SILIKA GEL BERBAHAN DASAR ABU DASAR BATUBARA-PASIR SILIKA DARI PABRIK GULA MADUKISMO SEBAGAI ADSORBEN ZAT WARNA MALASIT HIJAU

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INTISARI

Penelitian mengenai silika gel berbahan abu dasar batubara-pasir silika sebagai adsorben zat warna malasit hijau telah dilakukan. Abu dasar batubara-pasir silika diaktivasi dengan metode refluks selama 4 jam menggunakan larutan HCl 6 M. Penelitian dilanjutkan dengan pembuatan larutan natrium silikat dengan melebur abu dasar batubara-pasir silika menggunakan larutan NaOH 3 M. Natrium silika kemudian ditetesi dengan HCl 3 M sampai terbentuk silika gel. Abu dasar batubara-pasir silika, abu dasar batubara-pasir silika teraktivasi, dan silika gel hasil sintesis dikarakterisasi dengan fluoresensi sinar X (XRF), spektrometer inframerah (FTIR), dan difraktometer sinar X (XRD). Proses adsorpsi zat warna dipelajari dengan melakukan kajian terhadap parameter pH, waktu interaksi, massa adsorben, dan konsentrasi awal adsorbat.

Hasil karakterisasi menunjukkan bahwa komponen utama abu dasar batubara-pasir silika adalah Si dan Al. Hasil karakterisasi menunjukkan proses aktivasi berhasil menghilangkan pengotor dan meningkatkan rasio Si/Al. Silika gel hasil sintesis diketahui memiliki komponen utama berupa unsur silika serta memiliki situs aktif berupa gugus fungsi silanol dan siloksan. Kondisi optimum untuk adsorpsi zat warna malasit hijau dengan adsorben silika gel diperoleh pada pH 8, waktu interaksi 30 menit, massa adsorben 0,15 gram, dan konsentrasi awal zat warna sebesar 700 ppm. Adsorpsi zat warna malasit hijau mengikuti kinetika orde kedua semu dengan nilai konstanta sebesar 5,168 g mg^{-1} $menit^{-1}$ dan mengukti isoterm Langmuir dengan kapasitas adsorpsi sebesar 69,930 mg g^{-1} serta didapatkan energi adsorpsi sebesar 27,403 kJ mol^{-1}.

Kata kunci: abu dasar, adsorpsi, malasit hijau, silika gel

SILICA GEL BASED ON COAL BOTTOM ASH-SILICA SAND MADUKISMO SUGAR FACTORY AS AN ADSORBENT OF MALACHITE GREEN DYE

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ABSTRACT

Research on the silica gel based on coal bottom ash-silica sand Madukismo sugar factory as an adsorbent of malachite green dye has been carried out. Coal bottom ash-silica sand was activated with reflux method for 4 hours using 6 M HCl solution. Research continued with produce sodium silicate that the activated coal bottom ash-silica sand was melted with 3 M NaOH. The sodium silicate was then dripped with 3 M HCl until silica gel was formed. Coal bottom ash-silica sand, activated coal bottom ash-silica sand, and synthesized silica gel were characterized by X-Ray fluorescence (XRF), infrared spectrometer (FTIR), and X-Ray diffraction (XRD). The dye adsorption process was studied by various parameters, such as pH, interaction time, adsorbent mass, and initial concentration of adsorbate.

The characterization results show that the main components of coal bottom ash were Si and Al. The characterization results show that the activation process success in removing impurities and increasing the Si/Al ratio. The synthesized silica gel had a main components of silica elements and had an active sites of silanol and siloxane functional groups. The optimum condition for the adsorption process of cationic dye malachite green with silica gel adsorbent were obtained at a solution of pH 8, interaction time of 30 min., adsorbent mass of 0.15 g, and with initial concentration of 700 ppm. Adsorption of cationic dye malachite green with silica gel follows a pseudo-second order with rate constants of 5.168 g mg^{-1} min^{-1} and follows Langmuir isotherm with adsorption maximum capacity of 69.930 mg g^{-1} as well as adsorption energies of 27.403 kJ mol^{-1}.

Keywords: bottom ash, adsorption, malachite green, silica gel