

ABSTRAK

Penggunaan batubara di Indonesia yang semakin hari kian meningkat menyebabkan peningkatan limbah abu batubara, salah satunya abu dasar (*bottom ash*) batubara yang mencapai 250 ton setiap harinya. Di sisi lain, kandungan abu dasar batubara yang didominasi oleh alumina (Al_2O_3) dan silika (SiO_2) berpotensi untuk dijadikan zeolit. Zeolit dapat digunakan sebagai adsorben terhadap berbagai logam berat dan senyawa organik. Pada penelitian ini, dilakukan pengujian sifat adsorpsi zeolit yang dikonversi dari abu dasar batubara terhadap dua senyawa organik, yakni larutan lignin dan metilen biru. Konversi abu dasar batubara menjadi zeolit dilakukan pada suhu $90\text{ }^\circ\text{C}$ selama 24 jam menggunakan larutan NaOH. Sebelumnya, abu dasar batubara telah dipreparasi menggunakan asam sulfat (H_2SO_4) pekat pada suhu $\pm 188\text{ }^\circ\text{C}$ selama 3 jam. Konversi abu dasar batubara menjadi zeolit dikonfirmasi melalui analisa FTIR, XRF, XRD, SEM, dan BET. Hasil FTIR menunjukkan puncak serapan khas zeolit pada $900\text{-}1100\text{ cm}^{-1}$ dan $400\text{-}500\text{ cm}^{-1}$ berupa ikatan Si-O atau Al-O dan $550\text{-}660\text{ cm}^{-1}$ untuk Si-O-Al. Hasil XRD yang menunjukkan terbentuknya senyawa natrium aluminum silikat hidrat pada komposisi abu dasar batubara dan larutan NaOH 5 M sebesar 1:8. Hasil SEM menunjukkan adanya perubahan morfologi dan hasil XRF menunjukkan zeolit didominasi oleh Al_2O_3 dan SiO_2 . Aktivasi zeolit hasil konversi dilakukan dengan perendaman menggunakan HCl 0,5 M selama 48 jam. Hasil BET menunjukkan luas permukaan abu dasar batubara, zeolit hasil konversi, dan zeolit yang diaktivasi sebesar 0,598, 60,383, dan 58,286 m^2/g . Uji adsorpsi dilakukan dengan memvariasikan konsentrasi dan diolah menggunakan model isoterm adsorpsi Langmuir dan Freundlich. Berdasarkan model isoterm Langmuir, zeolit konversi dan zeolit aktivasi memiliki kapasitas adsorpsi maksimum (Q_{maks}) sebesar 34,13 mg/g dan 23,26 mg/g terhadap metilen biru, sedangkan terhadap lignin sebesar 16,13 mg/g dan 21,98 mg/g. Berdasarkan model isoterm adsorpsi yang diikuti, adsorpsi metilen biru mengikuti isoterm Langmuir, sedangkan adsorpsi lignin mengikuti isoterm Freundlich.

Kata kunci : abu dasar batubara, zeolit, uji adsorpsi, metilen biru, lignin

ABSTRACT

The increasing of use coal in Indonesia cause amount coal ash waste increase, one of them is coal bottom ash which reaches 250 tons per day. On the other side, the coal bottom ash content dominated by alumina (Al_2O_3) and silica (SiO_2) has potential to be zeolite. Zeolites can be used as adsorbents to various heavy metals and organic compounds. In this research, the zeolite adsorption properties were converted from coal bottom ash to two organic compounds, lignin and methylene blue solution. Conversion of coal bottom ash to zeolite was done at $90\text{ }^\circ\text{C}$ for 24 hours using NaOH solution. Previously, coal bottom ash had been prepared using concentrated sulfuric acid (H_2SO_4) at $\pm 188\text{ }^\circ\text{C}$ for 3 hours. The conversion of coal bottom ash to zeolite is confirmed through FTIR, XRF, XRD, SEM, and BET analyzes. FTIR results show zeolite absorption peak at $900\text{-}1100\text{ cm}^{-1}$ and $400\text{-}500\text{ cm}^{-1}$ is the bond of Si-O or Al-O and $550\text{-}660\text{ cm}^{-1}$ for Si-O-Al. XRD results indicating the formation of sodium aluminum silicate hydrate compound on the composition of coal bottom ash and 5 M NaOH solution of 1: 8. The SEM results show change of morphology and the XRF results show that zeolite is dominated by Al_2O_3 and SiO_2 . Activation of converted zeolite was done by immersion using HCl 0.5 M for 48 hours. The BET results show surface area of the coal bottom ash, converted zeolite, and activated zeolite of 0,598, 60,383, and 58,286 m^2/g . The adsorption test was carried out by varying the concentration and processed using Langmuir and Freundlich adsorption isotherm models. Based on the Langmuir isotherm model, the conversion zeolite and activation zeolite had a maximum adsorption capacity (Q_{max}) of 34.13 mg/g and 23.26 mg/g to methylene blue, for lignin 16.13 mg/g and 21.98 mg/g. Based on the adsorption isotherm model followed, methylene blue adsorption follow Langmuir isotherm, while lignin adsorption follow Freundlich isotherm.

Keywords : Coal bottom ash, zeolite, adsorption test, methylene blue, lignin