

ABSTRACT

Indonesia, as an agrarian country, produces abundant rice husk waste that is often underutilized. Rice husk contains both organic and inorganic components, making it a promising low-cost precursor for adsorbent production. This study aims to synthesize silica gel and activated carbon from rice husk, characterize their physicochemical properties, and evaluate their adsorption performance for Congo Red dye. Rice husk was combusted to obtain ash and char, which were then processed into silica gel via the sol-gel method with varying calcination temperatures. Activated carbon was produced through pyrolysis at 300 °C and chemically activated using 15% H₃PO₄ solution. Characterization was conducted using Fourier Transform Infrared (FTIR) and Gas Sorption Analyzer (GSA), while adsorption tests were performed using a UV-Visible spectrophotometer. The results revealed that silica gel exhibited Si–O–Si and Si–O functional groups with the highest surface area of 68.023 m²/g in the SGAB sample. Activated carbon showed successful chemical activation indicated by the presence of phosphate (P=O) groups, with moisture and ash contents of 0.8% and 33.45%, respectively. Adsorption tests demonstrated that silica gel achieved the highest adsorption capacity of 73.23 mg/g at an initial Congo Red concentration of 200 mg/L, outperforming activated carbon. These findings highlight the potential of rice husk as a single-source, eco-friendly material for producing efficient adsorbents to remove dye pollutants.

Keywords: *Rice husk, silica gel, activated carbon, Congo Red, adsorption*