TESIS

PENGARUH INKORPORASI MAGNETIT TERHADAP KARAKTERISTIK DAN KINERJA KARBON AKTIF MIKROPORI TERHADAP ADSORPSI PARASETAMOL

Diajukan sebagai salah satu syarat memperoleh gelar Magister Sains

Program Studi Magister Kimia

Disusun oleh:

Brigitta Stacia Maharani 2313429

Dosen Pembimbing

Prof. Fitri Khoerunnisa, Ph. D.

Dr. H. Budiman Anwar, M. Si.

PROGRAM STUDI MAGISTER KIMIA

FAKULTAS PENDIDIKAN MATEMATIKA DAN ILMU PENGETAHUAN ALAM

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Oleh
Brigitta Stacia Maharani

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Sebuah Tesis yang diajukan untuk memenuhi salah satu syarat memperoleh gelar Magister Sains (M.Si.) pada Fakultas Pendidikan Matematika dan IPA

HALAMAN PENGESAHAN

BRIGITTA STACIA MAHARANI

PENGARUH INKORPORASI MAGNETIT TERHADAP KARAKTERISTIK DAN KINERJA KARBON AKTIF MIKROPORI TERHADAP ADSORPSI PARASETAMOL

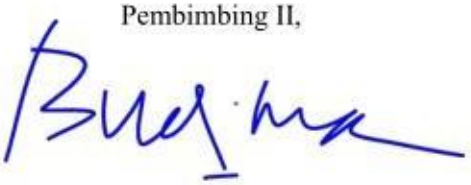
Disetujui dan disahkan oleh:

Pembimbing I,

Prof. Fitri Khoerunnisa, M.Si., Ph.D.

NIP. 197806282001122001

Pembimbing II,



Dr. H. Budiman Anwar, M. Si.

NIP. 197003131997031004

Mengetahui:

Ketua Program Magister Kimia

Prof. Fitri Khoerunnisa, M.Si., Ph.D.

NIP. 197806282001122001

PERNYATAAN KEASLIAN

Dengan ini saya,

Nama : Brigitta Stacia Maharani

NIM 1904604

Program Studi : Magister Kimia

Fakultas : Fakultas Pendidikan Matematika dan IPA

Menyatakan bahwa tesis yang berjudul "**PENGARUH INKORPORASI MAGNETIT TERHADAP KARAKTERISTIK DAN KINERJA KARBON AKTIF MIKROPORI TERHADAP ADSORPSI PARASETAMOL"** ini beserta seluruh isinya adalah benar-benar karya saya sendiri. Saya tidak melakukan penjiplakan atau pengutipan dengan cara-cara yang tidak sesuai dengan etika ilmu pengetahuan yang berlaku di masyarakat.

Atas pernyataan ini, saya siap menanggung risiko/sanksi apabila dikemudian hari ditemukan adanya pelanggaran etika keilmuan atau ada klaim dari pihak lain terhadap keaslian karya saya ini.

Bandung, Agustus 2024

Yang Menyatakan,

Brigitta Stacia Maharani

NIM. 2313429

KATA PENGANTAR

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Penyusunan tesis ini dilakukan sebagai salah satu persyaratan akademik untuk menyelesaikan pendidikan pada program studi magister kimia. Tesis ini merupakan hasil penelitian yang disajikan dari masalah penelitian, metode sintesis material mikropori karbon aktif magnetit, karakterisasi, analisis data, dan kesimpulan yang didukung dari berbagai teori yang dikemukakan oleh para ahli.

Penulis menyadari bahwa penulisan tesis ini masih banyak kekurangan baik dari segi bahasa, penyusunan, maupun penulisannya. Maka dari itu, dengan segala kerendahan hati, penulis berharap adanya kritik dan saran guna menjadi acuan yang lebih baik pada penelitian yang akan datang. Semoga tesis ini dapat bermanfaat bagi perkembangan ilmu pengetahuan di masa mendatang.

