

HIGHER TECHNICAL INSTITUTE
CIVIL ENGINEERING DEPARTMENT

DIPLOMA PROJECT

DESIGN OF A SMALL - SCALE SECONDARY
WASTEWATER TREATMENT PLANT

by
NICOLAS TH. COLAÇU
07811

JUNE 1967

HIGHER TECHNICAL INSTITUTE

CIVIL ENGINEERING COURSE

DIPLOMA PROJECT

DESIGN OF A SMALL -SCALE SECONDARY WASTEWATER TREATMENT PLANT

NICOLAS TH. NICOLAOU

JUNE 1997

HIGHER TECHNICAL INSTITUTE	PROJECT NO. 2775
----------------------------------	---------------------

HIGHER TECHNICAL INSTITUTE

NICOSIA - CYPRUS

CIVIL ENGINEERING DEPARTMENT

Academic Year 1996 - 97

Diploma Project Number: C/

Title: Design of a Small Scale Secondary Wastewater Treatment Plant

Objectives

1. To indicate the principles of Biological Treatment and to illustrate various methods using flow diagrams.
2. To show all working Drawings of a Small Scale Secondary Wastewater Treatment plant.
3. To comment on established wastewater qualities and standards.

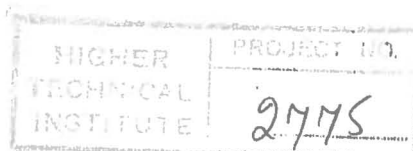
Terms and Conditions

1. Location and flows will be assigned by Project supervisor.
2. Trickling filter system will be used.

Student : Nicolas Nicolaou

Supervisor : Mr N. Kathijotes

External Assesor : Mrs Evi Theopemptou



CONTENTS

	PAGE
CHAPTER 1	
1.0 INTRODUCTION:	1
1.1 WASTEWATER:	1
1.2. WASTEWATER ENGINEERING :	1
1.3 SEWAGE:	1
1.3.1 DOMESTIC SEWAGE :	1
CHAPTER 2	
2.0 PHYSICAL CHARACTERISTICS OF WASTEWATER :	5
2.1 TOTAL SOLIDS:	5
2.2 SUSPENDED SOLIDS :	5
2.3 DISSOLVED SOLIDS:	5
2.4 COLOR :	6
2.5 TURBIDITY:	6
2.6 TASTE AND ODOR :	6
2.7 TEMPERATURE :	7
CHAPTER 3	
3.0 CHEMICAL CHARACTERISTICS OF WASTEWATER:	8
3.1 ALKALINITY:	8
3.2 HARDNESS:	8
3.3 FLUORIDE :	8
3.4 METALS & ORGANICS:	9
3.5 NUTRIENTS :	9
3.6 WASTEWATER COMPOSITION :	10

CHAPTER 4

PAGE

4.0 BIOLOGICAL CHARACTERISTICS OF WASTEWATER :	10
4.1 MICROORGANISMS :	10
4.1.2 CLASSIFICATION OF MICROORGANISMS :	10
4.2 PATHOGENS :	11
4.3 PROTOZOA :	11
4.4 BACTERIA :	12
4.5 VIRUSES :	12
4.6 HELMINTS :	13

CHAPTER 5

5.0 CHARACTERIZATION OF WASTEWATER :	14
5.1 THEORETICAL OXYGEN DEMAND THOD :	14
5.2 CHEMICAL OXYGEN DEMAND COD :	14
5.3 BIOCHEMICAL OXYGEN DEMAND BOD :	15
5.4 TOTAL ORGANIC CARBON TOC :	15
5.5 PH :	16

CHAPTER 6

6.0 WASTEWATER - MANAGEMENT :	17
6.1 COLLECTION OF SEWAGE :	17
6.2 SEWAGE TREATMENT :	18
6.3 EFFLUENT RE - USE :	18

CHAPTER7	PAGE
7.0 WASTEWATER TREATMENT :	19
7.1 PRIMARY TREATMENT :	19
7.1.1 PURPOSE :	19
7.1.2 SCREENING :	19
7.1.2.1 FINE SCREENS :	19
7.1.2.2. COARSE SCREENS :	20
7.1.3 GRIT REMOVAL :	22
7.1.4 GRIT DISPOSAL :	22
7.1.5. SEDIMENTATION :	22
7.1.5.1 TYPES OF SETTLING :	23
a) DISCRETE SETTLING :	23
b) FLOCCULENT SETTLING :	23
c) ZONE SETTLING :	23
7.2 SECONDARY TREATMENT :	23
7.3 TERTIARY TREATMENT :	24
7.3.1 SUSPENDE SOLIDS REMOVAL :	24
7.3.2. CARBON ADSORPTION :	25
7.3.3. ION EXCHANGE :	25
7.4 ELECTRODIALYSIS :	25
7.5 CHLORINATION :	26
7.6. NUTRIENT REMOVAL :	26

