposed to heat and incoming air. The sludge and pumpable slurry are injected into the kiln through the nozzles.

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http://www.pollutionissues.com/Ho-Li/Incineration.html#ixzz7ZMXyti4ihttp://www.pollutionissues.com/Ho-Li/Incineration.html includes reduction, storage, collection, processing, utilization, hoarding and/or raising of B3 waste and articles (58-61) on the protection and management of the environment.

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