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Used Oil Utilization for Lime Production as Hazardous Waste Minimization

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Abstract

The number of hazardous waste, in Indonesia often called B3-waste, for the past three years has been increasing quite significantly from maintenance activities and others. Increased accumulation of B3-waste is in line with the increase of production capacity with the opening of new mine projects in PT Freeport Indonesia (PTFI). One of the B3-wastes that has increased its accumulation is the used oil. As of December 2015, the used oil utilization produced has been as much as 1,119,797 gallons, experiencing a surge compared to the one generated in the previous years. In order to decrease this number of used oil, a company did not send it to the third party, since the number was large so it would affect the operational shipping cost, and prevent from spillage incident by transport in order to protecting the environment. PTFI therefore took action to reclaim by utilized of the used oil as a mixture of fuel for operational works at lime production plant. According to the policy on the used oil utilization, PTFI is obliged to monitor the emission that comes out from lime plant's chimneys. The test result documented that the stack emission had met the requirement of the Decree of the Minister of Environmental and Forestry Number 07.03.06 year 2015 on Hazardous Waste Management Permit. This test was completed to identify Total Particulates, Metals and gaseous emission of the lime plant.

Keywords: B3-waste; Emission; Lime plant; Used oil; Utilization

Introduction

In line with the rapid advance of technology and current development, a variety of industrial activities came to existence [1]. The impact of this rapid industrial development, is inversely proportional with environmental condition [2]. Pollution increases caused by hazardous materials which are the residuals of production processes [3]. The more industrial development, the more accumulation of hazardous waste (B3-waste) produced [2]. B3-waste pollution potential is quite significant so a proper management is needed. One of B3-waste that needs to be well managed is used oil [3,4]. Used oil contains some heavy metals, on of which is Pb (lead). Lead heavy metal contamination has become an environmental problem [4].

At PTFI, used oil becomes the main concern. In the last three years, used oil accumulation increased in line with the increase of production capacity, with the opening of new mine projects. As of December 2015, the used oil generated was 1,119,797 gallons, experiencing a surge compared to previous years. Lime plant consists of a rotary kiln with nominal design 400 tons of lime per day and which can range produce 200-380 tons of lime per day. The exhausts gases from the kiln are fed through a dust collector bag house and then released to ambient air through a single steel stack [5]. Lime plant has obtained new permit from the Minister of Environmental and Forestry Number 07.03.06 year 2015 on Hazardous Waste Management Permit [6]. The testing was performed using methodology and procedures in accordance with Approved Apex Instrument Method 5 by USEPA (United States Environmental Protection Agency) concerning particulate sampling and Method 29 USEPA concerning metals as well as gaseous emission including CO, SO_2, NO_2, HCl and HF. All test works were completed according to Government of Indonesia Environmental Impact Management Agency (BAPEDAL) methods, which are equivalent to USEPA methods [6].

Methods

This research applied a descriptive method which describes the processes of used oil utilization at lime production plant. The process of reclaiming the used oil went through several processes and involved several parties (department). This research will portray processes from the beginning, i.e. when the used oil was produced, to the oxidation process resulting in emission.

The description stages of used oil reclaiming process are as follows (Figure 1):

1. Used oil management, involving used oil generation and transportation.
2. Lime plant operational requirements, covering used oil characteristics, utilization process, and emission tests.
3. Used oil management implementation based on the the Decree of the Minister of Environmental and Forestry Number 07.03.06 year 2015 on Hazardous Waste Management Permit at Lime Plant.

Results and Discussion

Used oil management

Concentrator is one of the largest used oil contributors at PTFI, and there are other used oil contributing divisions, i.e. Equipment Maintenance, Diesel Power Plant and Mechanical Shop. Within

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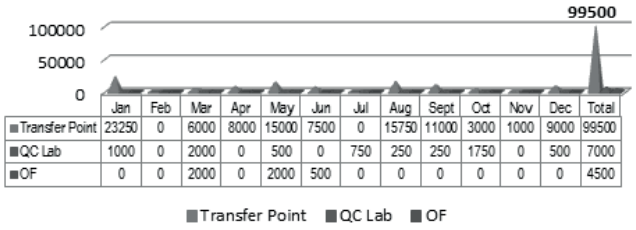

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	Total
Transfer Point	23250	0	6000	8000	15000	7500	0	15750	11000	3000	1000	9000	99500
QC Lab	1000	0	2000	0	500	0	750	250	250	1750	0	500	7000
OF	0	0	2000	0	2000	500	0	0	0	0	0	0	4500

Figure 1: Used oil generation from Concentrator in 2015.

