Egyptian Journal of Petroleum (2016) xxx, xxx–xxx

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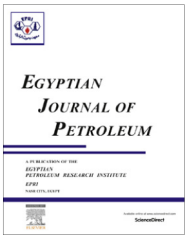

FULL LENGTH ARTICLE

Removal of Copper ions from aqueous solutions using polymer derivations of poly (styrene-alt-maleic anhydride)

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Received 28 February 2016; revised 25 April 2016; accepted 19 May 2016

KEYWORDS

X-ray diffraction analysis;
Chelating resins;
Scanning electron microscopy;
Intra-particle diffusion

Abstract In this study chelating resins have been considered to be suitable materials for the recovery of Copper (II) ions in water treatments. Furthermore, these modified resins were reacted with 1,2-diaminoethane in the presence of ultrasonic irradiation for the preparation of a tridimensional chelating resin on the Nano scale for the recovery of Copper (II) ions from aqueous solutions. This method which is used for removing and determining Copper (II) ions using copolymers derived resins of poly (styrene-alternative-maleic anhydride) (SMA) and atomic absorption spectroscopy. The method is simple, sensitive, inexpensive and fast. The various parameters such as pH, contact time, concentrations of metal ions, mass of resin, and agitation speed were investigated on adsorption effect. The adsorption behavior of Copper (II) ions were investigated by the synthesis of chelating resins at various pHs. The prepared resins showed a good tendency for removing the selected metal ions from aqueous solution, even at an acidic pH. Also, the prepared resins were examined for the removal of Copper (II) ions from real samples such as industrial wastewater and were shown to be very efficient at adsorption in the cases of Copper (II) ions. The pseudo-first-order, pseudo-second-order, and intra-particle diffusion kinetics equations were used for modeling of adsorption data and it was shown that pseudo-second-order kinetic equation could best describe the adsorption kinetics. The intra-particle diffusion study revealed that external diffusion might be involved in this case. The resins were characterized by Fourier transform infrared spectroscopy, scanning electron microscopy, and X-ray diffraction analysis.

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1. Introduction

Water is one of the most insistent requirements for living on the earth. All plants and animals must have water to live. It is also fundamental for the human stirs. Water impurity is increasing globally because of the sudden growth of industry,

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Peer review under responsibility of Egyptian Petroleum Research Institute.

