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Performance of hydrogel beads composites derived from sodium alginate-cetyltrimethylammonium bromide toward congo red dye adsorption from aqueous solution Marchanda Wahyu Chrisandi**,** NIMB31210182, Yaressa Vaskah Situngkir , NIMB31210916, tahun 2024, 46 Halaman, Teknologi Pertanian, Politeknik Negeri Jember, Rizza Wijaya, S. TP., M. Sc. (Dosen Pembimbing)

Dyes are widely used in the textile and printing industries. Most dyes are organic compounds known for their toxicity, stability, and resistance to environmental degradation. Despite primary treatments, the large-scale release of dye-laden effluents from these industries poses significant environmental risks. Common dyes include reactive, disperse, vat, and direct dyes, such as Congo Red (CR), discovered in 1884. CR, an azo dye derived from aniline compounds, is known for its coloring properties but also poses carcinogenic risks, making its removal from effluents crucial. While advanced physicochemical techniques like ozonation, coagulation, and membrane separation are used to remove CR, these methods are costly, inefficient, and produce hazardous by-products. Adsorption is considered a more effective and economical alternative, with various adsorbents such as banana peel powder, hydrochar, and ZnO nanomaterial used. However, these adsorbents often require complex preparation processes.

Hydrogel beads, particularly those made from sodium alginate (SA) derived from brown algae, offer a promising solution due to their ease of preparation, affordability, and stability. SA can be crosslinked with calcium ions to form stable hydrogels suitable for CR dye adsorption. Surfactants like CTAB enhance the adsorption capacity and stability of these hydrogels. CTAB-modified adsorbents, due to their amphiphilic nature and stability in various conditions, improve dye capture through electrostatic attraction. This study evaluates the effectiveness of SA-CTAB hydrogel bead composites with varying CTAB ratios for CR dye removal, examining factors such as pH, initial dye concentration, and adsorption duration, while also exploring adsorption mechanisms and regeneration potential.