ADSORPSI ZAT WARNA KRISTAL VIOLET MENGGUNAKAN ADSORBEN BERBASIS SELULOSA KULIT NANAS TERMODIFIKASI ASAM TRIMELITAT

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INTISARI

Penelitian tentang adsorpsi zat warna kristal violet menggunakan adsorben berbasis selulosa kulit nanas termodifikasi asam trimelitat (SAT) telah dilakukan. Penelitian ini bertujuan untuk melakukan modifikasi selulosa kulit nanas dengan anhidrida trimelitat, menentukan kondisi optimum pH larutan, massa adsorben, waktu adsorpsi, dan konsentrasi awal adsorbat dalam proses adsorpsi, menentukan kinetika dan isoterm adsorpsi, serta melakukan uji desorpsi dan menentukan jenis interaksi yang terjadi antara adsorben SAT terhadap zat warna kristal violet. Penelitian ini diawali dengan isolasi selulosa dari kulit nanas melalui proses pemutihan dengan H_2O_2 dan perlakuan alkali menggunakan NaOH kemudian dilakukan modifikasi selulosa menggunakan anhidrida trimelitat dilanjutkan dengan karakterisasi adsorben menggunakan FTIR, XRD, dan SEM. Larutan zat warna kristal violet sebelum dan setelah adsorpsi dianalisis menggunakan spektrofotometer UV-Vis pada panjang gelombang 590 nm. Kajian desorpsi dilakukan menggunakan larutan pendesorpsi seperti akuades, HCl pH 3 dan 4, serta NaCl 0,1 dan 1,0 M.

Hasil penelitian menunjukkan bahwa modifikasi selulosa dengan anhidrida trimelitat telah berhasil dilakukan. Kondisi optimum adsorpsi zat warna kristal violet menggunakan adsorben SAT diperoleh pada pH 7, massa adsorben 100 mg, waktu kontak adsorpsi 60 menit, dan konsentrasi awal adsorbat 200 ppm. Proses adsorpsi yang terjadi mengikuti model kinetika orde kedua semu (Ho dan McKay) dengan nilai konstanta laju adsorpsi 0,2059 g mg^{-1} $menit^{-1}$ dan mengikuti model isoterm Langmuir dengan kapasitas adsorpsi 35,587 mg g^{-1} dan energi adsorpsi 25,785 kJ mol^{-1}. Proses desorpsi berjalan dengan pelarut optimum HCl pH 3 dan waktu desorpsi optimum pada 120 menit. Interaksi antara kristal violet dengan adsorben SAT didominasi oleh ikatan hidrogen dan terdapat juga interaksi elektrostatik.

Kata kunci: adsorpsi, asam trimelitat, desorpsi, kristal violet, selulosa.

ADSORPTION OF CRYSTAL VIOLET DYE USING TRIMELLITIC ACID MODIFIED PINEAPPLE PEEL CELLULOSE-BASED ADSORBENT

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ABSTRACT

Research on the adsorption of crystal violet dye using an adsorbent based on cellulose-based pineapple peel modified with trimellitic acid (CTA) has been carried out. This study aims to modify pineapple peel cellulose with trimellitic anhydride, determine the optimum conditions of solution pH, adsorbent mass, adsorption time, and initial concentration of adsorbate in the adsorption process, determine adsorption kinetics and isotherms, as well as perform desorption tests and determine the type of interaction that occurs between the CTA adsorbent and the crystal violet dye. This research started with the isolation of cellulose from pineapple peel through a bleaching process with H_2O_2 and alkaline treatment using NaOH, then modified cellulose using trimellitic anhydride, then characterization of the adsorbent using FTIR, XRD, and SEM. Crystal violet dye solution before and after adsorption was analyzed using a UV-Vis spectrophotometer at 590 nm. Desorption studies were carried out using desorbent solutions such as distilled water, HCl pH 3 and 4, and NaCl 0.1 and 1.0 M.

The results showed that the modification of cellulose with trimellitic anhydride had been successfully carried out. The optimum conditions for adsorption of crystal violet dye using CTA adsorbent were obtained at pH 7, adsorbent mass of 100 mg, adsorption contact time of 60 minutes, and initial concentration of adsorbate 200 ppm. The adsorption process follows a pseudo-second-order kinetic model (Ho and McKay) with an adsorption rate constant of 0.2059 g mg^{-1} min^{-1} and follows the Langmuir isotherm model with an adsorption capacity of 35.587 mg g^{-1} and adsorption energy of 25.785 kJ mol^{-1}. The desorption process runs with the optimum solvent HCl pH 3 and the optimum desorption time is 120 minutes. The interaction between crystal violet and CTA adsorbent is dominated by hydrogen bonding and an electrostatic interaction.

Keywords: adsorption, cellulose, crystal violet, desorption, trimellitic acid.