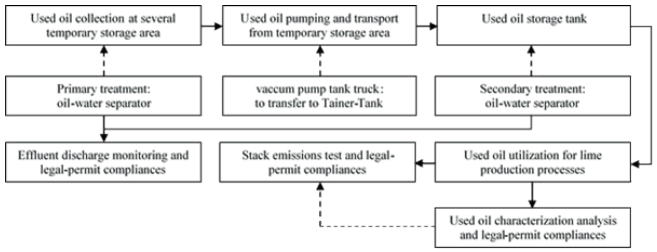

Figure 2: Used oil management and utilization as waste minimization stages.

Concentrator Division itself, operations and maintenance departments are the ones producing the largest used oil. In one month, approximately 8,000 liters of used oil was produced in average. The following (Figure 2) describing the number of used oil generation from Concentrator (from Mill Transfer point, Quality Control Laboratory and Oreflow System) in 2015.

In 2015 used oil generation reached 1,119,797 gallon. Used oil produced by operations and maintenance departments will be transfered and compiled at a specific reception area for B3-waste. i.e. Mill Transfer Point. The used oil in the transfer point, before the pumping to be done, will be drained first so that the water content in the used oil can be reduced. In the transfer point, used oil is then pumped into a container called the tank-tainer with a capacity of 5,000 gallons. The used oil that has been in the tank-tainer is then transported to the used oil tanks with capacity 200.000 gallons.

Lime plant operations

Limestone processing plant was established with its maximum production capacity 400 metric tons of quick lime ($CaCO_3$) per day. The limestone production is adjusted with the ore-processing plant's operational needs and the other usage such as covering stone mixer in the mining area. Lime dehydrator is utilized to convert the limestone into hidroxide form and reserved for limestone need fulfilment in concentrators so limestone purchases from outside PTFI area can be reduced. In the burning process (Figure 3), the used oil and the diesel fuel are mixed and heated on a preheater at 46°-70°C and then injected to the burning oven at 850°-960°C.

Control equipment and stack

Main bag house (powder dust system) consists of four fragmentary compartments. Each compartment contains 336 filter bags. Filter bag uses Huyglass-materials, which is resistant to temperature up to 260°C. Air from rotary kiln are sucked into bag house using ID fan through the filters and leftover the dust particle at filter bag's surface.

The stack dimension is 29.6-meter high and 2.5-meter in diameter. Four sampling ports at right angels' position were installed with a 10 cm diameter each and at a level of 20.4 meters from the base and 1.2 meters above platform. The stack is equipped with steel ladder and safety climbing device. The gas temperature is approximately 130°C. The stack tested at lime plant had an estimated temperature and dimensions as shown in the Table 1 below. For aiding in the representative measurement of pollutant emissions and/or total volumetric flow rate from a stationary source, a measurement site where the effluent stream is flowing in known direction selected. Then, the cross-section of the stack divided is into a number of equal areas. After that, a traverse point is located within each of these equal areas (Table 2). This method is commonly applicable to flowing gas streams in stacks.

Emissions monitoring

As an effort to manage the exhaust air quality from the limestone-processing plant so that it complies the required quality standard, a number of maintenance action on 200 thousand liters of taks and monitoring action on exhaust air from oil-water separator have been taken. This step is the follow up action on the used oil utilization permit extension until oil/used oil composition ratio is 80%.

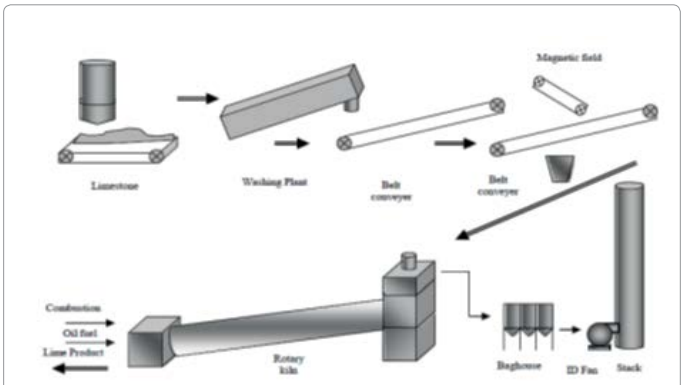

Figure 3: Flow chart of used oil utilization in lime plant.

Estimated Temperature (°C)	Inside Diameter (m)	Length	Port Location from Down/ upstream
130	2.5	11.8 D	8.16D / 3.64 D

Table 1: Stack temperature and dimensions.

