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PROCESSING OF *FLY ASH* & *BOTTOM ASH* IN THE MANUFACTURING OF PAVING BLOCKS TO REDUCE THE TOTAL POLLUTION OF NON-B3 WASTE AT PLTU NAGAN RAYA

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Abstract

Industrial waste remains a problem in today's industrial era. The rapid development of industry has led to an increase in solid, liquid and gaseous wastes. Fly ash and bottom ash (FABA) are solid wastes from coal combustion. In this study, the authors wanted to know how to utilize fly ash and bottom ash solid waste in the manufacture of paving blocks in order to reduce non-B3 waste pollution by combining cement as the adhesive material. This research is descriptive with a qualitative approach, the data collection method is obtained through direct interviews with environmental operators who are responsible for the manufacture of paving blocks, and the data is taken from the PLTU Nagan Raya document. The results showed that the operational activities of PLTU Nagan Raya produce 60-70 tons of fly ash and 8-10 tons of bottom ash per day in the form of solid waste in one operating unit. Temporary Storage Area (TPS) Fly ash and bottom ash are coated with High-Density Polyethylene (HDPE), and Geonet. The results of the research suggest that the use of fly ash and bottom ash should not only be used in the manufacture of paving blocks and internal materials, but also in the manufacture of other external building materials, so as to reduce the amount of non-B3 waste at PLTU Nagan Raya.

Keywords : *Paving, Fly Ash, Bottom Ash, Non B3 Waste.*

1. INTRODUCTION

Industrial waste is still a problem in the current era of industrialization. The rapid development of industry has resulted in an increase in solid, liquid and gas waste. One of the wastes from burning coal known as fly ash and bottom ash or FABA is solid waste from burning coal (Prischa Oktaviani, et al, 2021). can Fly Ash Ash be used as a material to make high quality paving blocks. According to many studies, this effluent can react with calcium hydroxide (Ca(OH2)) of cement to form calcium silicate hydrate gel and seal cement, cement pores, Used in concrete mixes to improve performance when mixed to Give concrete increase and strength, Compressed concrete (Firdaus, et al. 2017, 2019; Rosidawani, et al. 2015, 2020). However, bottom ash is an excellent alternative to sand in concrete mixes. The use of 100% bottom ash can be applied to concrete whose workability is negligible, such as in the manufacture of road pavements (Singh & Siddique, 2015). In the fluidized bed (CFB) circulation system, the bottom ash consists of a mixture of coal ash, quartz sand, and flakes from the furnace walls which are eroded during the combustion process.

The raw materials used to make strong paving blocks depend on the quantity and quality of cement. This adds value to the paving block. Therefore, if possible it is desirable to create competitiveness by using cheaper raw materials. Alternative building materials that can increase the strength of concrete, such as the use of *fly ash* and *bottom ash* as raw materials for paving blocks which are the same as concrete. These two materials are distinguished by their disposal. Apart from the basic difference between the two properties, *fly ash* is much finer than *bottom ash.*

Coal *ash fly ash* and *bottom ash* are waste produced by PLTU Nagan Raya which uses coal as its energy source. The previous conditions were *fly ash* and *bottom ash* as B3 waste, but since the issuance of Government Regulation Number 22 of 2021 concerning Implementation of Environmental Protection and Management on February 2, 2021, FABA is not classified as B3 waste. However, for use it must be more useful and still be done wisely. Therefore, this FABA

producer must be effective and prudent in regulating the distribution of this FABA material to the responsible party. Prior to further processing in the use of FABA, *a toxicity characteristic leaching procedure* (TCLP) test will be carried out, or a characteristic test. This method is used as one of the determinations of the characteristics of B3 waste in Indonesia for the toxic category, and the amount to determine the mobility of organic and inorganic pollutants in liquid and solid waste. with established quality standards.

Very large amounts of ash can cause pollution problems and require a lot of space to contain it. Therefore, ash needs to be reused as a useful material so that the amount of ash can be reduced. Therefore, innovation is needed to add value to this ash and make it a material that can be reused as a main component or as a mixed material for building materials.

In this study the authors wanted to see how to utilize *fly ash* and *bottom ash* in the manufacture of paving blocks in order to reduce non-B3 waste pollution by combining cement as the adhesive material. The purpose of this research is to find out whether *fly ash* and *bottom ash* that have been processed into paving blocks can reduce non-B3 waste at PLTU Nagan Raya.

2. IMPLEMENTATION METHOD

This type of research is a descriptive research conducted by interviewing and observing researchers on the manufacture of paving blocks to reduce non-B3 waste pollution. This survey was conducted at the PLTU Nagan Raya Regency in Aceh and was carried out from March to May 2022.

