

SINTESIS ASAM HUMAT TERTAUT SILANG PADA KARBOKSIMETIL SELULOSA DAN APLIKASINYA SEBAGAI ADSORBEN METILEN BIRU DAN SAFRANIN O

Nadhila Athira
21/484406/PPA/06184

INTISARI

Telah dilakukan penautan silang terhadap asam humat pada karboksimetil selulosa menggunakan epiklorohidrin. Dihasilkan material yang kemudian digunakan sebagai adsorben zat warna metilen biru (MB) dan safranin o (SO). Material asam humat-karboksimetil selulosa yang tertaut silang epiklorohidrin (CMC-Epi-AH) bersifat stabil pada berbagai pH. Pengaplikasian CMC-Epi-AH pada MB dan SO dievaluasi melalui kajian adsorpsi untuk menentukan pH optimum, model isoterm adsorpsi dan model kinetika adsorpsi. Kajian desorpsi MB dan SO dilakukan untuk mengetahui pelarut yang sesuai yang selanjutnya digunakan dalam melihat kemampuan penggunaan kembali adsorben.

Pembuatan adsorben diawali dengan isolasi selulosa dari limbah kertas, selanjutnya dimodifikasi menjadi karboksimetil selulosa. Kemudian asam humat ditautkan silang pada karboksimetil selulosa menggunakan epiklorohidrin. Adsorben CMC-Epi-AH dikarakterisasi dengan FT-IR, XRD, dan SEM-EDX. Larutan zat warna MB dan SO sebelum dan setelah adsorpsi dianalisis dengan spektrofotometer UV-Vis. Kajian desorpsi zat warna MB dan SO dilakukan pada larutan etanol 0,4 M, HCl 0,4 M, NaCl 0,4 M, dan NaOH 0,4 M.

Hasil karakterisasi FTIR menunjukkan adsorben CMC-Epi-AH memiliki situs aktif spesifik -OH, C=O dan -COOH. Hasil XRD menunjukkan puncak difraksi pada sudut 2θ 20,16°; 21,45°; dan 26,66°. Hasil SEM-EDX menunjukkan permukaan adsorben yang kasar dan tidak seragam serta adanya unsur C, N, O dalam CMC-Epi-AH maupun unsur S dan Cl setelah adsorpsi zat warna MB dan SO. pH optimum adsorpsi MB dan SO oleh adsorben terjadi pada pH 6 dengan konsentrasi 250 mg/L, dan waktu kontak 60 menit untuk MB dan 30 menit untuk SO. Pada adsorpsi zat warna MB dan SO mengikuti isoterm Freundlich dan model kinetika orde dua semu. Pada kajian desorpsi menunjukkan HCl 0,4 M paling efektif mendesorpsi MB dan SO. Kemampuan penggunaan kembali adsorben cukup baik hingga lima siklus pengulangan.

Kata kunci: adsorpsi, asam humat, karboksimetil selulosa, taut silang, epiklorohidrin

SYNTHESIS OF CROSS-LINKED HUMIC ACID ON CARBOXYMETHYL CELLULOSE AND APPLICATION AS ADSORBENT FOR METHYLENE BLUE AND SAFRANIN O

Nadhila Athira
21/484406/PPA/06184

ABSTRACT

The cross-linking of humic acid with carboxymethyl cellulose using epichlorohydrin has been carried out. The resulting material was used as an adsorbent for methylene blue (MB) and safranin o (SO) dyes. Humic acid-carboxymethyl cellulose cross-linked with epichlorohydrin (CMC-Epi-HA) is stable at various pH values. The application of CMC-Epi-HA to MB and SO was evaluated through adsorption studies to determine the optimum pH, adsorption isotherm model, and adsorption kinetic model. Desorption studies on MB and SO were also conducted to determine the most effective solvent, which was then used to assess the reusability of the adsorbent.

The adsorbent preparation was initiated by isolating cellulose from waste paper and modifying it into carboxymethyl cellulose. Then, humic acid was cross-linked to carboxymethyl cellulose using epichlorohydrin. The CMC-Epi-HA adsorbent was characterized by FT-IR, XRD, and SEM-EDX. Before and after adsorption, the MB and SO dye solutions were analyzed using a UV-Vis spectrophotometer. Desorption studies of MB and SO dyes were conducted in solvents such as ethanol 0,4 M, HCl 0,4 M, NaCl 0,4 M, and NaOH 0,4 M.

The FTIR characterization showed that the CMC-Epi-HA adsorbent had specific active sites for -OH, -C=O, and -COOH. XRD characterization showed diffraction peaks at 2θ angles of $20,16^\circ$; $21,45^\circ$; and $26,66^\circ$. SEM-EDX results showed a rough and non-uniform adsorbent surface and the presence of C, N, and O in CMC-Epi-HA as effectively as S and Cl after the adsorption of MB and SO dye solutions. The optimum adsorption of MB and SO dyes by the adsorbent occurred at pH 6, with a concentration of 250 mg/L and a contact time of 60 min for MB and 30 min for SO. The adsorption of MB and SO dyes followed Freundlich and pseudo-second-order kinetic models. Desorption studies showed a 0.4 M HCl solution was the most effective at desorbing MB and SO. The reusability of the adsorbent was good for up to five repetition cycles.

Keywords: adsorption, humic acid, carboxymethyl cellulose, crosslinked, epichlorohydrin