Traverse Point	Distance from the inside stack wall (cm)
1	6.9
2	22.9
3	41.9
4	69.8
5	146.2
6	174.1
7	193.3
8	20

Table 2: Traverse Points (distance from the inside stack wall).

As an effort to manage the exhaust air quality from the limestone-processing plant's chimney so that it complies the required quality standard, the following seven steps must be taken:

1. Conducting routine maintenance on the pollution control devices such as filter bag on the baghouse dust collector, ID fan maintenance, oil heater according to the maintenance schedule.
2. Controlling the air pressure and the fuel debit that influence directly on the exhaust air quality from the chimney.
3. Controlling the debits of fuel, use oil, burning oven temperature and other parameters that directly influence the exhaust air quality

from the chimney.

4. Conducting monitoring internally on the exhaust emission from the plant's chimney quarterly and annually by the Government Agency, i.e. BPPT.
5. Changing the refractory flint, preheater repair. chute and cooler transfer.
6. A number of maintenance action on 200 thousand liters of tanks by dewatering the oil sludge sedimented at the bottom of the tanks.
7. Besides conducting exhaust air quality management, as an effort to prevent pollution to utilize the used oil on OWS (Oil Water Separator), skimmer and chamber maintenance is regularly conducted. The dewatering and monitoring of exhaust water from OWS (Oil-Water Separator) are done monthly so that it complies with the quality standard, apart from the maintenance of those 200 thousand liters of tanks.

Monitoring the air quality at the limestone plant is conducted twice a year. This monitoring is done periodically so that the exhaust gas complies the ambient air quality standard and refers to the Decree of the Minister of Ennvironmental and Forestry Number: 07.37.06 year 2015, effectively updated on 3 June 2015. The measurement of exhaust gas emission has to be conducted internally and externally. Table 3 demonstrates the result of exhaust gas emission monitoring in 2015.

The measurement of used oil characteristics is done twice a year (Table 4) to identify the heavy metal that is contained in the oil as well as other contents such as PCBs, water content, etc.

Pursuant to the Decree of the Minister of Environmental and Forestry of the Republic of Indonesia Number 07.37.06 year 2015 on Hazardous Waste Management Permit for Hazardous Utilization Activities at PTFI, the applications of this regulation are as follows:

Fifth dictum: PTFI is obliged to provide B3-waste temporary storage facility. This facility must have a building plan with storage capacity suitable with the type, number and characteristics of B3-waste to be stored. It also has one tank unit with 200 tons capacity with water resistant basin to prevent any spills. Now has a temporary storage facility at a transfer point and has already built a 200-tons capacity tank (Figure 4).

Sixth dictum: In the sixth dictum, it is required that the used oil must comply with the standards (Table 4). Based on the stated regulatory requirements above, the measurement results that have been conducted

Parameter	Semester 1	Semester 2	Maximum Limit
Isokinetic, %	108.6	103.2	-
Particulate, mg/m^3	5.25	5.03	200
As, mg/m^3	0.005	0.00018	1
Cd, mg/m^3	0.001	0.00253	0.2
Cr, mg/m^3	0.001	0.00053	1
Hg, mg/m^3	0.0001	0.000001	0.2
Pb, mg/m^3	0.005	0.00756	5
Tl, mg/m^3	0.01	0.001	0.2
HF, mg/m^3	0.05	0.05	10
HCl, mg/m^3	0.08	0.67	70
SO_2, mg/m^3	16.3	32.3	700
NO_x, mg/m^3	97.6	165.8	700
CO, mg/m^3	4.2	7	100
CH4, mg/m^3	ND	ND	35

Table 3: Stack emission test results in 2015.

No.	Measuremant Parameter	Units	Result	Maximum Limit
	Total Metals			
1	Arsenic, As	mg/kg	0.46	5
2	Cadmium, Cd	mg/kg	0.7	2
3	Chromium, Cr	mg/kg	1	10
4	Lead, Pb	mg/kg	6	100
	Miscellaneous			
1	Flash point	^{0}C	152	≥ 37.7
2	Heating value	Kcal/kg	9970	2500
3	Moisture content in oil sample	%	6.90	≤ 15%
4	Total organic halides, TOX	mg/kg	118	4000
	Polychlorinated Biphenyls, PCBs			
1	Arochlor 1242	µg/kg	<20	-
2	Arochlor 1248	µg/kg	<20	-
3	Arochlor 1254	µg/kg	<20	-
4	Arochlor 1260	µg/kg	<20	-
5	Total PCBs as Arochlor	µg/kg	<20	-

Table 4: Used oil charcateristics tests result.

