Electrochemical water remediation based on green materials

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Removal of organic pollutants, industrial wastes, pesticides and heavy metals from potable water is an important process. Heavy metals have become a serious problem to human and animal health in most of the developing countries. Consumption of water contaminated with arsenic and cadmium may produce health related issues such as cardiac problems, tumors, and lung and liver cancers. Therefore, it is essential to eliminate these metal ions from drinking water prior to consumption. Most remediation techniques are expensive, time consuming and may produce secondary products. Use of green materials for the remediation of heavy metal ions has gained the attention of the researchers due to low cost and eco-friendliness. Electrocoagulation technique has been developed rapidly by various means, which has made it more reliable than other conventional water remediation techniques. This research was carried out on a green and reliable iron source, spinach extract, along with electrocoagulation to remove arsenic and cadmium from contaminated drinking water. Active Fe^{2+}, Fe^{3+} ions and Fe clusters help in metal ion removal by forming coagulants of $Fe(OH)_2$ and $Fe(OH)_3$. A bare aluminum and an aluminum plate attached with a layer of absorbent soaked with spinach extract were used as the cathode and the sacrificial electrodes respectively to perform the electrocoagulation. As a final purification step, the solution was passed through an iron coated sand filter. This method was tested with water samples spiked with arsenic and cadmium and the atomic absorption spectrophotometer was used to determine the level of metal ion removal. Initial arsenic concentration ranged from 20 to 50 ppb, and cadmium concentration from 10 to 80 ppb.

Arsenic purification was not possible through this method, since it gave impossible higher final concentration, though several steps were carried out to overcome the problem. Statistical analysis was carried out to validate the results obtained from many trials. Based on the results, it can be concluded that the proposed method can be used to lower the cadmium to a concentration less than the permitted levels recommended by the World Health Organization.

Key words: Electrocoagulation, green water purification, cadmium, arsenic