Faculty of Science
Ain Shams University
Chemistry Department

"Removal of organics and heavy metals from tannery waste water for water reuse"

A Thesis

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By

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In partial fulfillment of the requirements for the degree of Master of Science in Physics

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ABSTRACT

Tanning industry is the backbone of the Egyptian leather industry. The tanning process includes multiple stages in which use and extract different inorganic and organic chemicals that eventually dumped as wastewater. These chemicals include fats, proteins, chromium-complexes, collagen, surfactants, tannins, sulfide, chromium cations, sodium cations, chlorides and other salts. Most of these compounds are not easily biodegradable. About 40 m^3 of water and 700 kg of various chemicals are used to convert one tone of hides or skins into leather generating about 32 m^3 wastewater.

Water pollution and its scarcity are the main problems that most of countries all over the world are facing nowadays. In this regards, great attention is being given to the removal of these pollutants from groundwater and wastewater by advanced oxidation processes (AOPs) that are based on generation of highly reactive species, especially hydroxyl radicals. Among the advanced oxidation processes, fenton and photo-

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fenton's processes are of special interest involving lower operational costs. So, these advanced processes are studied in details with Egyptian tannery wastewater.

A comparison between different advanced oxidation processes such as fenton process, H_2O_2/UV oxidation and photo-fenton process for treatment of tannery wastewater was discussed from technical and operational point of views.

Firstly, the physical and chemical properties of the filtered effluent were characterized. The chemical oxygen demand (COD) is 554 mg/L, total organic carbon (TOC) is about 171 mg/L, total dissolved solids is 50 g/L and the pH is 3.5. The optimum pre-treatment conditions of the fenton process are pH 3.5, added Fe^{2+} 0.8 g/L, added H_2O_2 35 g/L and retention time of 2h. At the optimum conditions, the achieved chemical oxygen demand (COD)removal efficiency was about 83%. Additionally, the optimum pre-treatment conditions of the H_2O_2/UV oxidation process are pH 3, added H_2O_2 20 g/L and retention time of 2h. Again at these optimum

conditions, the achieved chemical oxygen demand (COD) removal efficiency was about 85%. Moreover, the optimum pre-treatment conditions of the photo-fenton process are pH 3, added Fe^{2+} 0.5 g/L, added H_2O_2 30 g/L and retention time of 2h. At these optimum conditions, the achieved chemical oxygen demand (COD) removal efficiency was about 90%.

Using cost-effective ferrous sulfate that is by product in Iron Pickling process in Egyptian Iron and Steel Company and achieving high COD removal efficiency lead to photo-fenton process superior method for degradation of organic pollutants from tannery wastewater compared to other processes.

Co-precipitations of chromium and magnesium hydroxides from the pretreated tannery solutions with advanced oxidation processes (AOPs) were carried out by addition of sodium hydroxide or magnesium oxide to attain a pH value ranged from 8.0 to 8.5. The achieved total chromium removal

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efficiency was more than 99%. The dry precipitate was calcined at different temperatures in the range of 300-650 °C. Nano magnesium chromite ($MgCr_2O_4$) was synthesized from tanning solution which can be used as catalytic supports and refractory material. The produced magnesium chromite was investigated using XRD, FE-SEM, FT-IR, DSC, TGA and TEM analyses.

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