

**PEMANFAATAN ZEOLIT ALAM GUNUNG KIDUL DAN PASIR BESI
PANTAI COMAL KULON PROGO UNTUK PEMBUATAN
NANOKOMPOSIT MAGNETIT@ZEOLIT SEBAGAI ADSORBEN Cd(II)**

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INTISARI

Nanokomposit magnetit@zeolit telah disintesis dengan memanfaatkan bahan alam Yogyakarta sebagai bahan dasar yaitu pasir besi Pantai Comal Kulon Progo dan zeolit alam Gunung Kidul. Nanokomposit diaplikasikan sebagai adsorben logam berat kadmium (Cd). Tahapan penelitian yang dilakukan adalah preparasi bahan alam Yogyakarta melalui aktivasi zeolit alam Gunung Kidul dengan larutan asam dan ekstraksi material magnetik pasir besi Pantai Comal Kulon Progo dengan larutan basa. Sintesis nanokomposit magnetit@zeolit dengan variasi perbandingan magnetit:zeolit yang dilakukan dengan menambahkan zeolit alam saat dilakukannya preparasi material magnetik hasil ekstraksi dan dilanjutkan penambahan larutan NH_4OH sebagai agen pengendap hingga pH 11. Sifat-sifat material dipelajari melalui karakterisasi FTIR, XRD, SEM-EDX, TEM dan VSM. Kajian adsorpsi Cd(II) dilakukan melalui penentuan kondisi optimum untuk parameter pH larutan, waktu kontak dan konsentrasi awal larutan Cd(II).

Hasil penelitian menunjukkan bahwa pemanfaatan bahan alam Yogyakarta dalam sintesis nanokomposit magnetit@zeolit telah berhasil dan dibuktikan melalui hasil studi karakterisasi yang telah dilakukan. Perbandingan massa magnetit:zeolit 1:1 memberikan hasil terbaik dalam sintesis nanokomposit magnetit@zeolit dibuktikan dengan hasil studi FTIR dan XRD. Citra TEM menunjukkan distribusi ukuran partikel nanokomposit magnetit@zeolit yang memiliki rata-rata ukuran partikel 19,871 nm. Kondisi optimum adsorpsi Cd(II) oleh adsorben nanokomposit magnetit@zeolit diperoleh pada pH 9, waktu kontak adsorpsi selama 90 menit dan konsentrasi awal 12 mg/L. Studi kinetika adsorpsi menunjukkan bahwa proses adsorpsi mengikuti orde dua-semu model Ho-McKay dengan konstanta laju adsorpsi sebesar $0,1144 \text{ g mg}^{-1} \text{ menit}^{-1}$. Studi isoterm adsorpsi menunjukkan proses adsorpsi yang terjadi mengikuti model Langmuir dan parameter termodinamika menunjukkan bahwa adsorpsi Cd(II) oleh nanokomposit magnetit@zeolit terjadi secara spontan dan bersifat endotermis.

Kata kunci: adsorpsi; bahan alam; kadmium; nanokomposit magnetit@zeolit

***THE UTILIZATION OF NATURAL ZEOLITE FROM GUNUNG KIDUL
AND IRON SAND FROM COMAL BEACH, KULON PROGO
ON THE SYNTHESIS OF MAGNETITE@ZEOLITE NANOCOMPOSITE
FOR Cd(II) ADSORBENT***

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ABSTRACT

Magnetite@zeolite nanocomposite has been synthesized by utilizing Yogyakarta natural materials as the raw material, namely iron sand from Comal Beach Kulon Progo and natural zeolite from Gunung Kidul. The nanocomposite was applied as an adsorbent for heavy metal, cadmium (Cd). The research was carried out by preparation of the Yogyakarta natural materials which was activation of Gunung Kidul natural zeolite with an acid solution and extraction of magnetic material from Comal Beach Kulon Progo iron sand with an alkaline solution. Synthesis of magnetite@zeolite nanocomposite with variations in the ratio of magnetite:zeolite conducted by adding natural zeolite during the preparation of the extracted material and adding NH_4OH solution, as a precipitating agent, to pH 11. The properties of the materials were studied through the characterization of FTIR, XRD, SEM-EDX, TEM, and VSM. The study of Cd(II) adsorption was performed achieve the optimum conditions for the parameters of pH, contact time, and initial concentration of Cd(II) solution.

The results showed that the utilization of Yogyakarta natural materials in the synthesis of magnetite@zeolite nanocomposites has been successful and has been proven through the results of characterization studies that have been carried out. In addition, the 1:1 mass ratio of magnetite:zeolite gave the best results in the synthesis of magnetite@zeolite nanocomposites, as shown by the results of FTIR and XRD studies. The TEM image shows the particle size distribution of the nanocomposite which has an average particle size of 19.871 nm. The optimum conditions for Cd(II) adsorption by magnetite@zeolite nanocomposite adsorbent were obtained at pH 9, adsorption contact time of 90 minutes, and initial concentration of 12 mg/L. The study of adsorption kinetics showed that the adsorption process followed the pseudo-second order with the value of adsorption rate constant is $0.1144 \text{ g mg}^{-1} \text{ min}^{-1}$. The adsorption isotherm showed that the adsorption process followed the Langmuir model and the thermodynamic parameters showed that the adsorption of Cd(II) by magnetite@zeolite nanocomposite occurred spontaneously and was endothermic.

Keywords: adsorption; cadmium; magnetite@zeolite; natural material