Figure 4: Oil-water separator facility and used oil storage tank.

can be determined whether the measured parameter exceeds the quality standard.

The above table shows that the used oil characteristics have complied with the required quality standards. For PCBs, the measurement result shows that the value is <20 while in the regulation, there is no clear number or range PCBs contents in the used oil. However, it can concluded that PCBs contents in the used oil not categorized into 'pure' PCBs where their value is ≥ 50 ppm. In the sixth dictum, it is required that the consumption of used oil as a fuel substitution does not exceed 80% from the total fuel needs (Figure 5).

From the diagram above the biggest ratio of used oil and diesel fuel consumption ratio was recorded in April, i.e. around 65%. However the figure does not exceed or equal to 80%. The smallest ratio was recorded in July, i.e. around 30%. In the sixth dictum, it is also required that the utilization of used oil as a fuel in the lime combustion that uses kiln is equipped with the following tool specifications (Table 5): The followings are the figures of chimney, rotary kiln facility and baghouse as required. Emission control becomes an absolute requirement in used oil utilization. In the regulations, it is mandatory to conduct emission control twice a year and it cannot exceed the quality standards (Table 3 and Figure 6).

Conclusion

The utilization of used oil in Lime Plant has met the requirements of the government regulation to minimize hazardous waste in order environmental protecting from spillage. Stack emission test to monitor

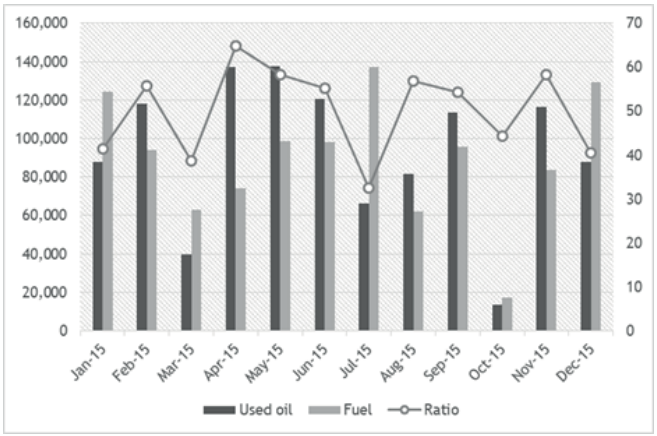

Figure 5: Used oil and diesel fuel usage ratio in 2015 at lime plant.

Parameter	Specification
Equipment type	Rotary kiln
Operation type	Continous
Temperature along the kiln	850 - 960 ^{0}C
Height of Cerobong	29.6 m
Diameter of Chimney	2.5 m
Air pollution controlling device	Baghouse
Maximum combustion capacity	400 tons / day

Table 5: Combustion equipment requirement for kiln.

Figure 6: Rotary kiln and baghouse facility.

air quality and characteristic analysis of used oil, are stipulated in the permit from Decree of the Minister of Environmental and Forestry Number 07.03.06 year 2015 on Hazardous Waste Management Permit.

References

1. Alfiyan M, Akhmad YR (2010) Radioactive Waste Management Strategy in Indonesia Judging from the concept of Cradle to Grave. Radioactive Waste Technology Center National Nuclear Energy Agency, J Waste Manage Technol 13 1-7.
2. Ministry of Environmental and Forestry of Republic of Indonesia, Minister of Environment and Forestry No. 2015 07:03:06 On Permits the management of hazardous and toxic at Lime Factory Mahaka. Jakarta, 2015.
3. Ministry of Environmental of Republic of Indonesia, Training modules management of hazardous and toxic, Identification Types and Characteristics of Hazardous and Toxic. P3KNLH (The Education and Training Ministry of Environment). Jakarta, 2008.
4. Ministry of Environmental and Forestry of Republic of Indonesia, Indonesian Government Regulation No. 101 of 2014 concerning Management of Hazardous and Toxic. Jakarta, 2014.
5. Ministry of Environmental of Republic of Indonesia, Training Module Waste Management Hazardous and Toxic Materials, General Impact of Hazardous Toxic to the Environment and Human Health. P3KNLH (The Education and Training Ministry of Environment). Jakarta, 2008.
6. Pratiwi Y(2013) Used Lubricating Oil Management Method Using Acid Clay Treatment. J Civil Eng Untan 13: 1-12.