

## Pengaruh asam sulfat sebagai media pertukaran kation dan suhu kalsinasi terhadap Kaolin sebagai bahan baku Zeolit = Effect of sulfuric acid as a media for cation exchange and calcination temperature of Kaolin as Raw Material for Zeolite

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### Abstrak

Kaolin merupakan mineral dengan kandungan silika dan alumina yang tinggi. Indonesia memiliki sumber daya alam berupa kaolin yang melimpah, salah satunya di Badau Belitung. Kaolin sebagai sumber silika dan alumina harus diubah menjadi metakaolin dengan rangkaian proses yaitu aktivasi dan kalsinasi sebelum bisa digunakan sebagai bahan dalam sintesis zeolit. Pada penelitian ini dilakukan aktivasi kaolin dengan menggunakan media pertukaran kation berupa larutan asam sulfat dengan konsentrasi yang berbeda, yaitu 3M dan 4M. Pencampuran dilakukan secara mekanik menggunakan magnetic stirrer selama 24 jam pada suhu 50oC. Kalsinasi dilakukan dengan furnace pada temperatur 500oC dan 700oC. Karakterisasi infra merah (FTIR) dilakukan untuk membuktikan bahwa gugus fungsi O-H hilang pada suhu kalsinasi tersebut, dengan melakukan analisis perbandingan terhadap kaolin tanpa perlakuan apapun. Sampel kaolin mengalami peristiwa dehidroksilasi, vibrasi ulur, dan vibrasi tekuk pada beberapa daerah serapan yaitu 3692 cm-1, 3653 cm-1, 3620 cm-1, 1114 cm-1, 1029 cm-1, 911 cm-1, 527 cm-1, dan 460 cm-1. Karakterisasi dengan metode mikroskop elektron yang dilengkapi dispersi energi sinar-X (SEM-EDX) dilakukan untuk mengetahui morfologi dan komposisi secara semi kuantitatif dari kaolin yang telah melalui proses aktivasi dan kalsinasi. Hasil SEM memperlihatkan bahwa morfologi Kaolin Badau Belitung berupa lembaran yang berlapis, hal ini masih terlihat pada temperatur kalsinasi 500oC, sedangkan pada temperatur kalsinasi 700oC sudah tidak ditemukan lagi. Sementara EDX memperlihatkan bahwa larutan H<sub>2</sub>SO<sub>4</sub> 3M sebagai media pertukaran kation dapat mengurangi kadar pengotor pada Kaolin Badau Belitung berupa Kalium, Besi dan Zinc masing-masing sebanyak 17,5%, 56,7%, dan 54% pada temperatur kalsinasi 500oC. Sedangkan pada temperatur kalsinasi 700oC, kadar pengotor tersebut berkurang masing-masing sebanyak 56%, 9%, dan 29,2%. Sedangkan pada penggunaan larutan H<sub>2</sub>SO<sub>4</sub> 4M berdasarkan hasil karakterisasi EDX, kadar pengotor Besi naik 18%, Kalium berkurang 12% dan tidak ditemukannya lagi Zinc pada temperatur kalsinasi 500oC. Sedangkan pada temperatur kalsinasi 700oC, kadar pengotor Besi naik 30%, Kalium berkurang 15%, dan tidak ditemukannya lagi Zinc. Karakterisasi Brunauer-Emmett-Teller (BET) dilakukan untuk mengetahui pengaruh temperatur kalsinasi terhadap luas permukaan dari kaolin yang telah melalui proses aktivasi dan kalsinasi. Volume pori dan luas permukaan spesifik meningkat seiring dengan peningkatan temperatur kalsinasi masing-masing 311,36% dan 350% pada temperatur kalsinasi 500oC, sedangkan pada temperatur kalsinasi 700oC masing-masing menjadi 445% dan 515,62%. Sebaliknya diameter pori mengalami penurunan 26% dan 42%, masing-masing pada temperatur kalsinasi 500oC dan 700oC. Karakterisasi difraksi sinar-X (XRD) dilakukan untuk mengetahui perubahan kristalinitas dari kaolin, dimana grafik XRD menunjukkan hilangnya peak kaolinit.

.....Kaolin is a mineral with a high content of silica and alumina. Indonesia has abundant natural resources in the form of kaolin, one of which is in Badau Belitung. Kaolin as a source of silica and alumina must be converted into metakaolin by a series of processes, namely activation and calcination before it can be used

as an ingredient in zeolite synthesis. In this study, kaolin activation was carried out using cation exchange media in the form of sulfuric acid solution with different concentrations, namely 3M and 4M. The mixing was done mechanically using a magnetic stirrer for 24 hours at a temperature of 50°C. Calcination was carried out in a furnace at temperatures of 500°C and 700°C. Fourier Transform Infrared Spectroscopy (FTIR) characterization was carried out to prove that the O-H functional group is lost at the calcination temperature, by performing a comparative analysis of kaolin without any treatment. Kaolin samples experienced dehydroxylation, stretching vibrations, and bending vibrations in several absorption areas, namely 3692 cm<sup>-1</sup>, 3653 cm<sup>-1</sup>, 3620 cm<sup>-1</sup>, 1114 cm<sup>-1</sup>, 1029 cm<sup>-1</sup>, 911 cm<sup>-1</sup>, 527 cm<sup>-1</sup>, and 460 cm<sup>-1</sup>. Characterization using Scanning Electron Microscopy with Energy Dispersive X-Ray (SEM-EDX) was carried out to determine the morphology and composition of kaolin which had gone through the activation and calcination processes. SEM results showed that the morphology of Kaolin Badau Belitung form is layered sheets, this is still visible at the calcination temperature of 500°C, but at the calcination temperature of 700°C the layered sheets are no longer found. Meanwhile, EDX showed that the H<sub>2</sub>SO<sub>4</sub> 3M solution as a cation exchange can reduce the impurities levels in Badau Belitung Kaolin such as Potassium, Iron and Zinc, respectively 17.5%, 56.7%, and 54% at calcination temperature of 500°C. Whereas, at calcination temperature of 700°C, the levels of those impurities were reduced 56%, 9% and 29.2%, respectively. Whereas in the use of H<sub>2</sub>SO<sub>4</sub> 4M solution based on the results of EDX characterization, showed that impurities content of Iron increased by 18%, but potassium was reduced by 12% and zinc was not found at the calcination temperature of 500°C. Meanwhile, the calcination temperature of 700°C, iron impurities levels increased by 30%, but potassium was reduced by 15%, and zinc was no longer found. Brunauer-Emmett-Teller (BET) characterization was carried out to determine the effect of calcination temperature on the surface area of kaolin which had gone through the activation and calcination processes. The pore volume and specific surface area increased with increasing the calcination temperature, respectively 311.36% and 350% at 500°C, while at the calcination temperature 700°C became 445% and 515.62%, respectively. In contrast, the pore diameter decreased 26% and 42%, respectively at the calcination temperature of 500°C and 700°C. X-ray Diffraction (XRD) characterization was carried out to determine the change in crystallinity of kaolin, where the XRD graph showed the loss of kaolinite peaks.