ELIA NABIL / Wastewater Treatment by Using Cascade Technology

By ELIA NABIL SHOKRY GAD ALLAH

WORD COUNT 14401

TIME SUBMITTED 24-JAN-2018 10:44AM

PAPER ID 34595188

Wastewater Treatment by Using Cascade Technology for Nitrogen Removal

A Thesis
Submitted to the Faculty of Engineering
Ain Shames University for the Partial Fulfillment
of the Requirements of the Degree of Master of Science
in Civil Engineering

Prepared by
ENG. ELIA NABIL SHOKRY GAD ALLAH
B.Sc. in Civil Engineering, 2012
Higher Institute of Engineering – El Shorouk Academy

Supervisors

Prof. Dr. FIKRY HALIM GHABRIAL
Professor, Sanitary Engineering,
Ain Shams University, Cairo, EGYPT

Ass. Prof. Dr. MAHMOUD ROUSHDI ABDEL GHANY
Associate Professor, Environmental Engineering,
National Water Research Centre, Qalubia, EGYPT

MOHAMED EL BORAIE Dr. MOHAMED
Researcher, Central Laboratories for Environmental Monitoring,
National Water Research Centre, Qalubia, EGYPT

2018

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THESIS APPROVAL

EXAMINERS COMMITTEE	SIGNATURE
Prof. Dr. Khaled Abd El-Fattah Kheireldin Professor, Water Resources Engineering, National Water Research Centre.	----------
Prof. Dr. Mohmed Hassan Abd El-Raziek Professor, Sanitary Engineering, Faculty of Engineering, Ain Shams University.	----------
Prof. Dr. FIKRY HALIM GhABRIAL Professor, Sanitary Engineering, Faculty of Engineering, Ain Shams University.	----------

ACKNOWLEDGMENTS

All gratitude to almighty God, the most merciful, the most compassionate.

I would like to pleasure in expressing my deep gratitude to my employer, the Environment and Climate Changes Research Institute Egypt (ECRI),

I would like to thank all those who have helped me during my study. My sincere thanks are to my supervisor **Prof. Dr. Fikry Halim Ghabrial**, Professor, Sanitary Engineering, Ain Shams University, for his great help, encouragement throughout this work, valuable comments and sound guidance.

I would like to acknowledge **Ass. Prof. Dr. Mahmoud Rousdi Abd Elghany** Associated Professor, Environmental Engineering, National Water Research Centre, for his helpful directions and honest assistance, encouragement and advice.

I am grateful to **Dr. Mohamed Mohamed El Boraie**, Researcher, Central Laboratories for Environmental Monitoring, National Water Research Egypt for providing valuable advice.

I avail of this opportunity to express my gratitude to all the staff members of Environment and Climate Changes Research institute, especially **Prof. Dr. Khaled Khaireldin** the director of the institute for their kind helping in the supplying the data necessary as well as the facilities offered for conducting this work. I'm deeply grateful to

In the end, I offer all the meanings of love, thanks and appreciation to my family (**my father**, **mother**, **wife and daughter**) .

ABSTRACT

Wastewater treatment plants typically remove nutrients (nitrogen and phosphorus) from wastewater because of environmental, public health, or economical concerns. Nutrients stimulate the growth of algae in surface water. Ammonia can be toxic to certain species of fish. The main goal of this research was to obtain the optimum influent distribution flow in achieving nitrogen removal. A pilot-plant activated sludge system was constructed, consisting of two step cascade for removal of carbon and nitrogen. Each step consists of anoxic and oxic zone. The volumes ratio between anoxic and oxic compartments could be controlled by internal moving partitions. Synthetic wastewater having the same properties of municipal wastewater was used in all experiments. The influent total flow rate was fed to the pilot plant at distribution percentages of 50/50%, 75/25% and 87.5/12.5% to the 1st and 2nd anoxic zones, respectively. The results for the entire experimental period showed high removal efficiencies of organic matter of 96% as total chemical oxygen demand, 97% as biochemical oxygen demand, and 93% removal of total Kjeldahl nitrogen. The highest removal efficiency and the optimum performance were recorded at volume of anoxic zone equals 35% of oxic zone volume and at distribution percentages of 75/25%. Consequently, the plant configuration enhanced removal efficiency, optimized performance, saved energy, formed good settling sludge and provided operational conditions that could be implemented in existing plants to enhance nitrogen removal.

