



شبكة المعلومات الجامعية

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ





شبكة المعلومات الجامعية



شبكة المعلومات الجامعية

التوثيق الالكتروني والميكرو فيلم

جامعة عين شمس

التوثيق الالكتروني والميكرو فيلم

قسم

نقسم بالله العظيم أن المادة التي تم توثيقها وتسجيلها
علي هذه الأفلام قد اعدت دون أية تغيرات



يجب أن

تحفظ هذه الأفلام بعيداً عن الغبار

في درجة حرارة من 15 – 20 مئوية ورطوبة نسبية من 20-40 %

To be kept away from dust in dry cool place of
15 – 25c and relative humidity 20-40 %



شبكة المعلومات الجامعية



بعض الوثائق الأصلية تالفة



شبكة المعلومات الجامعية



بالرسالة صفحات
لم ترد بالأصل



El-Mansoura University.
Faculty of Engineering.
Public Works Dept.

**The Use of Dissolved-Air Flotation
in Reducing The Pollutant Load on
The Rapid Sand Filtration.**

By

Mohamad Ragab El-Adawy

B.Sc. Civil Engineering, El-Mansoura University, 1992

A Thesis

**Submitted in Partial Fulfillment for the Requirements
of The Degree of Master of Science.**

In

Public Works Engineering

Supervisors

Prof. Dr.

Ahmad Fadel Ahmad Ashry.

Prof. of Sanitary Engineering
Faculty of Engineering
El-Mansoura University.

Prof. Dr.

Said Ebrahim

Faculty of Engineering.
El-Mansoura University.

Dr.

Mohamad Esmail

Faculty of Science
El-Mansoura University.

1997

B

1-11/0



El-Mansoura University.
Faculty of Engineering.
Public Works Dept.

The Use of Dissolved-Air Flotation in Reducing The Pollutant Load on The Rapid Sand Filtration.

By

Mohamad Ragab El-Adawy

B.Sc. Civil Engineering, El-Mansoura University, 1992

A Thesis

**Submitted in Partial Fulfillment for the Requirements
of The Degree of Master of Science.**

In

Public Works Engineering

Supervisors

Prof. Dr.

Ahmad Fadel Ahmad Ashry.

Prof. of Sanitary Engineering
Faculty of Engineering
El-Mansoura University.

Prof. Dr.

Said Ebrahim

Faculty of Engineering.
El-Mansoura University.

Dr.

Mohamad Esmail

Faculty of Science
El-Mansoura University.

1997

EXAMINATION COMMITTEE




Researcher Name:

Mohamad Ragab El-Adawy

Thesis Title:

The Use of Dissolved-Air Flotation in Reducing The Pollutant Load
on The Rapid Sand Filtration.

Examination Committee

<i>Name</i>	<i>Position</i>	<i>Signature</i>
Prof. Dr. Ezzat Abd El-Shafy	Professor of Sanitary Engineering, Faculty of Engineering, Cairo University.	
Prof. Dr. Fathy Awad Mansour	Faculty of Science, El-Mansoura University.	
Prof Dr. Ahmad Fadel Ashry	Professor of Sanitary Engineering, Faculty of Engineering, El- Mansoura University.	

ACKNOWLEDGMENT

My gratitude and thankfulness to my major adviser, Prof. Dr. Ahmad Fadel Ahmad Ashry,, El-Mansoura University for Excellent Practical and theoretical experience and for all his encouragement, guidance, Patience, and support througout the coarce of this study.

I should like to thank my supervisor, Prof. Dr. Said Eberahim, and Dr. Mahamad Esmail, El-Mansoura University for their considerable guidance, criticism, and encouragement.

My thank to my father, mother, family, wife, children, and my friends for their help during the preparation of thesis.

Abstract

Flotation is an important process in the water treatment. Flotation can be described as a gravity separation process in which gas bubbles attach to solid particles to cause the apparent density of the bubbles-solid agglomerates to be less than that of the water, thereby allowing the agglomerate to float to the surface. Different methods of producing gas bubbles give rise to different types of flotation processes: electrolytic flotation, dispersed-air flotation, and dissolved-air flotation.

A pilot plant was constructed in Sandoop water treatment plant to evaluate dissolved air flotation for treating raw surface water. The raw water was brought El-Bahr El-Sagheir branch from the Nile river.

