Characteristics and Chemical Composition of Fly Ash From Pulang Pisau’s Power Plant as A Potential Material for Synthesis of Aluminosilicate Materials

Karakteristik dan Komposisi Kimia Abu Layang PLTU Pulang Pisau Sebagai Bahan Baku Potensial untuk Sintesis Material Aluminosilikat

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ABSTRACT

The Steam-Electric Power Station (PLTU) is one of the initiatives to meet the nation's current electricity requirements. The use of fuel for steam power plant is still dominated by fossil fuels such as coal. Even though domestic energy needs are met, steam power plant turns out to be a contributor to gas emissions that cause global warming, as well as a by-product in the form of fly ash which can cause environmental and ecosystem problems. Fly ash contains silica oxide (SiO₂) and aluminum oxide (Al₂O₃) compounds which can be used as raw materials for synthesizing aluminosilicate-based materials such as geopolymers and zeolites. This study tested the characteristics and composition of chemical compounds in fly ash from Pulang Pisau’s power plant, Central Kalimantan. Characterization using X-Ray Diffraction (XRD) showed that peaks of quartz material dominated fly ash from Pulang Pisau’s power plant at 2θ=20.82°;26.61° and mullite minerals at 2θ=31.2°;33.1°;35.4°;39.2°;59.8°. The results of the chemical compound composition were tested using the ASTM-D3682-12 standard. Fly ash has a composition of 29.00% SiO₂, 9.98% Al₂O₃, 13.75% Fe₂O₃, and 28.37% CaO. Fly ash from Pulang Pisau’s power plant is classified as type C fly ash, which can potentially be used as a source of aluminosilicate-based material synthesis.

Keywords: PLTU, fly ash, aluminosilicate.
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The type of fly ash influences the quality of aluminosilicate-based materials. Fly ash is generally classified into two types based on its chemical composition (type C and F). Based on the American Society for Testing Material (ASTM) C618 standard, fly ash type F contains more than 70% (wt%) SiO₂, Al₂O₃, and Fe₂O₃ and less than 20% CaO. Type C fly ash contains less than 70% wt% SiO₂, Al₂O₃, and Fe₂O₃ and a CaO content of more than 10% (Hidayati et al., 2020). Based on the ASTM C618 standard, the fly ash from the Pulang Pisau’s power plant can be categorized as type C. Table 2 illustrates the classification of fly ash classes from various steam power plants.

Previous research by Wattimena et al. (2017) reported that geopolymers synthesized with high calcium content would have high compressive characteristics. Over time, apart from the geopolymerization reaction, a hydration reaction will occur. Based on this fact, the fly ash of the Pulang Pisau’s power plant, which is classified as type C with a very high CaO content, is suitable as a raw material for the synthesis of geopolymer materials. In contrast to zeolite materials, the calcium content in fly ash will affect the crystallinity of the zeolite during the synthesis process. Zeolite synthesized with type C fly ash will produce a residue characteristic of quartz, whereas when the zeolite is synthesized with type F fly ash, it will produce residues of quartz and mullite. Hence, the zeolite synthesized from type C fly ash will have a higher crystallinity than the zeolite synthesized from type F fly ash (Kunecki et al., 2020). Therefore, fly ash from Pulang Pisau’s power plant with high CaO content is suitable as raw material for zeolite synthesis.

### Table 2. Classification of Fly Ash Class from Various Steam Power Plant in Indonesia

<table>
<thead>
<tr>
<th>Fly Ash</th>
<th>Classification</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLTU Pacitan</td>
<td>Type F</td>
<td></td>
</tr>
<tr>
<td>Semen Gresik</td>
<td>Type C</td>
<td></td>
</tr>
<tr>
<td>Petrokimia Gresik</td>
<td>Type F</td>
<td>Sari et al., 2018</td>
</tr>
<tr>
<td>Abu Layang PT. IPMOMI</td>
<td>Type F</td>
<td></td>
</tr>
<tr>
<td>Pulang Pisau’s Power Plant</td>
<td>Type C</td>
<td>Results of this study</td>
</tr>
</tbody>
</table>
4. CONCLUSIONS

The characteristics of fly ash will affect the quality of fly ash used as a raw material for synthesizing aluminosilicate materials. Peaks of quartz and mullite material dominate the characteristics of fly ash based on the XRD test. Based on the ASTM C618 standard, the fly ash of the Pulang Pisau’s power plant is classified as type C, which is very suitable as a raw material for the synthesis of aluminosilicate materials such as geopolymers and zeolites.

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LIST OF REFERENCES


*Characteristics and Chemical Composition...*