The preparation of this journal uses a qualitative approach while the method used is a literature study or reviewing previous findings related to the identification of potential waste pollution. The data collection method in this journal is primary data obtained from direct interviews with the environmental division operator who is responsible for processing the paving blocks of PLTU Nagan Raya. Meanwhile, secondary data was obtained from documents at PLTU Nagan Raya and previous findings or studies cited according to scientific principles. The research was conducted with data collection, data processing and data analysis. This data collection activity includes the processing of *fly ash* and *bottom ash* well as the steps in the process of making paving blocks.

3. RESULTS AND DISCUSSION

3.1 Results

3.1.1 Treatment *Fly Ash* and *Bottom Ash* in Paving Block Making

Waste *fly*and *bottom ash* generated from PLTU Nagan Raya activities in the coal combustion process is 60-70 tons/day for *ash* and 8-10 tons/day for *bottom ash*. Until now, the waste is managed by the environmental manager of PLTU Nagan Raya. Below you can see the amount of *fly ash* and *bottom ash* used for making paving blocks in 2022.

Table 1 Results of *Fly Ash* and *Bottom Ash* Processing for Paving Blocks

The 2022 Period	Total Paving Production (pcs)	Accumulated production (pcs)	Total used faba (kg)
February	4,636	54,573	2318
March	6,681	257,139	3,340.5
April	100	11417	50
Total	111,317	11,728,712	5,708.5

Source: PT PLN (Persero) UPK Nagan Raya

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3.1.2 Chemical Content Test Results for *Fly Ash* and *Bottom Ash*

The results of analysis of *fly*and *bottom ash*, PT PLN (Persero) Nagan Raya Generation Implementing Unit, 1st quarter period (January – March 2022)

Table 2 Material Analysis of the Chemical Composition of *Fly Ash* and *Bottom Ash*

Parameters	Test results	
	***Fly ash* (%)**	***Bottom ash* (%)**
SiO_2	46.71	58.90
AI_2O_3	25.52	26.62
Fe_2O_3	8.35	4.40
CaO	8.62	3.36
MgO	3.88	1.93
SO_3	2.17	0.06
P_2O_5	0.68	0.70
Na_2O	1.49	2.03
K_2O	0.82	0.87
TiO_2	1.16	0.91
MnO_2	0.13	0.01
Loi	0.42	0.22

Source: Results of sample analysis January – March 2022

3.1.3 TCLP *Fly Ash* And *Bottom Ash*

Test Results TCLP test results on *fly ash* and *bottom ash* at PT PLN (Persero) UPK Nagan Raya.

Table 3 Results of TCLP Test Analysis on *Fly Ash*

Parameter(s) of Analysis	Method	unit	Reg.limit	Result
Arsenic (As)	USEPA7062 (1994)	Mg/L	0,5'	-
Barium (Ba)	USEPA 6010D (2018)	Mg/L	35*	0.37
Boron (B)	USEPA 6010D (2018)	Mg/L	25*	18.4
Cadmium (Cd)	USEPA 6010D (2018)	Mg/L	0.15*	<0.01
Chromium Hexavalent (Cr^{6+})	USEPA 7196A (1992)	Mg/L	2.5*	0.002

Copper (Cu)	USEPA 6010D (2018)	Mg/L	10*	0.01
Lead (Pb)	USEPA 6010D (2018)	Mg/L	0.5*	0.13
Mercury (Hg)	USEPA 7470A (1994)	Mg/L	0.05*	<0.0006
Selenium (Se)	USEPA 7742 (1994)	Mg/L	0.5	0.03
Zinc (Zn)	USEPA 60100 (2018)	Mg/L	50*	0.09

Table 4. Results of TCLP Test Analysis on *Bottom Ash*

Parameter(s) of Analysis	**Method**	**unit**	**Reg.limit**	**Result**
Arsenic (As)	USEPA7062 (1994)	Mg/L	0.5'	0.028
Barium (Ba)	USEPA 6010D (2018)	Mg/L	35*	0.75
Boron (B)	USEPA 6010D (2018)	Mg/L	25*	0.81
Cadmium (Cd)	USEPA 6010D (2018)	Mg/L	0.15*	< 0.01
Chromium Hexavalent (Cr^{6+})	USEPA 7196A (1992)	Mg/L	2.5*	0.016
Copper (Cu)	USEPA 6010D (2018)	Mg/L	10*	0.02
Lead (Pb)	USEPA 6010D (2018)	Mg/L	0.5*	0.16
Mercury (Hg)	USEPA 7470A (1994)	Mg/L	0.05*	<0.0006
Selenium (Se)	USEPA 7742 (1994)	Mg/L	0.5	<0.02
Zinc (Zn)	USEPA 60100 (2018)	Mg/L	50 *	0.31

The TCLP test results in Tables 3 and 4 show *fly ash* and *bottom ash*. PT PLN (Persero) UPK Nagan Raya shows a value that is smaller than the EPA quality standard. The use of FABA waste as a substitute for cement in the manufacture of paving blocks will reduce CO2 emissions required for cement production, while the second use is the replacement of aggregates, which can reduce natural resource development and accumulation of pollution, Given the many benefits and evidence that *fly ash* and *bottom ash* in the manufacture of paving blocks at PT PLN Nagan Raya still meet the required quality standards, then FABA is non-toxic and harmless to the surrounding environment.

