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SELECTION METHODS OF FLY ASH AND BOTTOM ASH UTILIZATION FROM STEAM POWER PLANT 350 – 500 MW AS BUILDING SUBSTITUTION MATERIAL

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ABSTRACT

Waste ash (fly ash and bottom ash) is the main waste in the operation of steam power plants, especially those that use coal fuel. Research on the use of this waste has been done a lot, as well as the use of this waste to make other products (brick, light brick, paving, mortar). But until now, each PLTU has not yet integrated to utilize this ash waste to its full potential. This paper aims to provide a selection method in optimizing and selecting alternative uses of ash (fly ash and bottom ash) so that it has a benefit value by examining waste utilization in detail in terms of production aspects, environmental aspects and economic aspects. The method used in selecting the utilization of ash waste as building substitution material is carried out gradually in terms of technical, production, economic and market aspects.

KEY WORDS: Fly ash, Bottom ash, Power plant

INTRODUCTION

Fly ash and bottom ash are waste generated from burning coal in steam power plants. Fly ash is flying dust that is captured using an electrostatic precipitator. While bottom ash is the residual combustion that does not fly. Coal combustion waste itself is divided into 2 groups (Van Gerven *et al.*, 2015), there are bottom ash that is heavy ash and fly ash, which is fly ash/light.

The use of fly ash in various construction needs is based on considerations (Iyer and Scott, 2001) technical (benefits derived from the nature and property/character of fly ash material), environment (utilizing waste for useful purposes), and economy (produce more useful products).

Some objections to the use of fly ash, other than because of technical factors that cause adverse effects, are due to the influence of hazardous substances in fly ash. Both bottom ash and fly ash can be used for various purposes. Based on Nurhayati *et al.* (2018), filtration membrane can be made using slip casting method. Other uses of ash are for concrete brick, lightweight bricks, and paving block. Concrete brick making is a product of building materials that is stronger than the brick making which is generally available on the market and is environmentally friendly because it reduces the hazardous waste produced by industry (Eliche-Quesada *et al.*, 2015). The advantage of this product is that its strength exceeds that which does not use an additional fly ash brick, a brick that does not use fly ash is a quality II can be upgraded to quality I with an optimum composition of fly ash. Light brick

is generally used to build high-rise buildings and residential buildings. Light brick has a lighter weight than red brick. This light weight causes lower load on the structure and lightweight bricks to be easily transported. Paving block is a product made from concrete that is used for floors with various purposes. The product to be produced can be used depending on the quality produced, quality A can be used for roads, quality B is used for parking equipment, quality C is used for pedestrians, quality D is used for parks and other uses. This is in accordance with the applicable standards for concrete bricks, SNI 03-0691-1996. In the use of fly ash and bottom ash to make paving blocks, fly ash serves to replace some cement because of its small particle size and is pollozonic (Chindaprasirt *et al.,* 2007). While bottom ash is used to replace aggregates which generally use sand, the use of aggregates with the right size is needed to ensure good compressive strength of concrete bricks, because if the aggregate is too large then there will be parts of concrete that are not filled with aggregate (Castonguay and Thomassen, 2005).

Concrete roof tile is a building material used for roofing made from an even mixture of portland cement or the like with aggregates and water with or without the use of pigments (Qin *et al.,* 2017). the special characteristic of concrete roof tiles is its strength against the flexural load regulated in SNI 0096: 2007 and tiles must be impermeable. Similar with concrete roof tile, ready mix concrete ready mix concrete is concrete that is mixed before being sent using a Molen truck to the construction site (Sobolev, 2009).

MATERIALS AND METHODS

The stages of research on optimization studies and alternative uses of PLTU ash waste in terms of production, environmental and economic aspects. Collecting primary data, secondary data, and literature studies as well as determining the characteristics of PLTU Ash waste. The next step is gives alternative utilization of ash waste so that alternatives can be selected that are appropriate for the utilization of ash waste. Preparation and analysis of the system is required, so that studies can be done optimizing the utilization of waste ash. The next is optimizing the utilization of ash waste in terms of production, environmental and economic systems. The final stage is validation the system by looking at a case study in one of the existing power plants in Indonesia.

