Promising adsorption studies of bromophenol blue using copper oxide nanoparticles

M. Rashad\textsuperscript{a,b,*}, Hatem A. Al-Aoh\textsuperscript{c}

\textsuperscript{a}Department of Physics, Faculty of Science, Assiut University, Assiut 71516, Egypt, Tel. +966-556061705, email: mohamed.ahmed24@science.au.edu.eg (M. Rashad)
\textsuperscript{b} Nanotechnology Research Laboratory, Department of Physics, Faculty of Science, Tabuk University, Tabuk, Saudi Arabia
\textsuperscript{c} Department of Chemistry, Faculty of Science, University of Tabuk, 71474 Tabuk, Saudi Arabia

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\textbf{A B S T R A C T}

Nanoparticles (NPs) of copper oxide (CuO) were produced. Some physical properties of the prepared CuO NPs were investigated using XRD, TEM and BET surface analyzer techniques. pH at zero point charge (pH\textsubscript{ZPC}) of the synthesized CuO NPs was also determined. The specific surface area, total pore volume, average pore diameter and pH\textsubscript{ZPC} were found to be 6.188 mg/g, 0.0128 cm\textsuperscript{3}/g, 116.134 Å and 7.6, respectively. Adsorption of bromophenol blue (BB) on CuO NPs as adsorbent was conducted at various temperatures. The impacts of experimental conditions such as the primary concentration of BB solution, solution pH, agitation time and temperature were investigated. The adsorbate concentration of 300 mg/L, temperature of 60°C, 4h and pH of 1 were observed to be the ideal experimental conditions. Adsorption isotherm constants were investigated using the isotherm models of Langmuir and Freundlich. The data of this adsorption fits greatest to the isotherm model of Langmuir. The equilibrium amounts of BB uptake onto the surface of CuO NPs were found to be 20.19, 30.32 and 49.85 mg/g at 303, 318 and 333 K, in that order. The data of experimental kinetic were examined by the kinetic models of pseudo-first-order, second-order and intra-particle diffusion. The results of kinetic studies designate that the obtained data can be expressed well by the first-order kinetic model. Parameters of the thermodynamic were determined and their values indicate that the adsorption of BB by CuO NPs is un-spontaneous and endothermic processes.

\textbf{Keywords:} CuO nanoparticles; Bromophenol blue dye; Adsorption; Isotherm; Kinetics; Thermodynamics