Therefore, these Faba-producing producers must be effective and procedurally wise by complying with PP No. 22 of 2021 concerning Protection and Implementation of Environmental Management.

3.1.4 Paving Block Making

The materials used to make paving blocks in this research are cement, *fly ash*, *bottom ash*, sand, and water. Cement and *fly ash* are used as adhesives for the mixture, while bottom ash and sand are aggregates, water is used as a mixture to wet the aggregates. The cement used is Portland Pozzolan Cement (PPC). *The fly ash* and *bottom used* are from PLTU Nagan Raya. ash, sand, and water used are obtained from the location of the paving blocks.

From the results of the study, it was found that the steps in making paving blocks were carried out with 2 calculations of the composition of the target, namely making paving by utilizing *fly ash* and *bottom ash* as much as possible while still having paving qualifications according to national standards. Here's how to make paving blocks can be seen as follows:

1. Preparation
2. Make sure the materials and equipment needed are ready
3. Apply sufficient lubricant to the mold
4. Provide a base or pallet under the mold
5. Composition per paving block (FA:BA ;35%:10%) In kilograms: cement PCC 0.27, Sand 1.09, gravel size max 4 cm 0.69, Water 0.22, *Fly Ash* 0.14, *Bottom Ash* 0.12
6. The ingredients are put one by one into the mixer
7. The material is stirred until it is homogeneous
8. Pour the homogeneous material into the paving block mold
9. Press the mold using a hydraulic press machine
10. Give sufficient vibration by pressing the vibrator button
11. Pull the lever for the press by moving the joystick on the hydraulic press
12. Lift the base or pallet containing the product
13. drying sufficiently on the product
14. Product ready to use

3.2 DISCUSSION

Fly ash is coal combustion waste that flies and sticks to the top of the furnace, and *bottom ash* is combustion waste that falls to the bottom of the furnace (Aggarwal & Siddique, 2014). In addition, another fundamental difference is the two characteristics. The physical characteristics that distinguish it are different from the level of subtlety. *Fly ash* is much finer than *bottom ash*

Based on the research results, the production and utilization of *fly ash* and *bottom ash* in the 2022 period has been maximally utilized, so it can reduce the amount of Non-B3 waste, namely *fly ash* and *bottom ash*, the main ingredients used in making paving blocks blocks are *fly ash* and *bottom ash*, cement, sand and water. Use cement and *fly ash* as a mixed adhesive, *bottom ash* and sand as aggregate, and water as a mixture to wet the aggregate. Production results from *fly ash* and *bottom ash* are 111,317 paving blocks used from FABA waste.

The facility used for the disposal of *fly ash* and *bottom ash* the Nagan Raya PLTU uses a dump truck to transport ash from the ash silo to a temporary storage area (Aspon).storage areas *fly ash* and *bottom ash* have been coated with *High-density polyethylene* (HDPE), and Geonet, which aims to prevent leachate from this ash waste from penetrating into the ground and polluting the surrounding environment, by separating fly ash and bottom ash.

Before managing FABA waste, it is necessary to test the content of FABA waste, test the results of TCLP, whether the waste meets the required quality standards, but the FABA waste of PT PLN (Persero) UPK Nagan Raya has met the requirements. With the quality standards and standards set.

4. CONCLUSION

From the results of research that has been carried out the operational activities of PLTU Nagan Raya generate solid, liquid and gas waste. Solid waste production in the form of *fly ash* and *bottom ash has* been utilized as many as 111,317 paving in the 2022 period. Buildings/Temporary Storage Places (TPS) *Fly ash* and *bottom ash* have met the requirements for land area, geology, and distance from public facilities and certain ecosystems, because they are coated with *High-Density Polyethylene (HDPE), and Geonet.*

To avoid piles of *fly ash* and *bottom ash*, PLTU Nagan Raya utilizes them in the manufacture of paving blocks. Paving blocks derived from FABA containing a mixture of cement have a chemical composition that is safe for the environment based on the results of the TCLP test on *fly*

ash No. LHU-012/SICEH-X/WHY/2021 and *bottom ash* No. LHU-01/SICEH-X/WHY/2021, Here, the parameters are below the quality standard.

Based on the research results, it is suggested that the use of *fly ash* and *bottom ash* is not only used for the production of paving blocks and internal materials, but also for the production of other external building materials. In order to further reduce the amount of non-B3 waste at PLTU Nagan Raya.

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