

**HIGHER TECHNICAL INSTITUTE**

**DIPLOMA PROJECT**

**WASTEWATER REUSE EFFECTS ON SOIL**

**C/832**

**By:**

**KYRIAKOU CHRISTODOULOS**

**and**

**PARASKEVAS DEMETRIS**

**JUNE 1998**



**HIGHER TECHNICAL INSTITUTE  
NICOSIA, CYPRUS**

CIVIL ENGINEERING DEPARTMENT  
Academic Year 1997/98  
Diploma Project No. C/832

TITLE: Wastewater Reuse-Effects on Soil

OBJECTIVES

1. To present literature resulting from studies in Cyprus so far, in regard to wastewater reuse.
2. To carry out lab tests in order to investigate effects on soil, in terms of chemical and physical characteristics.
3. To comment on the results.

Terms and Conditions

1. Types of tests will be discussed by project supervision.

Students :  
1. Christodoulos Kyriacou  
2. Demetris Paraskevas

Supervisor : Mr. N. Kathijotes

## **TABLE OF CONTENTS**

Acknowledgements.....	i
Objectives.....	ii
Introduction.....	iii
<b>CHAPTER 1.....</b>	<b>1</b>
1.General Literature	
1.1 Composition of wastewater.....	2
1.2 Wastewater treatment.....	4
1.2.1 Primary treatment.....	4
1.2.1.1 Grit chamber.....	4
1.2.1.2 Sedimentation.....	4
1.2.1.3 Flotation.....	5
1.2.1.4 Digestion.....	5
1.2.1.5 Drying.....	6
1.2.2 Secondary treatment.....	6
1.2.2.1 Trickling filter.....	7
1.2.2.2 Activated sludge.....	7
1.2.2.3 Stabilization pond or lagoon.....	7
1.2.3 Advanced wastewater treatment or tertiary treatment.....	8
1.2.3.1 Liquid disposal.....	8
1.2.3.2 Septic tank.....	9
1.3 Wastewater reuse.....	11
1.3.1 Use of treated wastewater for irrigation.....	11
1.3.1.1 Introduction.....	11
1.3.1.2 Irrigation with wastewater.....	11
1.3.2 Problems associated with wastewater use for irrigation.....	13
1.3.2.1 Quality characteristics and considerations.....	13
1.3.2.2 Quality criteria for irrigation.....	13

1.3.2.3 Sodicity (Soil permeability).....	17
1.3.2.4 Heavy metals.....	17
1.3.2.5 Other problems.....	19
1.3.2.6 Wastewater as a source for crop nutrients.....	20
1.3.2.7 Nutrient load through irrigation with effluents.....	21
1.4 Sludge disposal.....	22
1.4.1 Land application.....	22
1.4.2 Liquid sludge application.....	23
1.4.3 Dewatered sludge application.....	23
<b>CHAPTER 2.....</b>	<b>24</b>
<b>2. Current situation in Cyprus</b>	
2.1 Introduction.....	25
2.2 Larnaca Sewerage Treatment Works.....	26
2.2.1 Plant description.....	62
2.2.2 Plant data.....	28
2.3 Inlet works area (Primary treatment).....	29
2.3.1 Inlet measuring station.....	29
2.3.2 Pre-mixing chamber.....	29
2.3.3 Screens.....	29
2.3.4 Grit removal plant.....	30
2.3.5 Odour control plant.....	30
2.4 Secondary treatment.....	31
2.4.1 Oxidation ditch.....	31
2.4.2 Final settlement tanks.....	31
2.4.3 Effluent storage.....	32
2.5 Tertiary treatment.....	33
2.5.1 Filter feed pumps.....	33
2.5.2 Rapid gravity sand filters.....	33
2.5.3 Chlorine contact tank.....	34

2.5.4 Chlorine dosing equipment.....	34
2.6 Irrigation pumps.....	34
2.7 Sludge treatment.....	35
2.7.1 Sludge digestors, air blowers and sludge bed feed pumps.....	35
2.7.2 Sludge drying beds.....	35
2.8 Service equipment.....	36
2.8.1 Emergency storage lagoon.....	36
2.9 Dams in Cyprus.....	42
2.10 Research in Cyprus.....	47
2.11 Quality guidelines for wastewater reuse in Cyprus.....	49
2.12 Distribution methods for irrigation.....	51
2.12.1 Sprinkler systems.....	51
2.12.2 Surface application systems.....	51
2.12.3 Drip or trickle application systems.....	52
<b>CHAPTER 3.....</b>	<b>55</b>
<b>3. Experiments, Results, Conclusions</b>	
3.1 Introduction.....	56
3.2 Evaluation of organic matter.....	56
3.2.1 Explanation of tables.....	57
3.3 Evaluation of pH.....	66
3.4 Evaluation of Total Nitrogen.....	69
3.5 Conclusions, Comments.....	72
3.6 Benefits of wastewater reuse.....	79
<b>REFERENCES.....</b>	<b>81</b>

## LIST OF PHOTOS

Photo 1: Pre-mixing Chamber.....	37
Photo 2: Screen.....	37
Photo 3: Detritor Tank.....	38
Photo 4: Oxidation Ditch.....	38
Photo 5: Final Settlement Tanks (FSTs).....	39
Photo 6: Sludge Thickener.....	39
Photo 7: Effluent Storage Reservoirs.....	40
Photo 8: Rapid Gravity Sand Filters.....	40
Photo 9: Sludge Drying Beds.....	41
Photo 10: Emergency Storage Lagoon.....	41
Photo 11: Apparatus of organic matter.....	68
Photo 12: Apparatus of pH.....	68