SINTESIS DAN KARAKTERISASI NANOPARTIKEL KALSIUM OKSIDA SERTA APLIKASINYA DALAM PENGOLAHAN LIMBAH INDIGO CARMINE

SKRIPSI

diajukan untuk memenuhi sebagian syarat untuk memperoleh gelar Sarjana Kimia

oleh

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UNIVERSITAS PENDIDIKAN INDONESIA

2023

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Menyatakan bahwa skripsi yang berjudul "**SINTESIS DAN KARAKTERISASI KALSIUM OKSIDA SERTA APLIKASINYA DALAM PENGOLAHAN LIMBAH INDIGO CARMINE"** 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.

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KATA PENGANTAR

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Penyusunan skripsi ini dilakukan sebagai salah satu persyaratan akademik untuk menyelesaikan pendidikan pada program studi kimia. Skripsi ini merupakan hasil penelitian yang disajikan dari masalah penelitian, metode sintesis nanopartikel kalsium oksida, karakterisasi, analisis data, dan kesimpulan yang didukung dari berbagai teori yang dikemukakan oleh para ahli.

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ABSTRAK

Penelitian ini bertujuan untuk menentukan kondisi optimum sintesis nanopartikel CaO melalui metode kopresipitasi, mengetahui karakteristik nanopartikel CaO hasil sintesis dan menyelidiki pengaruh kinerja nanopartikel CaO sebagai adsorben pengolahan limbah indigo carmine. Nanopartikel CaO disintesis menggunakan metode kopresipitasi. Nanopartikel CaO hasil sintesis dikarakterisasi menggunakan X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM) dan Fourier-transform infrared spectroscopy (FTIR). Pengujian kinerja nanopartikel CaO dalam adsorpsi indigo carmine (IC) dilakukan dengan metode batch, dimana jumlah IC yang teradsorpsi dianalisis menggunakan spektrofotometer Ultraviolet-Visible (UV-Vis). Nanopartikel CaO berhasil disintesis dengan metode kopresipitasi pada kondisi optimum konsentrasi NaOH 1 M dan suhu pembentukan sebesar 400+200℃ dengan % yield paling tinggi mencapai 74,56%. Keberhasilan pembentukan nanopartikel CaO dikonfirmasi melalui kemunculan puncak difraksi 2 theta 23,12°; 39,2°; 57,9°; dan 67,2° yang identik dengan struktur kisi CaO dengan indeks hkl (200), (311), (422) dan (600) serta ukuran kristal mencapai 4,96 nm. Gambar SEM mendukung terbentuknya nanopartikel CaO dengan ukuran rata-rata partikel mencapai 98,1 nm serta distribusi ukuran yang beragam. Spektra IR mengkonfirmasi pembentukan nanopartikel CaO dengan kemunculan puncak Ca-O pada panjang gelombang 3640 dan 791 cm-1 serta vibrasi stretching Ca-O pada 1400 dan 860 cm-1. Kapasitas adsorpsi indigo carmine pada nanopartikel CaO terbesar ditemukan pada dosis adsorben 10 mg, konsentrasi adsorbat 100 ppm dan waktu kontak 50 menit. Model isoterm adsorpsi yang paling cocok adalah model koble-corrigan dengan R^2 sebesar 0,99 dan nilai *chi-square* sebesar 0,39. Sedangkan pada pemodelan kinetika adsorpsi, model pseudo 2^{nd} order merupakan model yang paling cocok dengan nilai R^2 sebesar 0.99 serta nilai Q_{max} (experiment) mendekati nilai Q_e (perhitungan).

Kata kunci: adsorpsi, isoterm adsorpsi, kinetika adsorpsi, nanopartikel, indigo carmine, kalsium oksida.

ABSTRACT

This study aims to determine the optimum conditions for the synthesis of CaO nanoparticles through the coprecipitation method, to determine the characteristics of the synthesized CaO nanoparticles and to investigate the performance effect of CaO nanoparticles as an adsorbent for indigo carmine waste. CaO nanoparticles were synthesized using coprecipitation method. The synthesized CaO nanoparticles were characterized using X-Ray Diffraction (XRD), Scanning Electron Microscope (SEM) and Fourier-transform infrared spectroscopy (FTIR). Testing the performance of CaO nanoparticles in indigo carmine (IC) adsorption was carried out using a batch method, where the amount of adsorbed IC was analyzed using an Ultraviolet-Visible (UV-Vis) spectrophotometer. CaO nanoparticles were successfully synthesized by the coprecipitation method at the optimum conditions of 1 M NaOH concentration and formation temperature of 400+200℃ with the highest % yield reaching 74.56%. The successful formation of CaO nanoparticles was confirmed by the appearance of the diffraction peak of 2 theta 23.12°; 39.2°; 57.9°; and 67.2° which is identical to the lattice structure of CaO with hkl indices (200), (311), (422) and (600) and a crystal size of up to 4.96 nm. SEM images support the formation of CaO nanoparticles with an average particle size of 98.1 nm and a variety of size distributions. The IR spectra confirmed the formation of CaO nanoparticles with the appearance of Ca-O peaks at wavelengths of 3640 and 791 cm-1 and Ca-O stretching vibrations at 1400 and 860 cm-1. The greatest adsorption capacity of indigo carmine on CaO nanoparticles was found at an adsorbent dose of 10 mg, an adsorbate concentration of 100 ppm and a contact time of 50 minutes. The most suitable adsorption isotherm model is the Koble-Corrigan model with an R^2 of 0.99 and a chi-square value of 0.39. Whereas in the adsorption kinetics modeling, the pseudo 2^{nd} order model is the most suitable model with an R^2 value of 0.99 and the Q_{max} value (experiment) is close to the Qe value (calculation).

Keywords: adsorption, adsorption isotherm, adsorption kinetics, nanoparticles, indigo carmine, calcium oxide.

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