SYNTHESIS OF MAGNETIC PARTICLES-SILICA-CHITOSAN HYBRID USING (3-CHLOROPROPYL)TRIMETHOXYSILANE AND ITS APPLICATION FOR PHOSPHATE AND SULFATE IONS ADSORPTION

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ABSTRACT

Magnetic particles-silica-chitosan hybrids with 3-chloropropyltrimethoxy-silane as the coupling agent (NMP@SiO_2/CPTMS/Chi) have been prepared by using sol gel method and used for adsorption of phosphate and sulfate ions in aqueous solution. NMP@SiO_2/CPTMS/Chi materials have been characterized by using transmission electron microscope (TEM), X-ray difractometer (XRD), Fourier transform infrared (FTIR) spectrophotometer, thermo gravimetric analyzer (TGA), Elemental Analysis, and X-ray photoelectron spectrophotometer (XPS).

The NMP@SiO_2/CPTMS/Chi shows a high adsorption effectivity for phosphate and sulfate ions in acidic condition. Based on Langmuir isotherm model, the maximum adsorption capacity (Q_{max}) for phosphate and sulfate ions is 15.062 mg g^{-1} (at pH 6) and 108.521 mg g^{-1} (pH 3), respectively. The kinetics study showed that the adsorption of phosphate and sulfate ions followed the pseudo-second order model with the adsorption rate constants of 0.059 and 0.144 g mg^{-1} min^{-1} for phosphate and sulfate ions, respectively. The NMP@SiO_2/CPTMS/Chi was easily magnetically separated from aqueous solution less than 5 minutes. The acidic stability, high adsorption capacity, and easily magnetic separation make NMP@SiO_2/CPTMS/Chi as one of the excellent adsorbent candidates for removing phosphate and sulfate ions from wastewater.

Keywords: Silica-chitosan hybrid, NMP@SiO_2/CPTMS/Chi, phosphate, sulfate

SINTESIS HIBRIDA PARTIKEL MAGNETIK-SILIKA-KITOSAN MENGGUNAKAN (3-KLOROPROPIL)TRIMETOKSISILAN DAN APLIKASINYA UNTUK ADSORPSI ION FOSFAT DAN SULFAT

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INTISARI

Dalam penelitian ini telah disintesis material hibrida partikel magnetik-silika-kitosan (NMP@SiO_2/CPTMS/Chi) dengan metode sol gel dan digunakan untuk adsorpsi ion fosfat dan sulfat dari larutan. Material NMP@SiO_2/CPTMS/Chi dikarakterisasi dengan *transmition electron microscope* (TEM), *X-ray difractometer* (XRD), *Fourier transform infrared* (FTIR) *spectrophotometer*, *thermogravimetric analyzer* (TGA), analisis unsur, dan *X-ray photoelectron spectrophotometer* (XPS).

Material NMP@SiO_2/CPTMS/Chi menunjukan kemampuan adsorpsi yang tinggi terhadap ion fosfat dan sulfat pada kondisi asam. Berdasarkan model isoterm Langmuir, kapasitas adsorpsi maksimum (Q_{max}) ion fosfat dan sulfat masing-masing mencapai 15,062 mg g^{-1} (pH 6) dan 108,521 mg g^{-1} (pH 3). Studi kinetika menunjukkan bahwa adsorpsi ion fosfat dan sulfat mengikuti model kinetika orde kedua semu dengan nilai tetapan laju adsorpsi ion fosfat dan sulfat yaitu 0,059 dan 0,144 g mg^{-1} min^{-1}. Material NMP@SiO_2/CPTMS/Chi mudah dipisahkan dengan magnet eksternal dari larutan setelah proses adsorpsi berlangsung. Karakteristik material yang meliputi sifat magnetik, stabilitas terhadap asam, dan kapasitas adsorpsi yang tinggi merupakan keunggulan NMP@SiO_2/CPTMS/Chi sebagai adsorben potensial untuk penyerapan ion fosfat dan sulfat dari air limbah.

Kata kunci: hibrida silika-kitosan, NMP@SiO_2/CPTMS/Chi, fosfat, sulfat