

STUDY OF ADSORPTION, KINETICS AND EQUILIBRIUM OF Cu²⁺ ON ADSORBENT FORMED BY REACTION BETWEEN PARA-NITROACETANILIDE AND CONCENTRATED SULFURIC ACID

T.M.M.K. Bandara^{*} and V.N. Seneviratne

Department of Chemistry, Faculty of Science, University of Peradeniya, Peradeniya, Sri Lanka
**tm.madushani1111@gmail.com*

Pollution of drinking water is a pragmatic problem in the world today. Out of many causes of water pollution, the contamination by heavy metals and dyes are considered to be a major concern. This study focused on a new adsorbent made by reaction between para-nitroacetanilide and concentrated sulfuric acid. The resulting substrate has a high surface area and a porous structure. The adsorption of Cu²⁺ has been studied on this substrate. The prepared material was characterized by Fourier transform infrared spectroscopy (FTIR), scanning electron microscopy (SEM), X-ray fluorescence spectroscopy (XRF) and point of zero charge (pzc) analysis. The SEM images of the substrate showed the presence of a porous and rough surface. FTIR spectra revealed the presence of COOH, OH, C≡N, C≡C, C=C, NO₂, α, β-unsaturated C=O, C-O and C-N functional groups. The XRF analysis was used to confirm the adsorption of Cu²⁺ metal ions. This occurs through the formation of coordination bonds. The pH at which the net charge of total surface was calculated to be zero is 3. The adsorption experiments were carried out as a function of pH, the shaken time, the initial Cu²⁺ concentration and the adsorbent dosage. The optimized conditions were found to be pH 6, shaking time of 50 minutes and 96.25 mg L⁻¹ of the initial Cu²⁺ concentration for 0.125 g of the substrate. The adsorption data fits the Freundlich isotherm at higher concentration revealing multilayer adsorption. The adsorption kinetics fit more towards a pseudo second order kinetics with a R² value of 0.99 suggesting a chemisorption process. It was concluded that at lower concentrations, chemisorption will take place, while multilayer adsorption takes place at higher concentrations. At lower concentrations, surrounding water molecules which are chelated with Cu²⁺ ions form hydrogen bonds with the surface. However, at higher concentrations, it tends to form multilayers by other copper ions forming weak van der Waals interactions with already adsorbed species.

Keywords: Chemisorption, Copper adsorption, Para-nitroacetanilide, Physisorption, Water purification