Dissolved-Air flotation is regarded as "high-rate" process because of the relatively high surface loadings possible. This label also implies it is compact process and so occupies less area. That is important where land is at a premium. This process is also likely to need shallower and smaller tanks, which is important in coping with preparing foundations in difficult sites. Dissolved-air flotation is likely to be less expensive than floc-blanket sedimentation.

CONTENTS

	Page
AKNOWLEDGMENT	
CONTENTS	i
LIST OF FIGURES	iv
LIST OF TABLES	vi
LIST OF SYMBOLS	vii
CHAPTER 1: <u>INTRODUCTION</u>	
1.1 GENERAL	1
1.2 Scope and Objective of the Present Work	3
1.3 Thesis Contents	3
CHAPTER 2: <u>LITERATURE REVIEW</u>	
2.1 Water Characteristics	5
2.1.1 Physical Water - Quality	5
2.1.1.1 Suspended Solids	5
2.1.1.2 Turbidity	5
2.1.1.3 Color	6
2.1.1.4 Taste and Odor	7
2.1.1.5 Algae	7
2.1.2 Chemical Water Quality Parameters	7
2.1.2.1 Total Dissolved Solid (TDS)	8
2.1.2.2 Alkalinity	8
2.1.2.3 Hardness	8
2.1.2.4 Fluoride	9
2.1.2.5 Metals	9
2.1.2.6 Organic	10
2.2 Flotation	10
2.2.1 History of Flotation	10
2.2.2. Types of Flotation Processes	12
2.2.2.1 Electrolytic Flotation	13
2.2.2.2 Dispersed - Air Flotation	13
2.2.2.3 Dissolved - Air Flotation	13
2.2.3 Theory of Dissolved - Air Flotation	16
2.2.4 Mechanism of Flotation	16
2.2.5 Solubility of Air in Water	17
2.2.6 Effect of Bubble Size	17
2.2.7 Types of Flotation Tanks	21
2.2.7.1 Circular Tanks	21
2.2.7.2 Rectangular Tanks	21
2.2.8 Combined Flotation and Filtration	24
2.2.9 Air Saturation Systems	24
2.2.10 Factors Influencing Dissolved - Air Flotation Efficiency	27
2.2.10.1 Coagulation	27

	Page
2.2.10.2 Flocculation	28
2.2.10.3 Flocculation Time	28
2.2.10.4 Degree of Agitation	29
2.2.11 Hydraulic Flocculation	29
2.2.12 Quantity of Air Required for flotation	30
2.2.13 Design of Recycle Flow Pressurization System	31
2.2.13.1 Air Solubility and Pressure Calculations	32
2.2.13.2 Consideration of Hydraulic Rate in Design	35
2.2.14 Performance of Dissolved - Air Flotation Plants	38
2.2.14.1 Treatment of lowland Minera - Bearing (High-Alkalinity) River Water.	39
2.2.14.2 Treatment of Colored (Low - Alkalinity) Stored water	40
2.2.14.3 Treatment of Algae - Bearing (High - Alkalinity) Stood Water	41
 CHAPTER 3: <u>METHODOLOGY</u>	
3.1 Site Description	43
3.2 Sources of Raw Water	43
3.3 Raw Water Supply System	43
3.4 Pilot Plant Description	46
3.4.1 Chemical Feed System	46
3.4.2 Flocculation Tank	46
3.4.3 Flotation System	46
3.4.4 Filter System	47
3.4.5 Filter Media	49
3.4.6 Filter Underdrainage System	49
3.5 Miscellaneous Equipment and Materials	49
3.5.1 Head Losses Measurements	49
3.5.2 Chemicals	51
3.5.3 Ferric Chloride Optimum Dose	51
3.5.4 Instruments	51
3.5.5 Quality Control	51
3.5.6 Flow	52
3.5.7 Turbidity	52
3.5.8 Chemical Feeding	52
3.5.9 PH meter	52
3.5.10 Pilot Plant Operation	52
 CHAPTER 4: <u>RESULTS AND DISCUSSION</u>	
4.1 General	55
4.2 First Group	55
4.2.1 Run #1	56
4.2.2 Run #2	58
4.2.3 Run #3	58
4.2.4 Run #4	61
4.2.5 Run #5	61