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ABSTRAK

Penelitian ini bertujuan untuk menentukan kondisi optimum dalam aktivasi karbon aktif magnetit (MAC) menggunakan larutan basa KOH serta mengevaluasi pengaruh penambahan magnetit terhadap karakteristik fisikokimia dan kinerja adsorpsi serta desorpsi MAC pada limbah parasetamol. Proses sintesis MAC dilakukan melalui aktivasi kimia dengan larutan KOH, kemudian dimodifikasi menggunakan metode kopresipitasi untuk menambahkan magnetit. Karakterisasi MAC dilakukan menggunakan berbagai teknik seperti FTIR, XRD, Raman Spectroscopy, BET, TG-DTG, dan SEM untuk mengungkap sifat fisikokimia dan morfologi material. Kinerja adsorpsi dan desorpsi diuji menggunakan metode batch, dengan pengukuran konsentrasi parasetamol menggunakan spektrofotometer UV-Vis. Hasil penelitian menunjukkan bahwa MAC berhasil disintesis dengan kondisi optimum AC pada larutan KOH 2M, di mana karakterisasi FTIR mengidentifikasi puncak C-O (stretching) pada 1200 cm^{-1}. Analisis TG-DTG mengungkap perbedaan signifikan pada massa akhir. Penambahan magnetit pada karbon aktif menyebabkan perubahan pada karakteristik material, ditandai dengan munculnya puncak khas Fe-O pada 580 cm^{-1} dan puncak C-H stretching pada 2900 cm^{-1}. Penambahan magnetit juga mengubah pola difraksi XRD, dengan munculnya puncak baru pada 20, 29, 31,6, dan 36°. Kristalinitas material meningkat dari 7,7% (AC2) menjadi 12,7% (MAC7). Analisis Raman menunjukkan bahwa MAC7 memiliki tingkat grafitisasi terendah dengan nilai R sebesar 0,84. Analisis BET menunjukkan bahwa AC2 dan MAC1 memiliki isoterm tipe I dengan luas permukaan masing-masing 378 dan 474 m^2/g, serta rerata ukuran pori 1,7 dan 1,6 nm. Morfologi SEM mendukung hasil ini, menunjukkan bahwa peningkatan magnetit pada MAC7 menyebabkan penutupan pori dan peningkatan kekasaran permukaan. Studi adsorpsi dan desorpsi menunjukkan MAC3 memiliki efisiensi tertinggi sebesar 98% dan 65%. Kinetika adsorpsi mengikuti model pseudo first order, dan isoterm adsorpsi sesuai dengan model Langmuir dan Redlich-Peterson dengan $R^2 = 0,99$ dan chi-square mendekati 0,0.

Kata kunci: karbon aktif magnetit, parasetamol, adsorpsi, kinetika, isoterm, mikropori.

ABSTRACT

This study aims to determine the optimal conditions for activating magnetite-activated carbon (MAC) using a KOH base solution and to evaluate the effects of magnetite addition on the physicochemical characteristics, as well as the adsorption and desorption performance of MAC in paracetamol wastewater. The MAC synthesis process was carried out through chemical activation with a KOH solution, followed by modification using the coprecipitation method to introduce magnetite. MAC characterization was conducted using various techniques such as FTIR, XRD, Raman Spectroscopy, BET, TG-DTG, and SEM to reveal the physicochemical properties and morphology of the material. The adsorption and desorption performance were tested using the batch method, with paracetamol concentration measured by UV-Vis spectrophotometry. The results showed that MAC was successfully synthesized under optimal conditions using 2M KOH for AC activation, where FTIR characterization identified a C-O (stretching) peak at 1200 cm^{-1}. TG-DTG analysis revealed a significant difference in final mass. The addition of magnetite to activated carbon resulted in changes in material characteristics, marked by the appearance of a characteristic Fe-O peak at 580 cm^{-1} and a C-H stretching peak at 2900 cm^{-1}. The inclusion of magnetite also altered the XRD diffraction pattern, with the emergence of new peaks at 20°, 29°, 31.6°, and 36°. The crystallinity of the material increased from 7.7% (AC2) to 12.7% (MAC7). Raman analysis indicated that MAC7 had the lowest degree of graphitization with an R value of 0.84. BET analysis showed that AC2 and MAC1 exhibited Type I isotherms with surface areas of 378 and 474 m^2/g, and average pore sizes of 1.7 and 1.6 nm, respectively. SEM morphology supported these results, showing that increased magnetite in MAC7 led to pore blockage and increased surface roughness. Adsorption and desorption studies revealed that MAC3 exhibited the highest efficiency, at 98% and 65%, respectively. The adsorption kinetics followed a pseudo-first-order model, and the adsorption isotherms were consistent with the Langmuir and Redlich-Peterson models, with $R^2 = 0.99$ and chi-square values close to 0.0.

Keywords: magnetite-activated carbon, paracetamol, adsorption, kinetics, isotherms, micropores.

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DAFTAR GAMBAR

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