

# **EFFECT OF DESIGN PARAMETERS MODIFICATION ON CAPACITY AND PERFORMANCE OF EXISTING WASTEWATER TREATMENT PLANTS**

**By**

**Sobhy Sayed Abed El-Kader**

B.Sc. Mechanical Engineering - Faculty of Engineering, Helwan  
University, 1976

Master in Environmental Science, Environmental Engineering Dep.,  
Institute of Environmental Studies & Research,  
Ain Shams University, 2001

A Thesis Submitted in Partial Fulfillment

Of

The Requirement for the Doctor of Philosophy Degree

In

Environmental Science

Department of Environmental Engineering Science

**Under The Supervision of:**

**1- Prof. Dr. Mohamed Shabaan Negm**

Prof. of Sanitary & Environmental  
Faculty of Engineering  
Ain Shams University

**2- Prof. Dr. Fikry Halim Ghobrial**

Prof. of Sanitary & Environmental  
Faculty of Engineering  
Ain Shams University

**3- Prof. Dr. Mohamed Hamdy Mohamed El-Awady**

Prof. of water Pollution Control, Water Pollution Research  
& Control Department  
National Research Center

**2012**



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رسالة مقدمة من الطالب  
**صبحى سيد عبد القادر محمود**  
بكالوريوس الهندسة الميكانيكية - كلية الهندسة - جامعة حلوان 1976  
ماجستير فى العلوم البيئية - قسم الهندسة البيئية - معهد الدراسات و البحوث البيئية - جامعة عين  
شمس 2001

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فى علوم البيئة  
قسم العلوم الهندسية البيئية

تحت إشراف

1- ا.د/ محمد شعبان نجم

أستاذ الهندسة الصحية والبيئية - كلية الهندسة  
جامعة عين شمس

2- ا.د/ فكرى حليم فبريال

أستاذ الهندسة الصحية والبيئية المتفرغ - كلية الهندسة  
جامعة عين شمس

3- ا.د/ محمد حمدي محمد العوضى

أستاذ تكنولوجيا معالجة المخلفات السائلة وحماية البيئة  
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## المستخلص

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Sobhy Abdel-Kader

Cairo, 2012

# ABSTRACT

Problems of providing qualitative wastewater services have been aggravated in most developing countries due to the lack of investment and necessary funds for collection, transportation, and treatment of wastewater safely and appropriately.

According to statistics conducted in this regard, the rate of water coverage has reached more than 95% in rural as well as urban areas, while the rate of wastewater coverage hasn't even reached 35% in urban and less 4% in rural areas "EWRA".

The increasing hydraulic and organic loads in most of the existing treatment plants, the increasing rates of potable water consumption, and the contradiction between the wastewater reaching the treatment plants and the standards based on which the plants were built restrain the plants from achieving the required treatment goals.

The most important reasons are the high costs required for constructing new wastewater treatment plants e.g.(land, construction, networks, missions, electromechanical equipment as well as operation and maintenance). A new trend is now emerging to make more benefits of the current treatment plants with the aim to increase their design capacities without causing violation of the standards and criteria of treated wastewater according to the

Egyptian Ministerial decrees and executive regulations in this regard.

Therefore, this thesis attempted to study the effect of design parameters modification on capacity and performance of an existing wastewater treatment plant through changing its retention time and the percentage of the return activated sludge in order to achieve the optimum retention, and % RAS that achieve the maximum removal efficiencies of TSS, BOD<sub>5</sub>, & COD, respectively.

A pilot plant scale was set up next to the primary sedimentation tank of El Berka WWTP, North Cairo, Egypt. The used pilot plant was subjected to variable flow rates that ranged from 0.46 to 2.3 l/min. The plant consists of aeration tank, final settling tank, compressed air supply system, pressured line for return sludge, and a mean of removing excess sludge.

The first phase of the experimental program was to keep all the design parameters of the plant, but apply variable retention times to the reactor (2hr, 4hr, 6hr, 8hr, and 10hrs). The impact on the reactor's efficiency was recorded and evaluated. The optimal retention time for the reactor which achieved the highest removal efficiency of BOD<sub>5</sub>, COD, and TSS was 6hr, which is the same retention for El-Berka WWTP.

The second phase was to apply the optimal retention time and to keep constant the rest of the parameters, with a variable percentage of return activated sludge “RAS” (20%, 45%, 75%, 100%, and 150%). The reactor highest removal efficiency under the selected scenario was noticed to be at RAS 45%, which accidentally happened to be the same RAS% in the El-Berka Plant.

Experimental results showed that there is a potential in increasing the treatment capacity of El-Berka plant to cope with the excessive flows received by the plant through reducing the retention time in the aeration tank. Full scale operation trials should be accordingly carried out in El-Berka WWTP to determine the optimal retention time under real/actual conditions of aeration and operation of the plant.

In the following Chapters of this thesis represent the following:- Chapter one represents the introduction and objectives, Chapter two presents a review of literature for the methods of wastewater treatment, activated sludge process description, and design parameters. Chapter three discuss the experimental work such as the sources of sewage samples, model description and operation, biological analysis methods used in this thesis. Chapter four presents and explains the results and discussion of the experimental work. Chapter five contains the summary of results and conclusions as well as economical and environmental considerations.

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