ABSTRACT

Rice husk ash, known for its high silica content (87–97%), presents significant potential as an adsorbent. Modification with chitosan enhances the adsorption capability of silica gel by introducing additional functional groups. This research focuses on synthesizing silica gel from rice husk ash and examining the effect of silica-chitosan composite modification on Congo red adsorption. The silica gel was produced by using the sol-gel method and later modified with chitosan in different ratios. Characterization methods such as Atomic Absorption Spectroscopy (AAS) and Fourier Transform Infrared Spectroscopy (FTIR) and Gas Sorption Analyzer (GSA) were utilized to analyze functional groups, surface area, and pore diameter. Silica gel and silica-chitosan were tested as adsorbents for Congo red. Adsorption experiments were conducted in various variations of contact time of 5, 10, 15, 20, 25, 30, 35, 40, 50, and 60 minutes and variations in concentration of 5, 10, 15, 20, 25, 30, 35, 40, 50, 60, 70, 100, and 150 mg/L. The results verified the successful synthesis of silica gel from rice husk ash and the formation of silica-chitosan composites in 1:1, 1:2, and 1:3 ratios. Atomic Absorption Spectroscopy (AAS) analysis revealed that the silica gel synthesis yielded 69.3% silicon, confirming the formation of sodium silicate and the presence of silicon in the ash. Fourier Transform Infrared (FTIR) analysis confirmed the presence of identical silanol, siloxane, and amine groups. Gas Sorption Analyzer (GSA) analysis showed the best performance in the 1:1 silica-chitosan composite, which exhibited a type IV nitrogen adsorption-desorption isotherm and categorize H4-type hysteresis, a surface area of 83.2696 m^2/g, a pore volume of 0.203942 cc/g, and a pore diameter of 4.5716 nm. The maximum adsorption capacity at 150 mg/L was 0.280 mg/g (silica gel), 0.381 mg/g (1:1), 2.095 mg/g (1:2), and 1.207 mg/g (1:3). The highest adsorption efficiencies were observed at 10 mg/L for silica gel (76.42%), silica-chitosan 1:1 (97.58%), silica-chitosan 1:2 (95.43%), and at 30 mg/L for silica-chitosan 1:3 (84.19%).

Keywords: Rice Husk Ash, Adsorption, Silica Gel, Chitosan, Congo red