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# Removal of Cu (II) from aqueous solutions using magnetite: A kinetic, equilibrium study

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**Abstract.** Water pollution means that the physical, chemical and biological properties of water are changing. In this study, adsorption was chosen as the treatment method because it is an eco-friendly and low cost approach. Magnetite is a magnetic material that can synthesize chemical precipitation. Magnetite was used for the removal of copper in artificial water samples. For this purpose, metal removal from water dependent on the pH, initial concentration of metal, amount of adsorbent and effect of sorption time were investigated. Magnetite was characterized using XRD, SEM and particle size distribution. The copper ions were determined by atomic absorption spectrometry. The adsorption of copper on the magnetite was studied in a batch process, with different aqueous solutions of Cu (II) at concentrations ranging from 10 to 50 mg $l^{-1}$. Optimum conditions for using magnetite were found to be concentration of 10 mg $L^{-1}$, pH: 4.5, contact time: 40 min. Optimum adsorbent was found to be 0.3 gr. Furthermore, adsorption isotherm data were analyzed using the Langmuir and Freundlich equations. The adsorption data fitted well with the Freundlich ($r^2$ = 0.9701) and Langmuir isotherm ($r^2$ = 0.9711) equations. Kinetic and equilibrium aspects of the adsorption process were studied. The time-dependent Cu (II) adsorption data were described well by a pseudo-second-order kinetic model.

**Keywords:** adsorption; chemical precipitation; copper; kinetic; magnetite; wastewater treatment

## 1. Introduction

Heavy metals are toxic because they are present as ions in aqueous systems and can be readily absorbed into the human body. Copper is among those hazardous materials that are most commonly found in industrial wastewater. Even a very small amount can cause severe physiological or neurological damage (Dönmez and Aksu 1999). Bivalent copper (Cu (II)) is a priority pollutant (Sparks 2005), thus its removal is of extreme importance. Copper is a widely used industrial metal whose applications include electrical wiring, plumbing, air conditioning tubing and roofing. The potential sources of copper in industrial effluents include metal cleaning and plating baths, pulp, paper board mills, wood pulp production, the fertilizer industry, etc (Ho 2003). Agricultural chemicals and their by-products are another source of copper waste. However, Cu (II) is known to be one of the heavy metals most toxic to living organisms and it is one of the

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