POTENTIAL FLY ASH UTILIZATION FOR CONCRETE ADMIXTURE AND CARBON CAPTURE TECHNOLOGY FROM BIOMASS-COAL CO-FIRING POWER PLANT IN INDONESIA

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Overview

Indonesia's Government has a commitment to mitigate climate change by setting targets for emission reduction and Net Zero Emission (NZE) by 2060. The roadmap has been established with a target of 23% renewable energy mix and should be achieved by 2025 (MEMR 2021). According to the Ministry of Energy and Mineral Resources (MEMR), biomass reserves in Indonesia have a total potential of 43.211 GWh per year (Kuvarakul et al. 2015). In this case, PLN as Indonesia State Electricity Company is committed to support the realization of targets by utilizing biomass. To support this target, PLN has program to use a mixture of biomass with coal (biomass-coal cofiring) for existing coal fired power plant (CFPP) in 52 locations.

Biomass has advantages as a substitute for fossil energy. Some of these advantages include: biomass can reduce the greenhouse effect, reduce organic waste, protect water and soil cleanliness, reduce air pollution, and reduce acid rain and acid fog. Biomass feedstock usually has to be converted in various ways into solid, liquid, or gaseous fuels that can be used to provide heat energy or generate electricity (European Parliament and the Council 2005).

Cofiring CFPP produces fly ash as a product of burning coal-biomass. The utilization of fly ash gives positive impact on landfill space and also encourage global emission reduction. Several studies have been done related to the performance of reinforced concrete containing fly ash and recently about the utilization fly ash in carbon capture technology (Balachandra et al. 2021).

The objective of this study is to analyze the characteristics of fly ash with the variation of biomass from cofiring CFPP and find out the potential fly ash utilization based on its characteristics.

Methods

Five different biomass of power plants are investigated in this research, such as woodchips, sawdust, Palm Kernel Shell (PKS), rice husk, and corn cobs. The literature review is applied for the methods in this paper. Recent numerous studies and literatures are investigated. A three-step approach was followed to investigate fly ash utilization for concrete admixture and carbon capture:

1. Investigation of fuel characteristic (coal and biomass) and fly ash analysis from each power plant.

2. Comparison of fly ash analysis with standard ASTM C618 and review of the recent FA utilization studies for cement admixture. A carbonation test with phenolphthalein pH indicator is conducted to confirm the depth of carbonation in concrete visually after immersion in NaCl 3.5% solution.

3. Characterization of fly ash with Scanning Electron Microscope (SEM) and review from the recent studies of fly ash utilization for carbon capture from each power plant.

Results

1. Chemical compositions of fuel and fly ash are mainly affected by the characteristic of biomass, coal and boiler technology.

2. Based on ASTM C618 requirement, power plant that used PKS, and rice husk as biomass could be used for pozzolanic material as F Class. These several biomasses are very potential to be developed in Indonesia due to abundant natural resources.

3. All of the fly ash characteristics from cofiring have a potential development and research for carbon capture to give alternative sorbent material besides amine. Due to the round shape of fly ash, it becomes a porous material as shown in SEM results. Porous materials give a better adsorption characteristic and have stable metal oxides, like Al_2O_3, SiO_2, and, CaO.

Conclusions

CFPPs are still the main role in electricity generation in Indonesia. Biomass-coal cofiring as a strategic program, has potential to support the renewable energy mix target of 23% in 2025. Fly ash utilization as solid waste for cement admixture and carbon capture, able to reduce landfill of fly ash and emission reduction to achieve NZE by 2060.

References

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