Key Words: Nitrogen removal, municipal wastewater, treatment, two step cascade, aerobic, anoxic.

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CHAPTER I

INTRODUCTION

1.1 GENERAL

Wastewater engineering ultimate goal is the protection of public health in a manner corresponding to social, economic and environmental concerns. To save the environment and protect public health, the citizens must have the awareness of wastewater impacts on individuals when wastewater is discharged into the environment. Technologies of wastewater treatment are that can be used to remove wastewater pollutants such as organic matters, heavy metals, nutrients, pathogens …..etc. In addition to make the final production of treatment process safe to disposal or benefit to reuse.

A large amount of nutrients are found in municipal wastewater, which comes from several human activities. Nutrients mainly nitrogen (N) and phosphorous (P) are essential for growth of many plants and other organisms. N may found in several forms in the wastewater and in the environment may be exist in both organic and inorganic forms.

In recent times, chemical methods for nitrogen removal from wastewater were limited in use compared with the use of biological treatment methods. Because of that biological treatment methods are more effective and more economical. The main goal of treatment is to reduce the

nutrients concentration in the effluent wastewater at low cost. Cascade Technology with step feeding is considered one of the most effective and economic system which are used for nutrient removal. In this study an experimental work is carried out to study the effect of some parameters on cascade technology.

1.2 PROBLEM IDENTIFICATION

Nowadays, many governorates of Egypt are rapidly growing like Cairo, Alexandria. These governorates suffer from various problems regarding the availability of potable water for the human usage. So we need to reduce the amount of potable water used in irrigation and substitutes it with well treated wastewater. But we must apply economical and effective wastewater treatment techniques, biological treatment met these conditions global trend these days is to develop biological treatment methods.

1.3 RESEARCH OBJECTIVES.

The major goal of this research is to study the application of "wastewater treatment by using cascade technology for nitrogen removal" and finding the optimum operation conditions to obtain the best carbon and nitrogen removal.

1.4 SCOPE OF WORK

The scope of work will be divided into experimental and analytical works. The experimental work plan is implemented on a pilot plant

especially designed and established for this purpose. The experimental program was geared to carry out the following investigations:

- The treatment potential of synthetic wastewater using two stage cascade, which consist of a series of (anoxic) and nitrification (oxic) reactors followed by a sedimentation tank.
- The concentration of nitrogen through the different treatment stages.
- The effect of anoxic/oxic volume ratio on removal efficiency.
- The effect of changing the influent flow rate ratio between the first and the second stages.

To examine the nitrogen removal within the two stage cascade technology, samples were collected from each stage and from the outlet of the sedimentation tanks.

The Analytical work plan includes:

- Reviewing literature of all previous researches and studies related to biological nitrogen and phosphorus removal technologies.
- Developing an appropriate design of the pilot plant taking into consideration the possibility of applying alternative schemes and operational setups.
- Analysis and discussion of collected data and experimental results of the pilot plant in fulfillment of the above mentioned investigations including performance assessment and analysis.

- Developing a set of conclusions and recommendations for the optimum configuration and operational conditions for nitrogen removal using the cascade technology.
- Thesis write up

1.5 THESIS CONTENTS

Thesis contains of 6 chapters as follows:

CHAPTER 1: INTRODUCTION

There is a general overview of the objective of the current research and the scope of work in this chapter.

CHAPTER 2: LITERATURE REVIEW

In this chapter, general layout about biological treatment, theory, mechanism, different types of it and the previous studies in biological nitrogen and phosphorus removal technologies.

CHAPTER 3: MATERIALS AND METHODS

This chapter includes the design and description of the pilot plant, the comprehensive description of each experimental investigation is also addressed in this chapter. Startup, sampling schedule and testing procedures are also discussed.

CHAPTER 4: RESULTS AND DISCUSSION OF PHASE 1.

This chapter includes the experimental results obtained during the operation of the two stage cascade technology at phase 1 in addition to