CHAPTER 8

8.0 SEWAGE TREATMENT PLANTS :	27
8.1 ACTIVATED SLUDGE :	27
8.1.1 MECHANISMS OF BOD REMOVAL :	27
8.1.2 ACTIVATED SLUDGE SYSTEMS :	27
8.2 PONDS AND LAGGONS :	28

	PAGE
8.2.1 PONDS :	29
8.2.2 LAGOONS :	29
8.3 TRICKLING FILTERS :	30
CHAPTER 9	
9.0 LOCATION OF PLANT - OBJECTIVES OF PLANT :	40
CHAPTER 10	
10.0 PHYSICAL ENVIRONMENT :	44
10.1 SOILS - GEOLOGY :	44
10.2 HYDROLOGY :	44
10.3 CLIMATE AND METEOROLOGY :	44
10.4 AIR QUALITY AND ODOURS :	46
10.5 ENVIRONMENTAL CONDITIONS :	46
CHAPTER 11	
11.0 DESIGN PROCEDURES :	47
11.1 PRIMARY SETTLING TANK :	48
11.1.1 DESIGN CRITERIA :	48
11.1.2 DESIGN :	48
11.2 DESIGN OF TRICKLING FILTER :	54
11.2.1 DEPTH :	54
11.2.2 CALCULATION OF VOLUME :	54
11.2.3 REQUIRED FILTER AREA :	55
11.2.4 LOADINGS :	55
11.2.5 Q_{max} :	55

	PAGE
11.3 DESIGN OF FINAL SETTLING TANK:	58
11.3.1 DESIGN CRITERIA:	58
DESIGN	58

ACKNOWLEDGEMENTS

The project was carried out at the Department of Civil Engineering, Faculty of Engineering, Assiut University, Assiut, Egypt.

It was very difficult but I spent the daylight of my own. Therefore, I want to express all my thanks to the people who spent their time and share their knowledge to help me.

Firstly, I would like to express my gratitude and appreciation to Mr. H. M. Elmaghrabi, my project supervisor, for his guidance and the necessary assistance.

My special thanks go to Mr. H. M. Elmaghrabi, Lecturer in Civil Engineering, Assiut University, Assiut, Egypt, for his great help and cooperation during the development of my project.

I wish also to express my gratitude to Mr. Mohamed Elmaghrabi, Lecturer in Civil Engineering, Assiut University, Assiut, Egypt, for his great help and cooperation during the development of my project.

I would like to thank Mr. H. M. Elmaghrabi, Lecturer in Civil Engineering, Assiut University, Assiut, Egypt, for his great help and cooperation during the development of my project.

ACKNOWLEDGEMENTS

This project was carried out as a part of the conditions for the award of my diploma as a Technical Engineer in Civil Engineering.

It was very difficult to prepare this document in my own. Therefore I want to express all my thanks to the people who spent their time and share their knowledge to help me.

Firstly I would like to express my thanks and appreciation to Mr N. Kathijotes, my project supervisor for giving all the necessary guidance.

Special thanks are also given to Mrs Evi Theopempton, Civil Engineer in the Sewarage Board of Nicosia for her great help and cooperation during the development of my project.

I wish also to express my gratefulness to Dr Maria Dodou, the Engineer in the water Development for her useful informations.

Finally I would like to express my thanks to my family and all my related (especially Maria & Lakis Sophocleous) for their support throughout my project work.

SCOPE OF PROJECT

The scope of the project is to indicate the principles of Biological Treatment and to illustrate various methods using flow diagrams.

Also all working drawings of a Small Scale Secondary Wastewater Treatment plant in Dhali village have to be shown.

In addition to that to comment on established wastewater qualities and standards.

The location and flows were assigned by Project supervisor Mr N. Kathijotes.

The method of treatment was the trickling filter.