USING OF DRINKING AND INDUSTRIAL WATER SLUDGE IN THE TREATMENT OF INDUSTRIAL LIQUID WASTES PRODUCED FROM POWER PLANTS"

Submitted By

Ali Ahmed Maan El-Ghanam

B.Sc. Science, Faculty of Science, Mansoura University, 1985

Diploma of Environmental Sciences, Institute of Environmental Studies & Research, Ain Shams University, 2009

A thesis Submitted in Partial Fulfillment
Of
The Requirements for the Master Degree
In
Environmental Science

Department of Environmental Basic Science
Institute of Environmental Studies and Research
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APPROVAL SHEET

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*At First, I thank **God** for being giving me the power to complete this work and all his gifts along my life.*

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Abstract

The aim of this thesis is to study the probability of using drinking and industrial water sludge in the treatment of industrial liquid wastes produced from power plants.

Collection of four different types of sludge from different water treatment plants in power station. Complete analysis, TGA and X-ray investigation were performed for the different types of sludge.

The method of recovery of aluminium and iron from different types of sludge was carried out by acid digestion using sulphoric , nitric and hydrochloric acids.

The evaluation of the recovered aluminium and iron in the clarification of industrial waste water was carried out by Jar test method which the most way to simulate clarification and permits, the comparison of various chemical program in the clarification of water.

The obtained results showed that the optimum condition for maximum recovery was (pH =1 for 2 hours at $80^{o}C$) for aluminium and iron recovery. At these conditions, the percentage of aluminium and iron recovery reached to 99 and 98 % respectively.

The experiments confirm the significant effect of coagulant dosage (recovered aluminium and iron) on coagulation process. Under optimal conditions of process parameters, a coagulant dose about 20 to 30 mg/l at pH = 8 gives acceptable results better than that when using 35 to 45 mg/l of commercial alum and ferric chloride.

The specification of the produced water after treatment by recovered aluminium and iron is compatible with Egyptian standard to drain to surface water or to use as industrial water.

Keywords: Industrial water, sludge, recovered aluminium and iron, TGA , X-ray analysis.

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List of Abbreviations

AAS	: Atomic Absorption Spectroscopy.
ASTM	: American Society for Testing and Materials.
AWWA	: American Water Works Association.
BOD	: Biochemical Oxygen Demand.
COD	: Chemical Oxygen Demand.
OM	: Organic Matter.
TDS	: Total Dissolved Solid.
TGA	: Thermo Gravimetric Analysis.
TSS	: Total Suspended Solid.
TTWW	: Tertiary Treated Waste Water.
USEPA	: US Environmental Protection Agency.
WS	: Working Sludge.
WWTP	: Waste Water Treatment Plant.

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I-Introduction

Sludge produced from drinking and industrial water treatment results in some problems. Many studies have been tried to provide new and suitable solutions to solve part of sludge problem. One of them is to reuse water treatment sludge in several fields. It is still an issue to choose a disposal method for water treatment sludge that would be reasonable in terms of technology and economy. According to environment protection regulations it is required to minimize the quantity of wastes produced. If possible, the wastes should be re-used or processed as secondary raw materials as much as possible.

The composition and properties of the water treatment sludge depends typically on the quality of raw water as well as on types and doses of chemicals used during the water treatment. Typically hydrated aluminium oxides and iron oxides are present in the water treatment sludge (this depends on coagulants used for the treatment) (**Boaventura et al., 2000**).

The sludge that produced from the treatment of water and production of drinking water when alumina and iron coagulants are used for coagulation and clarification of surface water is mainly rich in some elements such as aluminium and iron.

Efforts are carried out to recover aluminium and iron from water treatment sludge during water treatment or to use the sludge for industrial wastewater treatment or as a secondary raw material. Recently, however, more work has been done to improve means of disposal of the solid residues from the municipal treatment processes **(Farrow and Warren, 1993; Fitzpatrick *et al.*, 2003 and Amuda *et al.*, 2006).**

Research Objectives:

Some of the water treatment plants discharge their sludge to the environment without consideration of possible side effects. Since this kind of sludge is generally considered pollutant, the sludge treatment of water industry seems to be an essential task. Obviously the weight and volume of solids produced during coagulation process are much more than other wastes of water treatment operations, and their treatment is much more difficult as well. Besides, this sludge contains metal hydroxide.

The overall objective of this study is:

1- To find an alternative solution to reduce the large volume of sludge produced in the water treatment plants in the Egyptian power station.
2- To reduce the consumption of chemicals used in the Treatment of water such as (alum and ferric chloride).
3- To prevent pollution resulted from sludge disposal by landfilling.

To face the aforementioned problems, recovery of coagulant metals from waste sludges for reuse has been investigated in this work.

Aluminum and iron metals were recovered by acidification of these sludges.

Therefore the thesis was designed to investigate the following:

1- Separation of aluminium and iron from water treatment sludge.
2- Choosing the optimum condition for maximum recovery of the above mentioned element.
3- Evaluation of obtained aluminium and iron doses in the clarification of industrial waste water by Jar test method which the most way to simulate clarification and permits, the comparison of various chemical program in the clarification of water.

2- Literature Review

2-1.Background:

Sludge is a by-product. It is one of final products of wastewater treatment at treatment plants. The wastewater treatment plants (WWTPs) equipment concentrate impurities in wastewater into solid form and then separate these solid from liquid. The solid remain is known by sludge (**Howard *et al*., 1985**).

The recovery of coagulant metals from water works sludge have been studied for several years, because of the toxic nature of free and complex aluminum and other species to aquatic life, cost benefit issues of metal recovery and the stringent environmental regulations on disposal of these sludge on land or into water bodies gain much concern **(Al-Malack et al., 2002 and Accepta, 2010)**.

The pollution resulted from discharge of sludge on land cause several problems, among them are:

- Difficulty in locating new landfill site due to the disposal cost.
- Pollution of ground water reservoir, which have adverse effect on human health and environment.

2.2- Sludge production in water treatment plants:

2.2.1- Water treatment:

Raw water that includes waste from industrial processes required treatment before it can be safely discharge and released back into local water systems. The water passed through a series of screens, chambers,