



A combined bio-system to improve effluent water quality from sewage wastewater plants for agricultural reuse

Samir I. Gadow¹ · Mohamed A. El-Shawadfy² · Fatma H. Abd El-Zaher¹

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Abstract

A continuous lab-scale integrated bio-system was conducted to treat sewage wastewater from Abu-Rawash wastewater treatment plant (WWTP). The bio-system showed high efficiency in removing chemical oxygen demand (COD), biological oxygen demand (BOD₅), and total suspended solids (TSS). The experimental analysis results indicated that the maximum COD removal and methane yields were 97.6 and 13.74 mmol CH₄/Kg COD at a hydraulic retention time (HRT) of 6 h, respectively. Zn, Mn, and Fe were removed at a high rate of up to 96.6%. The sponge bio-carriers have improved overall treatment performance and substantially improved mixed liquor volatile suspended solids/ mixed liquor suspended solids (MLVSS/MLSS) ratio at an appreciated range, and the total pathogenic organisms were removed up to 99.8% in the second stage. Because the innovative bio-system enables a rapid startup process, is simple to use, and is inexpensive, it can provide an economically feasible alternative for wastewater management and could be extended to full-scale applications for agricultural purposes.

Keywords Sewage wastewater · Bioenergy recovery · UASB · Aerobic treatment · HRT

Highlights

- At HRT 6 h, the highest COD removal and CH₄ yields were 97.6 and 13.74 mmol CH₄/Kg COD, respectively.
- An acceptable level of MLVSS/MLSS ratio was achieved with the sponge bio-carrier.
- The second step resulted in the elimination of up to 99.8% of total pathogenic organisms.
- With the combined bio-system, wastewater treatment will be decentralized and more efficient.

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1 Introduction

Egypt generates almost 3.5 billion cubic meters of wastewater per year, whereas the existing processing capacity is approximately 1.6 billion m³ per year. By 2017, an extra 1.7 billion m³ of treatment capacity is targeted [1]. The Abu-Rawash WWTP is the largest on the West Bank of the Nile River, serving 8 million people. The daily flow of sludge at Abu-Rawash WWTP reached the total constructed capacity of 2 million m³ per day. As a result, it is necessary to improve the performance in order to cope with the increased wastewater flows caused by population growth and wastewater services, as well as to increase its capacity. Although the capacity building of wastewater treatment plant operators is significant, it will not suffice to cope with the foreseeable rise in municipal wastewater generation. Therefore, untreated charges reaching water bodies will not reduce in years to come. Over 2 million m³/year are generated alone, mainly from Cairo and Alexandria, Egypt's two biggest cities. In the municipalities, treatment plants serve 55% of the population [2]. The selection and design of wastewater processing plants are heavily dependent on the costs of processes, including investment in capital, operation and maintenance (O&M), land needs, management and

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Proceedings of the Water Reuse Symposium, March 25-30, 1979, Washington, D.C. ,1979

Wastewater Recycling,

Reuse, and Reclamation - Vol. I Saravanamuthu Vigneswaran,2009-11-30 Total supply of fresh water on earth far exceeds human demand However scarcity of water currently faced in many regions of the world is caused by two reasons First its availability in time and space is not equally distributed Thus there is problem of water in the wrong place or at the wrong time and in wrong quantities Second while the population growth and expanded industrial activities are increasing demands on available water resources they also jeopardize the availability of freshwater in adequate quantities by discharge of pollutants into freshwater sources It is at times like these when the rising curve of water demand intersects the fluctuating curve of water availability recycle and reuse of wastewater is seriously considered Wastewater recycling reuse and reclamation have been now accepted as appropriate ways to conserve water resources as well as to contain polluted waters from contaminating other available clean water sources This book gives a comprehensive review on water quantity and quality simple water supply and sanitation systems and leads to domestic agricultural and industrial water reuse Thus it will provide useful information not only to technologists but also for planners managers and NGOs involved in the water sector The contribution to the book comes from a broad pool of experts working on technology policy health and economy aspects of water management Involvement of both academics and industry personnel from developing and developed countries makes this contribution broader and useable for a wide readership

Handbook of Wastewater Reclamation and Reuse

Donald R. Rowe,Isam Mohammed Abdel-Magid,2020-07-09 This comprehensive reference provides thorough coverage of water and wastewater reclamation and reuse It begins with an introductory chapter covering the fundamentals basic principles and concepts Next drinking water and treated wastewater criteria guidelines and standards for the United States Europe and the World Health Organization WHO are presented Chapter 3 provides the physical chemical biological and bacteriological characteristics as well as the radioactive and rheological properties of water and wastewater The next chapter discusses the health aspects and removal treatment processes of microbial chemical and radiological constituents found in reclaimed wastewater Chapter 5 discusses the various wastewater treatment processes and sludge treatment and disposal Risk assessment is covered in chapter 6 The next three chapters cover the economics monitoring sampling and analysis and legal aspects of wastewater reclamation and reuse This practical handbook also presents real world case studies as well as sources of information for research potential sources for research funds and information on current research projects Each chapter includes an introduction end of chapter problems and references making this comprehensive text reference useful to both students and professionals

Wastewater Treatment and Reuse by Land Application

Charles E. Pound,Ronald W. Crites,1973

Treatment and Use of Sewage Effluent for Irrigation

M. B. Pescod,A. Arar,2013-10-22 Treatment and Use of Sewage Effluent for Irrigation contains the Proceedings of the FAO Regional Seminar

on the treatment and use of sewage effluent for irrigation held in Nicosia Cyprus on October 1985 The book reviews available information and experience on the treatment and reuse of sewage effluent for increased agricultural production Papers are presented by international experts on health and agricultural guidelines for effluent quality and on the short term and long term effects of effluent reuse on public health soil fertility and crop productivity Appropriate sewage treatment systems are considered and sewage sludge treatment and agricultural utilization are discussed Case studies of sewage effluent treatment and reuse in irrigation in the Near East Region and elsewhere are presented as well Agriculturists horticulturists and civil engineers will find the compendium interesting *Manual, Guidelines for Water Reuse* United States. Environmental Protection Agency,1992 **Reuse of Sewage Effluent** ,1985 **EPA-600/8** ,1980-08 **Recent Research Reports** ,1984 *Artificial Recharge of Groundwater* Takashi Asano,2016-01-22 Artificial Recharge of Groundwater focuses on artificial recharge of groundwater basins as a means to increase the natural supply of groundwater along with the technical issues involved Special emphasis is placed on the use of reclaimed municipal wastewater as a source for artificial recharge of groundwater This book is comprised of 26 chapters organized into five sections After reviewing the state of the art of artificial recharge of groundwater the discussion turns to the fundamental aspects of groundwater recharge including the role of artificial recharge in groundwater basin management recharge methods hydraulics monitoring and modeling The next section considers pretreatment processes for wastewater and renovation of wastewater with rapid infiltration land treatment systems and describes the health effects of wastewater reuse in groundwater recharge A number of artificial recharge operations using reclaimed wastewater are then highlighted focusing on cases in various countries including Israel Germany Poland Japan the Netherlands and the United States The remaining chapters look at the extent of contaminant removal by the soil system and the fate of micropollutants during groundwater recharge as well as the legal and economic aspects of groundwater recharge Research needs for groundwater quality management are also explored This monograph is written for civil and sanitary engineers agricultural engineers hydrologists environmental scientists and research scientists as well as public works officials consulting engineers agriculturalists industrialists and students at colleges and universities

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