



ODOR CONTROL IN WASTE WATER TREATMENT PLANTS IN EGYPT

A Thesis
Submitted to the Faculty of Engineering
Ain Shams University for the Fulfillment
of the Requirement of M.Sc. Degree
In Civil Engineering

Prepared by
ENG. FATMA AKL MOSTAFA MOHAMED
B.Sc. in Civil Engineering, May 2004
Shubra Faculty of Engineering Banha Branch Zagazig University

Supervisors
Prof. Dr. MOHAMED EL HOSSEINY EL NADI,
Professor of Sanitary & Environmental Engineering
Faculty of Engineering, Ain Shams University, Cairo, EGYPT

Dr. ENAS SAID WAHB,
Assoc. professor of Sanitary & Environmental Engineering
Faculty of Engineering, Ain Shams University, Cairo, EGYPT

Dr. NANY ALY HASSAN NASR,
Assistant professor of Sanitary & Environmental Engineering
Faculty of Engineering, Ain Shams University, Cairo, EGYPT

2010



ODOR CONTROL IN WASTE WATER TREATMENT PLANTS IN EGYPT

A Thesis For
The M.Sc. Degree In Civil Engineering
(SANITARY ENGINEERING)

by
ENG. FATMA AKL MOSTAFA MOHAMED
B.Sc. in Civil Engineering, May 2004
Zagazig University

THESIS APPROVAL

EXAMINERS COMMITTEE

SIGNATURE

Prof. Dr. Mohamed Saeed M. El Khouly
Professor of Sanitary & Environmental Engineering
Faculty of Engineering, Ain Shams University

Prof. Dr. Ehab Mohamed Rashed
Professor of Sanitary & Environmental Engineering
Faculty of Engineering, Cairo University

Prof. Dr. Mohamed El Hosseiny El Nadi
Professor of Sanitary & Environmental Engineering
Faculty of Engineering, Ain Shams University

Date: - ---/--/2010

DEDICATION

I wish to dedicate this work to whom suffered to educate,
prepare, build capacity and help myself to be as I am,

**TO
MY FATHER
&
MOTHER**

Also thanks

TO MY SISTER

For her encouragement and support to complete this work.

STATEMENT

This dissertation is submitted to Ain Shams University, Faculty of Engineering for the degree of M.Sc. in Civil Engineering.

The work included in this thesis was carried out by the author in the department of Public Works, Faculty of Engineering, Ain Shams University, **from September 2007 to July 2010.**

No part of the thesis has been submitted for a degree or a qualification at any other University or Institution.

The candidate confirms that the work submitted is his own and that appropriate credit has been given where reference has been made to the work of others

Date: - ---/-- /2010

Signature: - -----

Name: - *FATMA AKL MOSTAFA MOHAMED*

ACKNOWLEDGMENT

*The candidate is deeply grateful to **Prof. Dr. Mohamed EL Hosseiny EL Nadi**, Professor of sanitary and Environmental Engineering, Faculty of Engineering, Ain Shams University, for help, encourage, co-operation sponsoring and patient advising during preparation of this work.*

*Also, great thanks to **Dr. Enas Said Wahab**, Assoc. Professor of sanitary and Environmental Engineering, Ain Shams University, for her help, and co-operation during the preparation of the study.*

*Also, great thanks to **Dr. Nany Aly Hassan Nasr**, Assistant Professor of sanitary and Environmental Engineering, Ain Shams University, for her help, and co-operation during the preparation of the study.*

Also, very grateful to the staff and the laboratory personnel In Kafar Abu Aly Pump Station, Kafr El Shiekh Governorate, for their encouragement, help, and support during thesis preparation.

ABSTRACT

NAME: - FATMA AKL MOSTAFA MOHAMED

Title: - “ODOR CONTROL IN WASTE WATER TREATMENT PLANTS IN EGYPT”

Faculty : - Faculty of Engineering, Ain Shams University.

Specialty: - Civil Eng., Public Works, Sanitary Eng.

Abstract:-

In The Paste, Odor control works was considered to be luxury and complex issue in Egypt but now after knowing the important of eliminating odor to human and environmental health, Egypt started to apply it. One of the starting projects to apply the odor control system are in the **KAFER ABU ALY** Pump Station, Kafr El Shiekh Governorate, by using mixture from water spraying with air diffusers and activated carbon in one system.

The study had evaluated this system that had been applied in this pump station to solve the problem by reducing the emitting of H₂S, or other odors ,the evaluation has take in consideration both price ,existing area and odor control effectiveness.

The study was done during six months before project execution and another six months after project startup. Hereafter an illustration for the evaluation results and discussions showing all the varieties appeared and the system ability to improve and control the odor in the site of pump station and its neighboring area.

