DEWATERING OF ALUM SLUDGE USING FLOATABLE MEDIA REACTOR

Submitted by

Sherif Abdel Monem Ibrahim Shehata

B.Sc. of Engineering, Faculty of Engineering Helwan University, 2001

Diploma of Environmental Sciences, Institute of Environmental Studies & Research, Ain Shams University, 2010

A thesis submitted in Partial Fulfillment
Of
The Requirement for the Master Degree
In
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APPROVAL SHEET

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This thesis Towards a Master Degree in Environmental Sciences
Has been Approved by:

Name Signature

1. **Prof. Dr. Abdel kawi Mokhtar Khalifa**
   Emeritus Prof. of Hydraulic and Irrigation
   Faculty of Engineering
   Ain Shams University

2. **Prof. Dr. Moustafa Mohamed Hassan Khalil**
   Professor, of Analytical and Inorganic Chemistry
   Faculty of Science
   Ain Shams University

3. **Prof. Dr. Taha Abdel Azim Mohamed Abdel Razek**
   Professor of Environmental Analytical Chemistry
   Vice Dean of Institute of Environmental Studies & Research for Community & Environment Affairs
   Ain Shams University

4. **Dr. Ahmed Shafik El-Gendy**
   Associate Prof., Department of Environmental Engineering Sciences
   Institute of Environmental Studies & Research
   Ain Shams University

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Under The Supervision of:

1. **Dr. Ahmed Shafik El-Gendy**
   Associate Prof., Department of Environmental Engineering Sciences
   Institute of Environmental Studies & Research
   Ain Shams University

2. **Prof. Dr. Taha Abdel Azim Mohamed Abdel Razek**
   Professor of Environmental Analytical Chemistry
   Vice Dean of Institute of Environmental Studies & Research for Community & Environment Affairs
   Ain Shams University.

2017

STATEMENT

This dissertation is submitted to the Institute of Environmental Studies and Research, Ain Shams University for the degree of Master of Environmental Sciences

The work included in this thesis has been carried out by the author in the Department of Environmental Engineering, Ain Shams University.

No part of this thesis has been submitted for a degree or a qualification at any other university or institution.

Date: 09/07/2017
Name: Sherif Abdel Monem Ibrahim Shehata
Signature: Sherif Abdel Monem

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ABSTRACT

Dewatering of drinking water treatment sludge aims to reduce the cost of sludge handling and transportation. In Egypt a large quantity of sludge is generated from surface water treatment for potable supplies typically involves coagulation, flocculation, sedimentation, and filtration processes for removing colloidal as well as suspended solids from raw water. A pilot scale filter was tested for dewatering and thickening of alum sludge generated during the production of potable water in a conventional compact water treatment plant (WTP). The alum sludge is produced from coagulation process using aluminum sulfate (Alum) (Al_2 $(SO_4)_3$. $18H_2O$). The pilot scale was fabricated from scheduled uPVC pipe. The reactor was filled with floatable media (polystyrene) working as filtration media with counter flow concept. The alum sludge was discharged into the pilot scale setup from the sludge holding tank in the WTP using submersible pump.

The pilot scale filter was tested at different rates of filtration (ROF) ranged from 25 to 400 $m^3/m^2/d$. In addition, different media heights (100 – 800 mm) were investigated to study the efficiency of the sludge thickening. The filter rate of washing (ROW) was tested to determine the optimum value that will clean the filter. ROW equal to one to four times the ROF were investigated. The optimum range of ROF was found to be 200 $m^3/m^2/d$ and the filtration media height 500 mm, at the optimum operating conditions, the floatable media filter had the ability to thicken the alum sludge and, the turbidity of the water produced after thickening were less than 18 NTU.

A comparison between pilot scale filter and the conventional thickener was performed to evaluate the dewaterability for both systems using drying beds as a dewatering method for the thickened sludge produced from pilot scale filter and conventional thickener. The efficiency of the Floatable Media Reactor

(FMR) in thickening of the alum sludge is better than the conventional thickener otherwise, the drying bed area shall be decreased to half of required area needed with the conventional thickener.

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LIST OF ABBREVIATIONS

WTP	:	Water Treatment Plant
TSS	:	Total Suspended solids
NTU	:	Nephelometric Turbidity Unit
NRC	:	National Research Centre
PVC	:	Polyvinyl chloride
FMR	:	Floatable Media Reactor
ROF	:	Rate of Filtration
ROW	:	Rate of Washing
HLR	:	Hydraulic Loading Rate
SLR	:	Surface Loading Rate
ECP	:	Egyptian Code of Practice
DAF	:	Dissolved Air Floatation
SDB	:	Sand Drying Bed

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CHAPTER (1)

INTRODUCTION

1.1 Background

Conventional drinking water treatment plants consist of several treatment processes. These processes include coagulation-flocculation, sedimentation, filtration and disinfection **(Jekel, 1989)**, which remove solids, organic and inorganic pollutants, some metals and pathogenic microorganisms. These processes and technologies used to remove contaminants from water and to improve and protect water quality are similar all around the world. Coagulation is a critical process in drinking water treatment involving colloid charge neutralization followed by aggregation into flocs that are amenable to solid/liquid separation with subsequent processes such as filtration. The most coagulant used in water treatment is alum [$(Al_2 (SO_4)_3. 18H_2O$], due to its effectiveness in treating a wide range of water types and relatively low cost so, it is commonly used in Egypt. The alum is usually added in a dose range of 25 – 40 mg/l **(El-Nahhas, 2011).** The coagulation process uses alum leads to the formation of sludge called ″ Alum sludge″ which are gelatinous in character and usually require to dewatering. **(Bache and Papavasilopoulos, 2003)**. A large quantities of alum sludge usually generated, which must be properly managed **(Jangkorn et al., 2011).** The added coagulant (Alum) reacts with water alkalinity and produces a gelatinous precipitate (called flocs) which grow by gentle mixing of water (called flocculation) and then