RESULTS AND DISCUSSION

The coal ash waste potential of the PLTU 50 MW to 500MW

The remaining combustion results with coal produce ash called ash (5-10%). The percentage of ash (fly ash and bottom ash) produced is fly ash (80-90%) and bottom ash (10-20%). Sources of Paiton PJB Based on the Environmental Protection Agency (EPA). So that in the next 10 years the amount of ash waste generated by the power plant is 62.95 - 125.9 billion tons, with details of fly ash waste of 50.36 - 113.31 billion tons and bottom ash waste of 6.295-25.18 billion tons.

Economical Aspects

Net present value (NPV) is the difference between the present value of cash inflows and the present value of cash outflows over a period of time. NPV is used in capital budgeting and investment planning to analyzed the profitability of a projected investment or project. NPV Value (in USD) for utilization fly ash and bottom ash from steam power plant 350 – 500 MW can be seen in Figure 1.

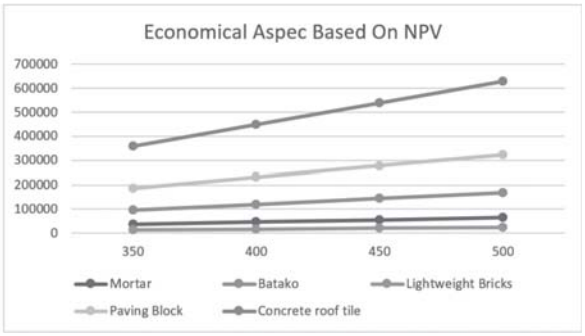

Fig. 1. Economical Aspect Based On NPV

The payback period refers to the amount of time it takes to recover the cost of an investment. Simply put, the payback period is the length of time an investment reaches a breakeven point. The desirability of an investment is directly related to its payback period. Shorter paybacks mean more attractive investment. Payback period (in year) for utilization fly ash and bottom ash from steam power plant 350 – 500 MW can be seen in Figure 2.

A benefit-cost ratio (BCR) is an indicator, used in cost-benefit analysis that attempts to summarize the overall value for money of a project or proposal. A

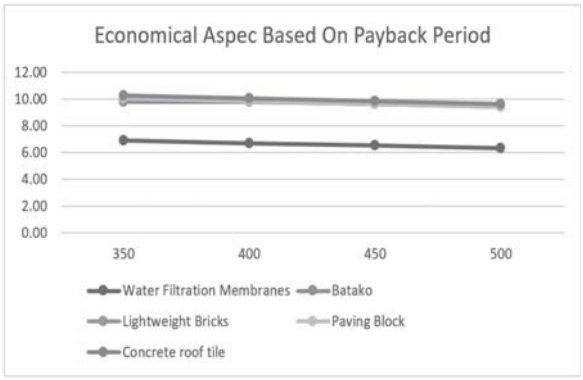

Fig. 2. Economical Aspect Based On Payback Period

BCR is the ratio of the benefits of a project or proposal, expressed in monetary terms, relative to its costs, also expressed in monetary terms. Benefit cost ratio (in percent) for utilization fly ash and bottom ash from steam power plant 350 – 500 MW shown in Figure 3.