http://dx.doi.org/10.1016/j.ejpe.2016.05.010

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increase human sully, and domestic and agricultural stirs. Water pollution containing heavy metal ions such as chromium, cadmium, copper, lead, nickel, mercury and zinc from industrial and domestic wastes is becoming one of the most serious environmental problems worldwide [1]. Because of the low concentration of heavy metals in various resources it can be more harmful to the environment and adversely affecting the human health. The remedy of heavy metals is so significant because of the continuance in the environment. The prevalent technologies for the elimination of heavy metal ions from aqueous solution include ion exchange, chemical precipitation, electrochemical treatment, reverse osmosis and adsorption. Among the different treatments described above, adsorption technology is commonly considered to be a simple performance, relatively of low cost and an effective method [2]. The general adsorbents include activated carbons, zeolite, clays, and biomass and metal oxides. The quick determination of minute quantities of Copper (II) ion species by simple methods is of great importance in analytical chemistry. The stable soluble form of copper, namely Cu (II) is toxic at elevated concentrations. Its reactivity and biological uptake are largely influenced by the free ion concentration that is controlled by the extent of copper complexation with ligands of many analytical methods accessible for the measuring of copper. Much of the copper that enters environmental waters will be accomplice with particulate matter. Copper is a natural maker of soil and will be transported into streams and waterways in runoff either due to natural weathering or anthropogenic soil disturbances. Sixty-eight percent of extricates of copper to the water is computed to emanate from these processes. Copper sulfate use exhibits 13% of extricates to water and urban rubbish consorts 2% [3]. In the absence of specific industrial sources, rubbish is the major factor contributing to increased copper levels in river water [4]. Because elimination efficiencies for copper from waste streams tend to remain constant rather than proportional to influence copper concentrations, it increases in copper concentrations in (Publicly Owned Treatment Works) **POTWs** influent streams will also outcome in increased copper concentrations in the effluent streams [5–7]. The copper in tame wastewater has been found to make up an innate fraction of the copper found in POTW influent in the wastewater systems of four Massachusetts municipalities. The range of elimination efficiencies reported for experimental and full scale plants proposes that elimination depends strongly on plant operation or influent characteristics. A source of copper released into waterways is from urban storm water runoff. Copper in storm water runoff originates from the sidings and roofs of buildings, various emissions from automobiles, and wet and dry deposition processes [8–11]. Concentrations of between 1 and 100 μg/L of copper in storm water runoff have been measured [12–14]. Strom-water rubbish normally contributes approximately 2% of the total copper escaped into waterways. In against, copper in rubbish that is gotten from the natural weathering of soil or is an escape from disturbed soils contributes to 68% of the copper escaped into waterways [15]. The best data on typical POTWs using secondary remedy show that 55–90% of copper is removed in these plants with a median and mean elimination efficiency of 82% [16]. By contrast, those plants using only primary remedy had 37% median elimination efficiency. A more recent study focused on the heavy metal elimination in three POTWs that arrived primarily as municipal sewage and used activated slough as a secondary treatment. The study looked at eliminations in both the primary and secondary remedy stages. The mean eliminations of soluble copper and total copper after secondary remedy was 49–82% and 83–90%, respectively. The average copper concentration in the final effluent was 17–102 ppb, which would value to an output of between 0.58 and 3.47 kg of copper into arriving waters per day, based on an effluent volume of 34,000 cubic meters (9 million gallons) per day [17]. Overflow outfalls within combined sewer systems (e.g., a combination of native and industrial wastewater plus storm water) are the primary sources of copper pollutants entering entrances and other coastal areas of the United States ([18]. For example, Crawford et al. (1995) compiled a summary of the sources of different metals and other pollutions in the Newark Bay estuary. The mass loadings of copper into the estuary as a function of source are (in kg/day): municipal treatment systems, 103.4; industrial direct discharge, 8.82; combined sewer overflows, 48.0; storm-water runoff, 62.2; tributary flow, 39.1 and discharges from the Passaic Valley Commission and Middlesex County Sewerage Authority, 126.5. Discharges to water from active mining and milling are small and most of the western operations do not release any water because water is a scarce resource and is recycled [19]. Discharges from electroplating operations are either made directly to the water environment or indirectly via POTWs. Runoff from abandoned mines is computed to contribute 314 metric tons annually to surface water [20]. These discharges are primarily irresolvable silicates and sulfides and readily Denizen out into a stream, river, or lake beds. Escapes from manufacturing products containing copper may be congenital, but are difficult to predict. Corrosion of copper in plumbing or structure may result in direct discharges or rubbish into waterways. Copper and brass production escapes relatively little copper in water. Wastewater produced from copper mining functions comes from transfusion, rubbish from tailing piles, or utility water used for the main function. The value of wastewater produced ranges from 0 to 300 L water/metric ton of ore mined for open pit copper mines and 8–4000 L water/metric ton of ore mined underground (EPA 1980b). Copper concentrations in wastewater from a selected open pit and underground copper mine were 1.05 and 0.87 ppm, respectively. Data regarding copper concentrations in wastewater associated with selected concentrating, smelting, and refining functions can be found in EPA (1980b). Drainage from mining functions and abandoned mines has been shown to have an effect on the copper content in local surface waters with concentrations as high as 69,000 ppb being determined [21]. Outcomes of an EPA industrial effluent survey show that mean and maximum levels of copper in remedied wastewater from six industries exceeded 1 and 10 ppm, respectively (EPA 1981). These industries and their mean and maximum discharges in ppm are: inorganic chemical manufacturing (<1.6, 18); aluminum forming (<160, 2200); porcelain mucilage (1.3, 8.8); glue and wood chemicals (1.4, 3.0); nonferrous metals manufacturing (1.4, 27.0) and paint and marrow formulation (<1.0, 60.0). Emission factors in Nano grams of copper escaped per L of water outflow have been computed for different industries. Effluents from power plants that use copper alloys in the heat exchangers of their cooling systems discharge copper into arriving waters [21]. During the normal action at two nuclear power stations 6.5×10^6 cubic meters (1700 million gallons) of seawater per day are applied as cooling water for these facilities and

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