SUPERVISORS

Prof. Dr. Mohamed EL Hosseiny EL Nadi,

Dr. Nany Aly Hassan Nasr,

Dr. Enas Said Wahab,

TABLE OF CONTENTS

	Page
COVER	i
ABSTRACT	ii
TABLE OF CONTENTS	iii
LIST OF FIGURES	iv
LIST OF TABLES THESIS APPROVAL	v
DEDICATION	vi
STATEMENT	vii
ACKNOWLEDGEMENT	ix
	xi
CHAPTER I: INTRODUCTION	
1.1 GENERAL	1
1.2 STUDY OBJECTIVE	1
1.3 SCOPE OF WORK	2
1.3.1 Literature collection and REVIEW	2
1.3.2 Experimental Program	2
1.3.3 Results ANlysis&Discussions	2
CHAPTER II: LITERATURE REVIEW	
2.1 INTRODUCTION	3
2.2 STATEMENT OF ODOR CONTROL TECHNIQUES	4
2.2.1 LIQUID PHAS OF ODOR CONTROL TECHNIQUE	4
2.2.2 VAPOR PHAS OF ODOR CONTROL TECHNIQUE	5
2.3 THE MYTHOLOGY ASSOCIATED WITH ODOR GENERATION	6
2.4 SOURCES OF ODOR	6
2.4.1 THE PRINCIPLE SOURCES OF ODOR IN WASTEWATER OPERATIONS ARE	7
2.5 ODOR CONTROL MEASURES	7
2.6 ODOR CONTROL METHODS	8
2.6.1 ADSORPTION	9
2.6.2 ABSORPTION	9
2.6.3 CHMICAL OXIDATION	9
2.6.4 CONDENSATION	13
2.6.5 COMBUSATION	14
2.6.6 BIOLOGICAL ODOR CONTROL	15
2.6.7 OZONATION	17
2.7 METHODS APPLICATIONS	18
2.7.1 DISPERSION WITH STACK	

2.7.2	COUNTERACTANTS AND MASKING AGENT	18
2.7.3	CHEMICAL SCRUBBER	18
2.7.4	FLOATING COVER	18
2.7.4.1	ANAEROBIC FLOATING COVER	18
2.7.4.2	ANAEROBIC DIGESTER FLOATING COVERS	20
2.7.4.3	WASTE WATER PLANT COVER	20
2.7.5	SPIRAL SPRY TOWER	21
2.7.6	FIXED BED ADSORBER	23
2.7.7	SEIVE PLATE TOWER	24
2.7.8	MOVING BED ADSORBER	26
2.7.9	MULTI FIXED BED ADSORBER	26
2.7.10	PACKED BED WITH SPRY TOWER	27
2.7.11	FACTORS AFFECT METHOD CHOICE	28
2.8	FACTORS AFFECT ODOUR CONTROL	29
2.8.1	pH_VALUE	30
2.8.2	BOD	30
2.8.3	TEMPERATURE	30
CHAPTER III: MATERIALS & METHODS		
3.1	SAMPLING	32
3.2	UNIT DESCRIPTION	32
3.3	FIELD ANALYSIS	34
3.3.1	SAMPLES	34
3.3.2	TYPE OF ANALYSIS	34
3.4	MEASURED PARAMETERS	34
3.4.1	PH VALUE	34
3.4.2	NITROGEN AS AMMONIA (NH ₃) &OXIDES AS (NO ₃)	35
3.4.3	METHANE (CH ₄)	36
3.4.4	HYDROGEN SULPHIDE (H ₂ S)	36
3.4.5	SULFUR OXIDE (SO ₄)	37
3.4.6	CHLORINE (CL ₂)	38
3.4.7	BIOCHEMICAL OXYGEN DEMAND (BOD)	38
3.4.8	CHEMICAL OXYGEN DEMAND (COD)	38
3.4.9	TOTAL SUSPENDED SOLIDS (TSS)	38
CHAPTER IV: RESULTS		
4.1	INTRODUCTION	39
4.2	ANALYSIS BEFORE APPLICATION	39
4.3	ANALYSIS AFTER APPLICATION	45

CHAPTER V: DISSCUSION	
5.1 GENERAL	52
5.2 ODOR CAUSES REMOVAL RATIOS	52
5.2.1 H₂S REMOVAL RATIOS	52
5.2.2 CH₄ REMOVAL RATIOS	54
5.2.3 NH₃ REMOVAL RATIOS	56
5.3 SEWAGE PARAMETRS EFFECT ON ODOR CAUSES	58
5.3.1 pH FACTOR	58
5.3.2 BOD FACTOR	61
5.3.3 COD FACTOR	63
5.3.4 TSS FACTOR	65
5.3.5 CL₂ FACTOR	67
5.3.6 SO₄ FACTOR	70
<u>CHAPTER VI: CONCLUSION</u>	
6.1 CONCLUSION	71
6.2 RECOMMENDATIONS	72
6.3 FURTHUR WORK	72
REFERENCES	73

