

## ABSTRAK

*Congo Red* merupakan salah satu pewarna sintetis yang banyak dipakai dalam industri tekstil. *Congo red* di perairan sangat berbahaya karena sifat toksiknya yang tinggi. Salah satu metode penanganan limbah *congo red* yang sederhana, ekonomis, dan efektif adalah adsorpsi. Penelitian ini difokuskan pada sintesis Fe-alginat gel beads (Fe-ABs) sebagai adsorben untuk adsorpsi *congo red*, dan mempelajari karakteristik adsorpsi, kinetika, isoterm, serta kemampuan *reusability* Fe-ABs. Fe-ABs disintesis menggunakan teknik *simple dripping*. Produk yang dihasilkan berupa gel *beads* berwarna kuning jingga, kemudian dikarakterisasi menggunakan FTIR dan SEM. Analisis FTIR menunjukkan adanya puncak serapan –OH pada  $3417,86\text{ cm}^{-1}$ , C=O pada  $1612,49\text{ cm}^{-1}$ , C–O–C dan –COOH pada  $1033,85\text{ cm}^{-1}$ , Na dalam isomer alginat pada  $1427,32\text{ cm}^{-1}$  serta pita Fe–O pada  $563,21\text{ cm}^{-1}$ . Hasil pengamatan SEM memperlihatkan morfologi permukaan berbentuk bulat padat tidak sempurna dan berpori dengan ukuran  $5,341\text{--}22,210\text{ }\mu\text{m}$ . Kondisi optimum adsorpsi *congo red* oleh Fe-ABs dicapai pada pH 2, dengan konsentrasi *congo red* 10 ppm dan waktu kontak 120 menit, menghasilkan efisiensi hingga 73%. Proses adsorpsi *congo red* mengikuti model kinetika pseudo orde dua dan isoterm Freundlich dengan nilai konstanta  $K_F$  sebesar  $5,7292\text{ mg/g}$ . Fe-ABs juga menunjukkan stabilitas yang baik, dengan efisiensi adsorpsi berkisar 37–73% dan desorpsi 33–44% selama lima siklus.

**Kata Kunci:** adsorpsi, Fe, alginat, *congo red*

## **ABSTRACT**

*Congo Red is a synthetic dye that is widely used in the textile industry. Congo red in waters is very dangerous because of its high toxic properties. One method of handling Congo red waste that is simple, economical and effective is adsorption. This research focuses on the synthesis of Fe-alginate gel beads (Fe-ABs) as an adsorbent for Congo red adsorption, and studies the adsorption characteristics, kinetics, isotherms, and reusability of Fe-ABs. Fe-ABs were synthesized using a simple dripping technique. The resulting product was orange-yellow gel beads, then characterized using FTIR and SEM. FTIR analysis shows the presence of –OH absorption peaks at 3417.86  $\text{cm}^{-1}$ , C=O at 1612.49  $\text{cm}^{-1}$ , C–O–C and –COOH at 1033.85  $\text{cm}^{-1}$ , Na in the alginate isomer at 1427.32  $\text{cm}^{-1}$  and the Fe–O band at 563.21  $\text{cm}^{-1}$ . The results of SEM observations show that the surface morphology is round, imperfectly solid and porous with a size of 5,341- 22,210  $\mu\text{m}$ . The optimum conditions for congo red adsorption by Fe-ABs were achieved at pH 2, with a congo red concentration of 10 ppm and a contact time of 120 minutes, resulting in an efficiency of up to 73%. The Congo red adsorption process follows a pseudo second order kinetic model and Freundlich isotherm with a KF constant value of 5.7292 mg/g. Fe-ABs also showed good stability, with adsorption efficiencies ranging from 37–73% and desorption 33–44% over five cycles.*

**Keywords:** adsorption, Fe, alginate, congo red