

HIGHER TECHNICAL INSTITUTE

CIVIL ENGINEERING COURSE

DIPLOMA PROJECT

DESIGN OF A SMALL SCALE
SECONDARY WASTEWATER
TREATMENT PLANT

C/831

BY

KYPRIANOU CHRISTOS

AND

IDEMETRIADIS TIMOTHEOS

HIGHER TECHNICAL INSTITUTE

CIVIL ENGINEERING COURSE

DIPLOMA PROJECT

DESIGN OF A SMALL SCALE
SECONDARY WASTEWATER
TREATMENT PLANT

BY

KYPRIANOU CHRISTOS

AND

DEMETRIADES TIMOTHEOS

JUNE 1998

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 2813
----------------------------------	---------------------

DESIGN OF A WASTEWATER
TREATMENT PLANT

BY
CHRISTOS KYPRIANOU
AND
DEMETRIADES TIMOTHEOS

PROJECT REPORT
SUBMITTED TO
THE DEPARTMENT OF CIVIL ENGINEERING
OF THE HIGHER TECHNICAL INSTITUTE
NICOSIA, CYPRUS
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DIPLOMA OF
TECHNICIAN ENGINEER

IN
CIVIL ENGINEERING

JUNE 1998

PROJECT SUPERVISOR: MR N. KATHIDJIOTES
LECTURER AT HTI

EXTERNAL ACCESSOR: MRS EVI THEOPEMPTOU

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 2813
----------------------------------	---------------------

HIGHER TECHNICAL INSTITUTE
NICOSIA - CYPRUS

CIVIL ENGINEERING DEPARTMENT

Academic Year 1997-98

Diploma Project Number: C/831

TITLE: Design of a wastewater treatment plant

Objectives:

1. To state wastewater qualities, treatment objective sand principles.
2. To carry a planning study including an environmental impact study.
3. To design a small scale secondary treatment plant.

Terms and Conditions:

1. Plant location and type of treatment will be assigned by project supervisor.

Students: Christos Kyprianou and Demetriades Timotheos

Supervisor: Mr N. Kathijotes

External Accessor: Mrs Evi Theopemptou

2813

CONTENTS

Page

ACKNOWLEDGEMENTS

CHAPTER 1: INTRODUCTION

1.1	Wastewater	1
1.2	Nature of wastewater	1
1.2.1	Physical contaminants	1
1.2.2	Chemical contaminants	1
1.2.3	Biological contaminants	2
1.3	Domestic wastewater	2

CHAPTER 2: WASTEWATER CHARACTERISTICS

2.1	Physical Characteristics of Wastewater	4
2.1.1	Total Solids	4
2.1.2	Suspended Solids	4
2.1.3	Dissolved Solids	4
2.1.4	Colour	4
2.1.5	Turbidity	5
2.1.6	Temperature	5
2.1.7	Taste and Odour	6
2.2	Chemical Characteristics of Wastewater	7
2.2.1	Alkalinity	8
2.2.2	pH	8
2.2.3	Biochemical Oxygen Demand	9
2.2.4	Total organic carbon	9
2.2.5	Chemical oxygen demand	9
2.2.6	Theoretical Oxygen Demand	10
2.2.7	Nutrients	10
2.2.8	Organics	10
2.2.9	Metals	11
2.2.10	Hardness	11
2.2.11	Fluoride	12

2.3	Biological Characteristics of Wastewater	13
2.3.1	Micro organisms	13
2.3.2	Pathogens	13
2.3.3	Protozoa	13
2.3.4	Bacteria	14
2.3.5	Viruses	14
2.3.6	Helminths	14

CHAPTER 3: WASTEWATER TREATMENT PROCESSES

3.1	Collection	16
3.2	Pre-treatment	18
3.3	Primary treatment	19
3.3.1	Preliminary treatment	19
3.3.2	Removal of suspended solids ...	20
3.3.3	Removal of gritty matter	20
3.3.4	Removal of grease and oil	21
3.3.5	Chlorination	22
3.3.6	Primary sedimentation	22
3.4	Secondary treatment	23
3.4.1	Aerobic biological treatment ..	23
	a. Trickling filters	24
	b. Rotating biological filters	26
	c. Aerated lagoon	28
	d. Oxidation ponds	29
	e. Activated sludge	30
3.5	Tertiary Treatment	32
3.5.1	Physical Processes	32
3.5.2	Chemical Processes	33
3.5.3	Biological processes	33
3.5.4	Advanced Wastewater Treatment .	34

CHAPTER 4: ACTIVATED SLUDGE TREATMENT

- 4.1 Activated Sludge Characteristics ... 45
- 4.2 Types of Sludge 49
- 4.3 Sludge Treatment 50
- 4.4 Sludge Disposal 50

CHAPTER 5: DESIGN PROCEDURES OF THE WASTEWATER
TREATMENT PLANT 54

CHAPTER 6: ENVIRONMENTAL CONSIDERATIONS

- 6.1 Environmental Conditions 72

CHAPTER 7: LOCATION OF THE WASTEWATER TREATMENT PLANT

- 7.1 THE PROPOSED LOCATIONS FOR THE
TREATMENT PLANT OF AGLANDJIA 74

CONCLUSIONS 77

REFERENCES

ACKNOWLEDGMENTS

The success of this project is due to the contribution of many people that we would like to thank.

We would like to thank and express our appreciation to Mr. N. Kathijotes, HTI Senior Lecturer, our project supervisor who had provided us with very helpful information and guidance through out the development of the project.

We would also like to give special thanks to Mrs Evi Theopemptou, Civil Engineer in the Sewerage board of Nicosia, who helped us to solve many problems that appeared during the designing of the project, and provided us with information related to future wastewater treatment plants of Aglandjia.

In addition we would like to thank Mr Mikis Chadjipanai, electrical engineer in the sewerage board of Nicosia, who is in charge of the Anthoupolis wastewater treatment plant and also Mr Costas Sophocleous, chemical engineer of the some treatment plant. They both provided us with useful information regarding the plant treatment processes.

The preparation of the manuscript could have not been done without the excellent job and the extreme patience of our friends Achilleas Georghiou and Christos Sevastides who did the typing.

Finally we would like to give thanks to our families for their patience and support during this difficult but beautiful period and every one else who supported us throughout the development of the project.