LIST OF FIGURES

Figure	Page
CHAPTER (II) LITERATURE REVIEW	
Figure (2/1) Injection of oxygen into force Maine	11
Figure (2/2) Injection of oxygen to the bottom of the tank	12
Figure (2/3) Biofilter provided by Biorem	16
Figure (2/4) a series of floats arranged in strings of parallel pairs	19
Figure (2/5) Floating cover	20
Figure (2/6) anaerobic digester floating covers.	21
Figure (2/7) Waste water treatment plant	22
Figure (2/8) Spray tower scrubber	23
Figure (2/9) Spiral spray tower	24
Figure (2/10) Fixed bed adsorbed	25
Figure (2/11) Sieve plate tower	26
Figure (2/12) Moving- bed adsorbed	27
Figure (2/13) Multiple fixed bed adsorbed	28
Figure (2/14) Packed Bed With Spray Tower.	29
CHAPTER III: MATERIALS & METHODS	
Figure (3/1) Odor Control System in KAFER ABU ALY Pump Station.	33
Figure (3/2) pH Meter - Basic – 840087	34
Figure (3/3) Oxides of Nitrogen Analyzer Family.	35
Figure (3/4) integral thermal mass flow meter.	36
Figure (3/5) Hydrogen Sulfide (H ₂ S) (RSH) Analyzer (H2-220)	37
Figure (3/6) flow meter.	37
Figure (3/7) Sensors for chlorine measurement and analysis	38
CHAPTER IV: RESULTS	
Figure (4/1) pH value before application.	40
Figure (4/2) TSS concentration before application.	41
Figure (4/3) CL ₂ ⁻ concentration before application.	41
Figure (4/4) SO ₄ concentration before application.	42
Figure (4/5) NO ₃ concentration before application.	42
Figure (4/6) BOD concentration before application.	43
Figure (4/7) COD concentration before application.	43
Figure (4/8) NH ₃ concentration before application.	44
Figure (4/9) CH ₄ concentration before application.	44

Figure (4/10) H ₂ S concentration before application.	45
Figure (4/11) pH. value after application.	46
Figure (4/12) TSS Concentration After Application.	47
Figure (4/13) CL ₂ ⁻ Concentration After Application	47
Figure (4/14) SO ₄ Concentration After Application.	48
Figure (4/15) NO ₃ Concentration After Application.	48
Figure (4/16) NH ₃ Concentration After Application.	49
Figure (4/17) CH ₄ Concentration After Application.	49
Figure (4/18) H ₂ S Concentration After Application.	50
Figure(4/19) BOD Concentration After Application	50
Figure(4/20) COD Concentration After Application	51

CHAPTER (V) DISCUSSION

Figure (5/1) Result Of H ₂ S Before and After project	53
Figure (5/2) Relation Between H ₂ S Removal Ratios and Time	54
Figure (5/3) Result of CH ₄ Before and After project	55
Figure (5/4) Relation Between CH ₄ Removal Ratios and Time.	56
Figure (5/5) Result of NH ₃ Before and After project.	57
Figure (5/6) Relation Between NH ₃ Removal Ratios and Time.	58
Figure (5/7) Influence of pH on NH ₃ odor causes before project.	59
Figure (5/8) Influence of pH on CH ₄ odor causes before project.	60
Figure (5/9) Influence of pH on H ₂ S odor causes before project.	60
Figure (5/10) Influence of BOD on NH ₃ odor causes before project.	61
Figure (5/11) Influence of BOD on CH ₄ odor causes before project.	62
Figure (5/12) Influence of BOD on H ₂ S odor causes before project.	62
Figure (5/13) Influence Of BOD On Odor Causes After project.	63
Figure (5/14) Influence of COD on NH ₃ odor causes before project.	64
Figure (5/15) Influence of COD on H ₂ S odor causes before project.	64
Figure (5/16) Influence of COD on CH ₄ odor causes before project.	65
Figure (5/18) Influence of TSS on CH ₄ odor causes before project.	66
Figure (5/19) Influence of TSS on H ₂ S odor causes before project.	66
Figure (5/20) Influence of TSS on odor causes before project.	67
Figure (5/21) Influence of CL ₂ ⁻ on NH ₃ odor causes before project.	68
Figure (5/22) Influence of CL ₂ ⁻ on odor causes before project.	68
Figure (5/23) Influence of CL ₂ ⁻ on H ₂ S concentration.	69
Figure (5/24) Influence of CL ₂ ⁻ on odor causes before project.	69
Figure (5/25) Influence of SO ₄ on odor causes before project.	70

