ABSTRAK

Limbah *fly ash* batubara dengan kandungan silika dan alumina yang tinggi berpotensi untuk dikonversi menjadi zeolit yang dapat dimanfaatkan sebagai adsorben untuk menjerap senyawa organik dalam larutan. Pada penelitian ini, konversi *fly ash* batubara menjadi zeolit dilakukan menggunakan metode refluks dengan *pretreatment* gelombang mikro dan ultrasonik. *Fly ash* dengan NaOH 2 M diultrasonikasi selama 30 menit dan diiradiasi menggunakan gelombang mikro selama 45 menit, dilanjutkan dengan refluks selama 24 jam. Zeolit yang disintesis menggunakan *pretreatment* gelombang mikro dilabeli zeolit C1, sementara zeolit yang disintesis menggunakan *pretreatment* gelombang mikro dan ultrasonik dilabeli zeolit C2. Keberhasilan konversi ditunjukkan oleh hasil analisa FTIR yang memberikan serapan khas zeolit yaitu pada 900-1100 cm^{-1}, 400-500 cm^{-1}, 550-660 cm^{-1} dan hasil XRD yang menunjukkan campuran natrium aluminum silikat hidrat kalsit, dan kuarsa. Sebelum diaplikasikan sebagai adsorben, zeolit diaktivasi dengan HCl 20 % selama 2 jam untuk meningkatkan kinerja adsorpsinya. Zeolit hasil aktivasi dilabeli sebagai AwC1 dan AwC2. Uji adsorpsi dilakukan menggunakan larutan model metilen biru dengan variasi konsentrasi dan diolah menggunakan model isoterm adsorpsi Langmuir dan Freundlich. Berdasarkan model isoterm adsorpsi Langmuir, *fly ash* memiliki kapasitas adsorpsi maksimum (Qm) sebesar 0,0003 mg/g, zeolit C1 44 mg/g, dan zeolit C2 51 mg/g. Adapun zeolit AwC1 memiliki Qm 69,44 mg/g dan zeolit AwC2 101 mg/g. Berdasarkan analisa BET, *fly ash* memiliki luas permukaan 7 m^2/g, zeolit C2 82,4 m^2/g, dan zeolit AwC2 82,6 m^2/g. Tingginya kapasitas adsorpsi dari AwC2 mengindikasikan berlangsungnya mekanisme adsorpsi melalui interaksi adsorbat dengan gugus Si-OH yang didukung oleh serapan pada bilangan gelombang 960 cm^{-1}.

Kata kunci : *Fly ash*, zeolit, adsorpsi, ultrasonik, aktivasi asam

ABSTRACT

The waste of Coal fly ash contained high silica and alumina has capacity to be converted into zeolite. It can be used as adsorbent for organic compounds in solution. In this study, the conversion of coal fly ash into zeolite conducted using reflux with microwave and ultrasonic pretreatment. Fly ash and NaOH 2 M was ultrasonicated for 30 minutes and irradiated using microwave for 45 minutes, followed by reflux for 24 hours. Variations pretreatment ultrasonic and microwave as well as zeolite synthesized using microwave pretreatment was labeled as zeolite C1, meanwhile the zeolite synthesized using microwave and ultrasonic pretreatment was labeled as zeolite C2. The accomplishment of obtaining zeolite from the conversion process is confirmed by the results of FTIR analysis which showed zeolite characteristic bands at 990-1100 cm^{-1}, 400-500 cm^{-1}, 550-660 $cm^{-1}$and the results of XRD analysis which showed a mixture of sodium aluminum silicate hydrate, calcite and quartz. Before zeolite applied as an adsorbent, zeolite was activated by 20% HCl for 2 hours to improve the adsorption performance. Activated Zeolite was labeled as AwC1 and AwC2. Adsorption test was conducted using a solution of methylene blue models with various concentrations. Parameter adsorption was studied using adsorption isotherm model of Langmuir and Freundlich. Based on the Langmuir adsorption isotherm models, fly ash has a maximum adsorption capacity (Qm) of 0.0003 mg / g, zeolite C1 44 mg/g, and zeolite C2 51 mg/g. The zeolite AwC1 have Qm 69.44 mg/g and zeolite AwC2 101 mg/g. Based on the analysis of BET, fly ash has a surface area of 7 m^2/g, zeolite C2 82.4 m^2/g, and zeolite AwC2 82.6 m^2/g. The high adsorption capacity of AwC2, indicated the adsorption mechanism going through the interaction of adsorbate with Si-OH groups were supported by absorption at 960 cm^{-1}.

Keywords : Fly ash, zeolite, adsorption, ultrasonic, acid activation