

**NEAR EAST UNIVERSITY**

**INSTITUTE OF APPLIED  
AND SOCIAL SCIENCES**

**IMPACT OF ANAEROBIC LAGOONS ON THE  
PERFORMANCE OF BOD AND TSS REMOVALS AT  
NICOSIA WASTEWATER PLANT**

**Samah J. ALMAQADMA**

**Master thesis**

**DEPARTMENT OF CIVIL ENGINEERING**

**NICOSIA – 2008**

## **ABSTRACT**

### **Impact of Anaerobic Lagoons on the Performance of BOD and TSS Removals at Nicosia Wastewater Treatment Plant**

**Samah j. ALMAQADMA**

**M.Sc., Department of Civil Engineering**

**Supervisor: Assoc. Prof. Dr. Umut TÜRKER**  
**Co-Supervisor: Asst. Dr. Mehmet OKAYGÜN**

**May 2008**

One of the most common tests for the determination of the strength and organic content of wastewaters is the biochemical oxygen demand (BOD). The capital of Cyprus, Nicosia has upgraded its wastewater treatment plant during the 2000s that has provided a significant improvement in BOD and total suspended solids (TSS) treatment efficiencies. This performance is tested through the data collected between 1993 and 2005 at which experiments were performed with three replications per treatment. Data were analyzed by analysis of variance using ANOVA to detect significant differences between means and the differences in the means were tested by the least significant difference (LSD). A one way ANOVA test showed significant difference ( $P < 0.05$ ) in the means of all samples investigated in the various locations and time intervals of the treatment plant. Experimental results showed that installation of these innovative anaerobic lagoons was able to reduce the concentrations of BOD and TSS to desirable values that fall within the limits of both national and international effluent standards before disposal into the stream. However, the limits for the reuse of effluent for irrigation purposes require more improvement on the treatment technology. The significant improvement on BOD removal increased the treatment performance of BOD up to 93%, whereas the TSS treatment performance increased up to 84%.

**KEY WORDS:** Waste Stabilization Pond, Anaerobic Lagoon, ANOVA, Nicosia Wastewater Treatment Plant, Biological Oxygen Demand, Total Suspended Solids.

## **ACKNOWLEDGMENT**

First, I would like to express sincere gratitude to my thesis advisors Assoc. Prof. Dr. Umut TÜRKER and Asst. Prof. Dr. Mehmet OKAYGÜN for their excellent guidance and advice, and their effort over this thesis.

Second, I would like to thank all the individuals who contributed to this thesis. Especially my co-supervisor, Asst. Prof. Dr. Mehmet OKAYGÜN and the head of the Nicosia wastewater treatment plant Miss. Taibe Efe for her helping in collection the data.

Third, I also would like to thanks to Asst. Prof. Dr. Dudu Özkum, whose contributions in statistical analysis enlarge the focus of this thesis.

Finally, I would also like to thank my husband for his encouragement, support and patience. Without him, it was not easy to complete this thesis.

# TABLE OF CONTENTS

<b><u>TOC \O "1-4" \H \Z \U <a href="#">ABSTRACT</a></u></b>	<b>2</b>
<b><u><a href="#">ACKNOWLEDGMENT</a></u></b>	<b>3</b>
<b><u><a href="#">TABLE OF CONTENTS</a></u></b>	<b>4</b>
<b><u><a href="#">LIST OF FIGURES</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">LIST OF TABLES</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">LIST OF SYMBOLS</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">LIST OF ABBREVIATIONS</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">CHAPTER 1</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">INTRODUCTION</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">CHAPTER 2</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">FUNDAMENTALS OF WASTEWATER ENGINEERING</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">2.1 Introduction</a></u></b>	Error! Bookmark not defined.
<b><u><a href="#">2.2 Definition of wastewater characteristics</a></u></b>	Error! Bookmark not defined.
<u><a href="#">2.2.1 Organic constituents</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.1.1 Biochemical Oxygen Demand (BOD)</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.1.2 Chemical Oxygen Demand (COD)</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.1.3 Total Organic Carbon (TOC)</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.2 Nitrogen constituents</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.3 Phosphorus compounds (P)</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.4 Solids</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.4.1 Suspended solids</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.4.2 Settable solids</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.4.3 Dissolved solids</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.5 pH</a></u>	<b>Error! Bookmark not defined.</b>
<u><a href="#">2.2.6 Alkalinity</a></u>	<b>Error! Bookmark not defined.</b>
<b><u><a href="#">CHAPTER 3</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">WASTEWATER TREATMENT TECHNOLOGY</a></u></b>	ERROR! BOOKMARK NOT DEFINED.
<b><u><a href="#">3.1 Introduction</a></u></b>	Error! Bookmark not defined.
<b><u><a href="#">3.2 Preliminary treatment</a></u></b>	Error! Bookmark not defined.

### 3.3 Primary treatment

Error! Bookmark not defined.

### 3.4 Secondary treatment

Error! Bookmark not defined.

#### 3.4.1 Activated sludge

**Error! Bookmark not defined.**

#### 3.4.2 Trickling filter

**Error! Bookmark not defined.**

#### 3.4.3 Lagoons

**Error! Bookmark not defined.**

### 3.5 Tertiary treatment

Error! Bookmark not defined.

### 3.6 Wastewater Stabilization Ponds

Error! Bookmark not defined.

#### 3.6.1 Advantages of Lagoon Systems

**Error! Bookmark not defined.**

#### 3.6.2 Disadvantages of Lagoon Systems

**Error! Bookmark not defined.**

#### 3.6.3 Classification of Waste stabilization Pond

**Error! Bookmark not defined.**

##### 3.6.3.1 Anaerobic ponds

**Error! Bookmark not defined.**

##### 3.6.3.2 Aerobic pond

**Error! Bookmark not defined.**

##### 3.6.3.3 Facultative ponds (anaerobic-aerobic)

**Error! Bookmark not defined.**

##### 3.6.3.4 Maturation ponds

**Error! Bookmark not defined.**

#### 3.6.4 Color of lagoon wastewater

**Error! Bookmark not defined.**

#### 3.6.5 pH in lagoon system

**Error! Bookmark not defined.**

#### 3.6.6 Operational problems in stabilization ponds

**Error! Bookmark not defined.**

#### 3.6.7 Maintenance

**Error! Bookmark not defined.**