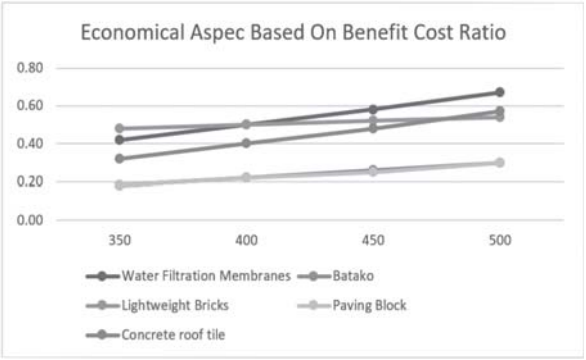

Fig. 3. Economical Aspect Based on Benefit Cost

Ratiodegradation, bio-removal treatments are beneficial for reducing food toxicity without losing the nutritional quality. The utilization of microorganisms in the removal of toxic heavy metals has been widely carried out. Lactic acid bacteria (LAC) microorganisms are widely known as safe probiotic microorganisms and are best known for reducing toxic metals from heavy metals. When fish eat food that contains probiotics, the microbes will help maintain the balance of the digestive tract and may be useful for the treatment of pathogens or infections. This bioremediation probiotic can adapt to extreme conditions exposed to Cd through resistance mechanisms either by heavy metal ion biosorption mechanisms, compiling complex cell walls, or inducing enzymatic systems to convert toxic heavy metals into non-toxic ones.

CONCLUSION

The selection of alternative uses of ash (fly ash and bottom ash) at the PLTU in accordance with the capacity and type of ash waste in detail in terms of production aspects and environmental aspects can be done more quickly so that it makes it easier for decision makers to choose alternative uses of ash waste. Reducing the effect of Fly ash and bottom ash waste globally can be done, so that within the next 10 years the amount of ash waste generated by the power plant is 62.95 - 125.9 billion tons, with details of Fly ash waste amounting to 50.36 – 113.31 billion tons and bottom ash of 6.295-25.18 billion tons.

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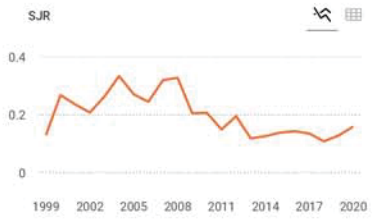

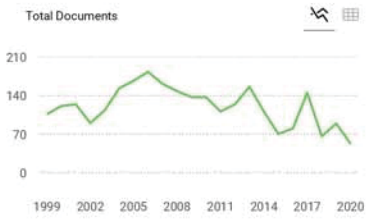

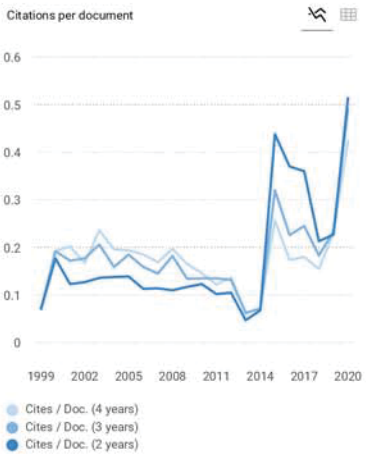

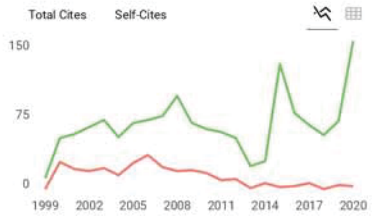

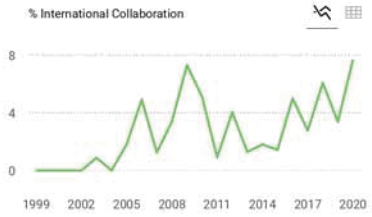

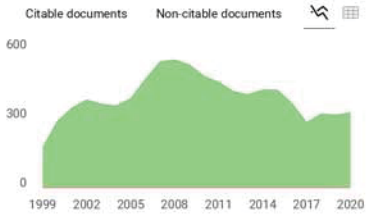

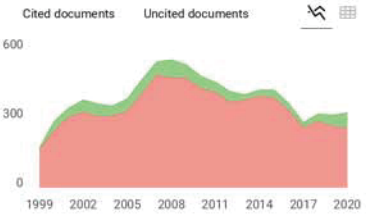

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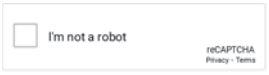

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