	Page
4.2.6 Run #6	61
4.2.7 General Discussion From Run # 1 to Run # 6 in Group #1	66
4.3 Second Group	66
4.3.1 Run #1	67
4.3.2 Run #2	69
4.3.3 Run #3	69
4.3.4 Run #4	72
4.3.5 Run #5	72
4.3.6 Run #6	72
4.3.7 General Discussion From Run # 1 to Run # 6 in Group #2	77
4.4 Third Group	77
4.4.1 Run #1	78
4.4.2 Run #2	80
4.4.3 Run #3	80
4.4.4 Run #4	83
4.4.5 Run #5	83
4.4.6 Run #6	83
4.4.7 General Discussion From Run # 1 to Run # 6 in Group #3	88
4.5 Fourth Group	88
4.5.1 Run #1	89
4.5.2 Run #2	91
4.5.3 Run #3	91
4.5.4 Run #4	94
4.5.5 Run #5	94
4.5.6 Run #6	94
4.5.7 General Discussion From Run # 1 to Run # 6 in Group #4	99
4.6 General Discussion of The Four Groups	100
CHAPTER 5: <u>COMPARATIVE COST ANALYSIS</u>	
5.1 Introduction	101
5.2 TCF -DAF - RSF Cost Analysis	102
5.2.1 Cost Estimation	102
5.2.1.1 Construction cost	102
5.2.1.2 Operation and Maintenance Cost	109
5.3 Compact unit Cost Analysis	110
5.4 Cost Comparison	112
CHAPTER 6: <u>CONCLUSION AND RECOMMENDATION</u>	113
APPENDIX (A)	115
APPENDIX (B)	139
APPENDIX (C)	142
ARABIC SUMMARY	

LIST OF FIGURES

<i>Figure</i>	<i>Page</i>	<i>Description</i>
(2-1)	15	Schematic Diagram of a Flotation Plant for Potable Water Treatment.
(2-2)	18	Mass of Gas Dissolved in Water as a Function of Pressure and Temperature.
(2-3)	20	Rate of Rise of Air Bubbles in Tapwater as a Function of Bubble Size.
(2-4)	20	Effect of Bubble Size on Flotation Tank Size.
(2-5)	22	Schematic Diagram of a Circular Flotation Tank.
(2-6)	25	Schematic Diagram of Combined Flotation - Filtration Plant.
(2-7)	36	Separation of Particle From wastewater by Dissolved Air Flotation.
(2-8)	36	Basic Design Concept of Flotation Unit.
(3-1)	44	Location of Sandoop Pumping Station
(3-2)	45	General Layout of Sandoop Water Treatment Plants.
(3-3)	48	Flotation Tank Details.
(3-4)	50	Schematic Flow Diagram For The Filter.
(3-5)	53	Pilot Plant Diagram.
(4-1, 4-2)	57	Run #1, Group #1.
(4-3, 4-4)	59	Run #2, Group #1.
(4-5, 4-6)	60	Run #3, Group #1.
(4-7, 4-8)	62	Run #4, Group #1.
(4-9, 4-10)	63	Run #5, Group #1.
(4-11, 4-12)	64	Run #6, Group #1.
(4-13, 4-14)	68	Run #1, Group #2.
(4-15, 4-16)	70	Run #2, Group #2.
(4-17, 4-18)	71	Run #3, Group #2.
(4-19, 4-20)	73	Run #4, Group #2.
(4-21, 4-22)	74	Run #5, Group #2.
(4-23, 4-24)	75	Run #6, Group #2.
(4-25, 4-26)	79	Run #1, Group #3.
(4-27, 4-28)	81	Run #2, Group #3.
(4-29, 4-30)	82	Run #3, Group #3.

<i>Figure</i>	<i>Page</i>	<i>Description</i>
(4 - 31 , 4 - 32)	84	Run #4, Group #3.
(4 - 33 , 4 - 34)	85	Run #5, Group #3.
(4 - 35 , 4 - 36)	86	Run #6, Group #3.
(4 - 37 , 4 - 38)	90	Run #1, Group #4.
(4 - 39 , 4 - 40)	92	Run #2, Group #4.
(4 - 41 , 4 - 42)	93	Run #3, Group #4.
(4 - 43 , 4 - 44)	95	Run #4, Group #4.
(4 - 45 , 4 - 46)	96	Run #5, Group #4.
(4 - 47 , 4 - 48)	97	Run #6, Group #4.