

Orange peel residue nanoparticles synthesized by combustion method for adsorptive removal of metal ions from aqueous solutions

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ABSTRACT

In the present study, new and low cost orange peel nanoparticles and magnetic supported on orange peel for the removal of copper ions were prepared. The nano adsorbents were synthesized by combustion technique by urea as fuel, and its characteristics were performed with BET, FESEM, and FTIR. FESEM and BET analysis display smaller particle size (100% below 30 nm), regular and narrow particle size distribution and higher specific surface area for combustion synthesized sample. Adsorption efficiency of copper was examined by 0%, 10%, 20%, and 30% magnetite supported on orange peel as adsorbents. Result indicated that the Fe10-OPCM is effective, efficient, and economic for Cu²⁺ ions removal from aqueous solution.

Keywords: Adsorptive Removal, Orange Peel, Combustion Method, Magnetic Supported.

1. INTRODUCTION

Heavy metals are found with high density in the industrial wastewaters and are a matter of serious concern worldwide due to their toxicity, inseparability and their harmful physiologic effects on environmental and creatures. Many heavy metals such as copper, zinc, cobalt, iron, and molybdenum are essential for metabolic activity but they become toxic above narrow limits [1]. Copper is one of the most widespread and commonly found heavy metals that some activities such as mining, metals melting, fungicide, paper industries, tanneries, and biocide by copper cause the water and soil pollution. [2]. The World Health Organization (WHO) and US Environmental Protection Agency (US EPA) has set the maximum permissible limits of 2 (mg/L) and 1.3 (mg/L) for copper respectively, in drinking water [3]. Technologies for treating the pollution by heavy metals include physical, chemical and biological methods like chemical precipitation, filtration, reverse osmosis, ion exchange, membrane separation, oxidation/reduction, and adsorption. Among these techniques, in recent years, adsorption method in the removal of heavy metal has received more attention, because it is most applicable, efficient, simple, and inexpensive process [4]. Recent studies show that agricultural wastes especially those containing cellulose shows potential metal biosorption capacity and can be used as biosorbents for removing heavy metals. The main advantages of biosorbents include low cost, high efficiency, minimization of chemical or biological sludge, renewable, availability in abundance, regeneration of biosorbents and possibility of metal recovery [5]. Orange peel (OP) is largely composed of cellulose, pectin (galacturonic acid), hemicellulose, lignin, chlorophyll pigments and other low molecular weight compounds, including limonene. These components contain various functional groups such as carboxyl, hydroxyl, amido- cyanogen and biopolymers [6], which play an important role in removing the heavy metals. The application of nano adsorbents in the removal of heavy metal has developed due to their unique physical and chemical properties, such as enhanced active sites, high adsorption efficiency, uniform sizes, high surface area to volume ratio, high selectivity, chemical stability, and abundant functional groups on their surfaces. These properties make them premier in a different field than traditional