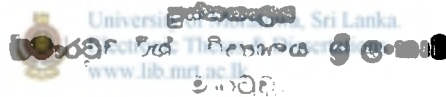


**PERFORMANCE OF THE EXISTING TRICKLING FILTER  
AT SOYSAPURA HOUSING SCHEME**

By

**S.G.G.Rajkumar**



**Department of Civil Engineering**

**University of Moratuwa**

**Moratuwa, Sri Lanka**

**March, 1997**

**PERFORMANCE OF THE EXISTING TRICKLING FILTER  
AT SOYSAPURA HOUSING SCHEME**

BY

**SOMASUNDARAM GNANAPIRAGASAM GANAN RAJKUMAR**

සමසුන්දරාම ගුණාපිරාගසාම ගානා රාජකුමාර  
මොරටුව විශ්ව විද්‍යාලයේ ඉංජිනේරු  
මොරටුව.

Thesis Submitted in Partial

Fulfillment of

The Requirement for the Degree of

Master of Engineering in

Environmental Engineering & Management

67575

Um Thesis  
coll.

Department of Civil Engineering

University of Moratuwa

March, 1997

624"97"  
628.3

67575

THIS THESIS HAS NOT BEEN PREVIOUSLY  
PRESENTED IN WHOLE OR PART TO  
ANY UNIVERSITY OR  
INSTITUTION FOR A HIGHER DEGREE



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

*S.G.G. Rajkumar*  
.....  
S.G.G. RAJKUMAR

MARCH, 1997

## **ABSTRACT**

Communities living in flats produce both liquid and solid waste in large quantities. The liquid waste is called the wastewater. This wastewater will be a potential threat to the environment.

Soysapura Housing Scheme treatment plant was taken up for this research study. This plant consists of Imhoff tank, trickling filter, humus tank and sludge drying beds. In this treatment plant performance of trickling filter was selected for detailed study.

Grab samples were taken from inlet of the imhoff tank, trickling filter, humus tank and from the outlet of the humus tank. Grab samples were taken from 05 30 hrs. to 19 30 hrs. in two hourly intervals. Sampling was done by having a small gap between the first set of sampling and second set of sampling with the idea to see any variation in wastewater inflow patterns over a period. From the samples collected bio-chemical oxygen demand (BOD), chemical oxygen demand (COD), suspended solids (SS) and pH were determined.

The performance of the trickling filter was under detail study. A relationship for organic loading and trickling filter efficiency was obtained. It was found that the removal efficiency improved with increase of organic loading. Also a relationship of COD & BOD for the influent of trickling filter was obtained. With the loading pattern, the plant could be classified as a low rate trickling filter. Also this plant could treat further additional load after carrying out the suggested improvements.

The cause of trickling filter performance are discussed and areas which require further study and development are identified and recommendations are made for future investigations.



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## ACKNOWLEDGEMENTS

The author wishes to express his deep gratitude to Mr. S. Pathinather, Senior Lecturer of the University of Moratuwa and the supervisor of this research for his guidance, encouragement and useful suggestions during this research study.

The author acknowledges the assistance and encouragement given by Mr. L.S.P.J. De Silva, D.G.M. (Western), National Water Supply & Drainage Board (NWS&DB).

The Cooperation extended by Mr. Melawathanthirige, Manager, Colombo Sewerage Operations, NWS&DB, is gratefully acknowledged.



University of Moratuwa, Sri Lanka  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

The author is thankful to Mr. Ranatunga, OIC, of the Soysapura, wastewater treatment plant for making necessary arrangement to collect sample and providing other need full assistance.

The wastewater sample collectors, Mr. Dharmasiri & Mr. Piyasiri are gratefully appreciated.

Sincere thanks are extended to Mrs. Shanthi Hewawasam for processing this script.

The author is thankful to National Water Supply & Drainage Board for the facilities provided to carryout this research study.

The facilities provided by the University of Moratuwa are gratefully appreciated.

The author is grateful to Mr. M. Wickramage, Former G.M., NWSDB, Dr. S. Buvendralingam, Dr. M. Jayaweera and course coordinator Prof. (Mrs) .N.Ratnayake for their contributions at the presentation prior to writing the thesis.

The author gratefully appreciates the National Resources and Environmental Policy Project (NAREPP) for the financial assistance given to carryout this research study.

Friends & colleagues are gratefully appreciated for their encouragement & assistance.

