MONITORING AND TREATMENT OF ACRYLAMIDE IN DRINKING WATER AND INDUSTRIAL WASTE WATER

Submitted By Emad Eldin Zaghloul Abou Baker

B.Sc. of Science (Chemistry-Physics), Faculty of Science, Cairo University, 1999

A thesis submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
Environmental Sciences

Department of Environmental Basic Sciences Institute of Environmental Studies and Research Ain Shams University

APPROVAL SHEET

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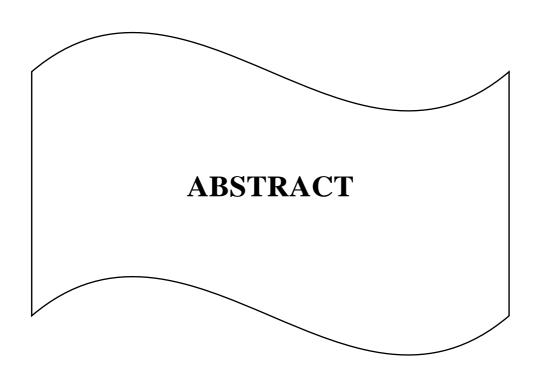
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ABSTRACT

Degradation of water quality is a major issue in Egypt. Discharge of untreated or partially treated industrial and domestic wastewater are often factors that affect the quality of water. Acrylamide one of the hazard industrial wastes where it is a probable carcinogen and has been shown to be a neurotoxic agent in animals and humans. The principal source of acrylamide in the environment is the release of residual monomers from polyacrylamide flocculants. Polyacrylamide is used in many products and activities such as grout, cement, drinking water and wastewater treatment, pesticides and food manufacturing. The objective of present study is to monitor acrylamide monomer concentration in raw Nile water and in treated tap water produced from a set of water treatment plants over one year during different climatic conditions and also monitoring of acrylamide residues on the discharged wastewater from several industries. Also, discussion of traditional additives of chlorine and alum in water treatment plants on the acrylamide removal were carried out. In addition, evaluating the effectiveness of using potassium permanganate as oxidant and granular activated carbon as potential adsorbents for acrylamide reduction in water.

The optimum operating conditions of acrylamide removal by potassium permanganate and granular activated carbon (GAC) were studied with respect to the initial pH, contact time and dose. Reaction kinetic data were fitted to pseudo-first-order and pseudo-second-order for potassium permanganate, in addition to intra-particle diffusion model for GAC. The experimental data of GAC also fitted to Langmuir and Freundlich models to analyze the adsorption equilibrium.

The annual monitoring of acrylamide concentrations showed Tap drinking water samples from a certain water treatment plants had acrylamide concentrations higher than the permissible level of Egyptian regulations which is 0.5 µg/l. While, the maximum results were observed during winter as a result of lower rate of biodegradation and pollutant concentration during winter block. During traditional water treatment process, changing aluminium sulfate concentrations found to have no significant effect on acrylamide removal while increasing chlorine dose cause a slight enhancement on acrylamide removal. Presence of acrylamide residues in some industrial discharge include paper industry discharge, food manufacturing discharge, waste water treatment effluent, sludge treatment unit in water treatment plant, dyes industry discharge.

Optimization study results indicated that a maximum acrylamide reduction of 60% at optimum dose of 10 g/l of GAC increased to 81.5% after 120-minute contact time and 85.55% at optimum pH 3. While, using potassium permanganate showed a maximum acrylamide reduction of 83.74% at optimum pH 3 and 96.67% using optimum dose of 1 mg/l increased to 100% after optimum time of 120-minute. The results showed that the experimental data was well represented by the second order kinetic model and first order kinetic model for potassium permanganate and GAC, respectively. As well, the data revealed that the process involve some intraparticle diffusion for GAC. The equilibrium data for GAC was better fitted to Freundlich model.

Keywords

Acrylamide, KMnO4 oxidation, GAC, Adsorption, LC/MS/MS.

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