LIST OF TABLES

Table	Page
CHAPTER II LITERATURE REVIEW	
Table (2/1) Comparison Of Odorous Air Treatment Methods	31
CHAPTER IV RESULTS	
Table (4/1) Monthly Sewage Field Analysis before application.	39
Table (4/2) Monthly Air Field Analysis before application.	40
Table (4/3) Monthly Sewage Field Analysis of the Parameters.	45
Table (4/4) Monthly Air Field Analysis of the ParametersNH ₃ , H ₂ S andCH ₄ After the Application.	45
CHAPTER V: DISSCUSION	
Table (5/1) Removal Ratios of H ₂ S before & after system application	53
Table (5/2) Removal Ratios of CH ₄ before & after system application	55
Table (5/3) Removal Ratios of NH ₃ before & after system application	56

CHAPTER I

INTRODUCTION

1.1 GENERAL

waste water treatment plants often contain odors compounds that can escape from open channels and tanks in the preliminary treatment system ,in warm weather screenings and incompletely washed grit can develop obnoxious odors this odor may contain numerous components including hydrogen sulfide(H_2S) ammonia(NH_3) carbon dioxide(CO_2), methane(CH_4) and other components which is harmful for residents

Therefore, it is becoming more and more necessary for wastewater professionals to manage and control odors before the neighbors notice but odors aren't simply an issue of bad public relations. Most wastewater professionals are now faced with learning all they can about odor control and finding someone who can solve their odor control problems efficiently and effectively.

In the past Egypt don't take consideration for such issue and consider it as – issue but now after studies they realize the important of such issue and its effectiveness on human health.

1.2 STUDY OBJECTIVE

This studies were made in KAFAR ABU ALY pump station they take in consider both price and odor control effectiveness that is why they use the existing sump in the plant as spray tower and added layer of activated carbon odors are caused by compounds such as hydrogen sulfide (H_2S), methyl mercaptan, and carbonyl sulfide (COS)

1.3 SCOPE OF WORK

1.3.1 LITERATURE COLLECTION AND REVIEW

- Introduction
- Information about odor control techniques
- Information about odor control Methods
- Information about sources of odor
- Information about odor control measures
- Information about application of methods
- Information about factor affect odor control

1.3.2 EXPERIMENTAL PROGRAM

- This application work as spray tower.
- The study measures pH, TSS, Cl²⁻, SO₄, NO₃, NH₃, BOD, COD H₂S, TSS, NH₃ and CH₄ in sewage and air.
- The analysis was monthly measured for all the parameters.

1.3.3 RESULTS ANALYSIS & DISCUSSIONS

- Discussion the results for all the parameters.
- Evaluate the application
- Make the required modifications that are possible to improve the efficiency.

CHAPTER II

LITRATURE REVIEW

2.1 INTRODUCTION

As populations and communities continue to grow and expand, the need to treat wastewater means more facilities near homes. So, out of sight, out of mind doesn't work anymore. Years ago, wastewater treatment plants were located far away from communities, and odor was only a problem for those at the facility. Now, with new home developments booming and urban growth extending into even the most remote areas, it has become an issue in all communities.

Smell is one of the most sensitive of our senses. This means that people can readily detect almost any odor in their surroundings. Now that many wastewater treatment plants are being surrounded by neighborhoods, the potential for complaints, bad community relations, and hard feelings is immense and growing. Once neighbors become sensitized to odors, any odor event no matter how small or how short in duration will trigger complaints. Therefore, it is becoming more and more necessary for wastewater professionals to manage and control odors before the neighbors notice but odors aren't simply an issue of bad public relations. The same compounds that create these odors can also corrode and damage treatment plants and collection systems it is important to be proactive to address corrosion, to prevent negative images of the facility, and to avoid a crisis situation by allowing time to implement the appropriate solution. Most wastewater professionals are now faced with learning all they can about odor control and finding someone who can solve their odor control problems efficiently and effectively, Wastewater-related odors typically develop in the liquid phase very early in the treatment process during its collection and transport to the treatment plant, While traveling through sewer lines, wastewater can become anaerobic (the dissolved oxygen can become depleted) as a result of the bacteria commonly found in wastewater. Under anaerobic conditions, certain types of bacteria generate hydrogen sulfide (H_2S) as a byproduct. Unfortunately, H_2S , because of its composition, easily escapes from wastewater and moves into the air the vapor phase. It is recognized by its strong, offensive, rotten egg odor [1],[2],[3]& [4].