SINTESIS DAN KARAKTERISASI ZEOLIT MAGNETIK BERBASIS ABU LAYANG BATUBARA DAN LUMPUR MERAH UNTUK ADSORPSI PEWARNA RHODAMINE B DAN ERIOCHROME BLACK T

SKRIPSI

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Sains pada Program Studi Kimia

Oleh:

Zahra Aulia Latifah

2101597

PROGRAM STUDI KIMIA

FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM

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LEMBAR HAK CIPTA

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Zahra Aulia Latifah

Sebuah Skripsi yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Sarjana Sains pada Program Studi Kimia Fakultas Pendidikan Matematika dan Ilmu Pengetahuan Alam

LEMBAR PENGESAHAN

ZAHRA AULIA LATIFAH

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Disetujui dan disahkan oleh pembimbing:

Pembimbing I

Galuh Yuliani, M.Si., Ph.D.

NIP.198007252001122001

Pembimbing II

Dr. H. Budiman Anwar, M.Si.

NIP.197003131997031004

Mengetahui,

Ketua Program Studi Kimia, FPMIPA UPI

Prof. Fitri Khoerunnisa, Ph.D.

NIP.197806282001122001

ABSTRAK

Pembuangan limbah pewarna sintetis ke lingkungan dapat meningkatkan toksisitas lingkungan perairan, dimana pewarna sintetis seperti *Rhodamine B* dan *Eriochrome Black T* memiliki sifat karsinogenik dan sulit terurai. Pada penelitian ini dilakukan sintesis zeolit magnetik dengan memanfaatkan limbah abu layang batubara yang dikombinasikan dengan lumpur merah untuk memperoleh sifat magnetik. Zeolit magnetik disintesis menggunakan metode alkali fusi hidrotermal dengan memvariasikan rasio NaOH dan waktu hidrotermal. Berdasarkan pengujian XRD, hasil terbaik dihasilkan pada rasio NaOH 2:1 (massa/massa) dengan suhu hidrotermal 160°C selama 12 jam (ZM-2:160). ZM-2:160 memiliki kemiripan pola XRD dengan jenis zeolit sodalit (SOD) dan cancrinit (CAN) dan dikategorikan sebagai partikel mesopori. Hasil analisis FTIR menunjukkan adanya serapan gugus aluminosilikat tetrahedral dan besi oksida yang mengonfirmasi terbentuknya zeolit magnetik. Mekanisme adsorpsi pewarna *Rhodamine B* dan *Eriochrome Black T* pada ZM-2:160 mengikutii model isoterm Temkin yang berlangsung secara fisisorpsi. Pengukuran zeta potensial menunjukkan permukaan adsorben bersifat negatif sehingga proses adsorpsi kedua pewarna optimal pada kondisi asam. Zeolit magnetik menunjukkan hasil pemakaian berulang yang baik hingga dua siklus dan mengalami penurunan kinerja pada siklus ketiga.

Kata kunci: abu layang batubara, adsorpsi, lumpur merah, pewarna, regenerasi, zeolit magnetik.

ABSTRACT

The release of synthetic dye waste into the environment can increase the toxicity of aquatic environments, as synthetic dyes such as Rhodamine B and Eriochrome Black T are carcinogenic and difficult to break down. In this study, magnetic zeolite was synthesized using coal fly ash waste combined with red mud to obtain magnetic properties. Magnetic zeolite was synthesized using the hydrothermal alkali fusion method by varying the NaOH ratio and hydrothermal time. Based on XRD analysis, the optimal results were obtained at a NaOH ratio of 2:1 (mass/mass) with a hydrothermal temperature of 160°C for 12 hours (ZM-2:160). ZM-2:160 has an XRD pattern similar to sodalite (SOD) and cancrinite (CAN) zeolites and is categorized as a mesoporous particle. FTIR analysis results show the absorption of tetrahedral aluminosilicate and iron oxide groups, confirming the formation of magnetic zeolite. The adsorption mechanism of Rhodamine B and Eriochrome Black T dyes on ZM-2:160 follows the Temkin isotherm model, which occurs through physisorption. Zeta potential measurements show that the adsorbent surface is negative, so the adsorption process of both dyes is optimal under acidic conditions. Magnetic zeolite shows good repeatability up to two cycles and experiences a decline in performance in the third cycle.

Keyword: *adsorption, coal fly ash, dye, magnetic zeolite, red mud, regeneration.*

DAFTAR ISI

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DAFTAR LAMPIRAN

DAFTAR SINGKATAN

CFA = *Coal Fly Ash* (Abu Layang Batubara)

RM = *Red Mud* (Lumpur Merah)

ZFA-RM = Zeolit *Fly Ash-Red Mud*

ZM = Zeolit Magnetik

SOD = *Sodalite*

CAN = *Cancrinite*

XRD = *X-Ray Diffraction*

XRF = *Fourier Transform Infrared Spectroscopy*

SEM-EDS = *Scanning Electron Microscopy-Energy Dispersive X-Ray Spectroscopy*

PBU = *Primary Building Unit*

SBU = *Secondary Building Unit*

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