## TABLE OF CONTENTS

	<u>Page No.</u>
(I) Abstract	i
(II) Acknowledgement	iii
(III) Table of Contents	v
(IV) List of Figures	x
(V) List of Tables	xi
(VI) Notations	xii
 <b>Chapter 1</b>	
1.0 Introduction	1
1.1 General	1
1.2 Objective of Sewage Treatment	4
1.3 History and Types of Attached Growth Biological Treatment	6
1.4 Scope of this Research	9
1.5 Arrangement of this Thesis	10
 <b>Chapter 2</b>	
2.0 Literature Review and Theoretical Consideration	11
2.1 Fixed Medium	12
2.2 Reaction & Interaction in Trickle Filter	13
2.3 Process Design	51



**Chapter 3**

3.0	Methods and Materials	54
3.1	Experimental Work	54
3.2	Treatment Plant Description	57
3.3	Sampling	58
3.4	Sundry Information About Soysapura Trickling Filter	59

**Chapter 4**

4.0	Results	61
4.1	Relationship Between BOD and COD in the Influent to the Trickling Filter	61
4.2	Treatment Efficiency	61
4.3	Relationship between Organic Loading and Removal Efficiency	63
4.4	Pattern of Organic Loading	64

**Chapter 5**

5.0	Discussion, Conclusions and Recommendations	68
5.1	Discussion	69

	<u>Page No.</u>
5.2 Organic Loading and Removal Efficiency	69
5.3 Present Performance	76
5.4 Conclusions	78
5.5 Recommendations	80
5.6 Recommendation for Further Work	81
List of References	82
Appendix A Tabulation of Results	86
Appendix B Photographs	100



University of Moratuwa, Sri Lanka.  
Electronic Theses & Dissertations  
[www.lib.mrt.ac.lk](http://www.lib.mrt.ac.lk)

## LIST OF FIGURES

		<u>Page No.</u>
<b>Chapter 2</b>		
Figure 2.1	Microbial Slime Layer	12
Figure 2.2	Biological Filter	15
Figure 2.3	Diagram of Aerobic and Anaerobic Sublayer for a Trickling Filter	24
Figure 2.4	Under Drain Blocks in Trickling Filter	33
Figure 2.5	Typical Cross-Section of a Trickling Filter	35
Figure 2.6	Reaction Type Jet Nozzle	37
Figure 2.7	Recirculation Patterns	48
<b>Chapter 3</b>		
Figure 3.1	Layout Plan of De Soysapura Sewage Treatment Plant	55
Figure 3.2	Details of Trickling Filter	56
<b>Chapter 4</b>		
Figure 4.1	Relationship between BOD and COD for Trickling Filter	62
Figure 4.2	Relationship between Organic Loading & Removal Efficiency of Trickling Filter	64
Figure 4.3	Diurnal Organic Loading in Trickling Filter	66
Figure 4.4	Diurnal Efficiency Variation in Trickling Filter	67

## Tables

		<u>Page No.</u>
Chapter 2		
Table 2.1	Typical Information for Trickling Filter	45
Table 2.2	Information on Physical Properties of Trickling Filter Media	46
Appendix A		
Table 1	Results	86
1.1	Sample 1	87
1.2	Sample 2	88
1.3	Sample 3	89
1.4	Sample 4	90
Table 2	Average Results	91
Table 3	BOD and COD Loading in Trickling Filter	92
Table 4	Ratio of COD/BOD <sub>5</sub> on Average Results	93
Table 5	Treatment Efficiency on Average Results	94
Table 6	Efficiency on Individual Results	95
Table 7	Variation of BOD removal efficiency with loading rate in trickling filter	97
Table 8	Hourly variation of organic loading in trickling filter	98
Table 9	Efficiency variation in trickling filter removal	99

## Notations

BOD	Bio Chemical Oxygen Demand	(mg/l)
cm	Centimetre	
COD	Chemical Oxygen Demand	(mg/l)
Cu.m	Cubic Metre	(m <sup>3</sup> )
d	Day	
hrs.	Hours	
Kg	Kilogramme	
l	Litre	
min	minute	
m	Metre	
Q	Volumetric Flow Rate	(m <sup>3</sup> /d)
rev	Revolution	
rpm	Revolution Per Minute	
Sa	Specific Surface Area per unit volume	(m <sup>2</sup> /m <sup>3</sup> )
Sec	Second	
SS	Suspended Solid	(mg/l)
T	Temperature	(°C)
V	Volume	(m <sup>3</sup> )
W <sub>z</sub>	Surface Area of Filter Medium	(m <sup>2</sup> )