ABSTRACT

The rapid development of the textile industry in Indonesia has resulted in an increasing amount of dye-containing wastewater. Congo red, an anionic azo dye, is among the most frequently detected synthetic dyes in textile effluents. Adsorption is considered a promising technique for wastewater treatment due to its operational simplicity, low cost, and the wide availability of adsorbent materials. Silica gel and activated carbon are notable adsorbents because of their high porosity, thermal stability, and ease of regeneration. This study was conducted to synthesize silica gel and activated carbon from rice husk, characterize their properties, and evaluate their adsorption capacity toward Congo red. The experimental procedure included the synthesis of silica gel from rice husk ash and husk charcoal, the preparation of activated carbon, the preparation of a 100 ppm Congo red stock solution, determination of the maximum absorption wavelength, construction of a calibration curve, adsorption experiments with variations in contact time and initial dye concentration, and characterization using GSA, FTIR, and UV-Vis. The results revealed that at the maximum Congo red concentration of 200 ppm, adsorption capacities were 68.14 mg/g for silica gel and 30.89 mg/g for activated carbon. FTIR spectra confirmed the presence of distinctive functional group peaks in both adsorbents, while GSA analysis showed that control silica gel had a surface area of 68.023 m^2/g, pore volume of 0.42 cc/g, and pore diameter of 12.356 nm, whereas silica gel S4 exhibited a surface area of 67.283 m^2/g, pore volume of 0.249 cc/g, and pore diameter of 7.413 nm. These findings suggest that silica gel derived from rice husk ash is more effective than activated carbon for Congo red adsorption.

Keywords: Silica gel, Activated carbon, Adsorption, Congo red