



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

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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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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 Proceedings of the Water Reuse Symposium, March 25-30, 1979, Washington, D.C., 1979 **Manual, Guidelines for Water Reuse** United States. Environmental Protection Agency, 1992 **EPA-600/8**, 1980-08 Recent Research Reports, 1984 **Selected Water Resources Abstracts**, 1991 Wastewater Irrigation, 1983-March 1988 Karl Schneider, 1988 **Indexes** United States. Environmental Protection Agency, 1983 Guidelines for Water Reuse, 2004 *Process Design Manual for Land Treatment of Municipal Wastewater*, 1977 **Wastewater Irrigation, 1979-86** Karl Schneider, 1986 *Reuse of Sewage Effluent*, 1985 **Research Reporting Series**, 1980 **EPA-600/2**, 1980

Decentralized Water Reclamation Engineering Robert L. Siegrist, 2016-10-26 This book presents technical information and materials concerning the engineering of decentralized infrastructure to achieve effective wastewater treatment while also minimizing resource consumption and providing a source of reclaimed water nutrients and organic matter The approaches technologies and systems described are targeted for green building and sustainable infrastructure across the United States and similar industrialized nations but they are also applicable to water and sanitation projects in developing regions around the world Today decentralized infrastructure can be used to sustainably serve houses buildings and developments with water use and wastewater flows of 100 to 100 000 gal d or more The book provides in depth engineering coverage of the subject in a narrative and slide format specifically designed for classroom lectures or facilitated self study Key topics are covered including engineering to satisfy project goals and requirements including sustainability contemporary water use and wastewater generation and methods to achieve water use efficiency and source separation alternative methods of wastewater collection and conveyance and treatment and reuse operations including tank based e g septic tanks aerobic treatment units porous media biofilters membrane bioreactors wetland based e g free water surface and vegetated subsurface bed wetlands and land based unit operations e g subsurface soil infiltration shallow drip dispersal Approaches and technologies are also presented that can achieve nutrient reduction and resource recovery in some cases or pathogen destruction to enable a particular discharge or reuse plan The book also describes requirements and methods for

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Guidelines for Water Reuse DIANE Publishing Company,1996 Presents guidelines for utilities and regulatory agencies that primarily address water reclamation for nonpotable urban industrial and agricultural reuse Chapters include technical issues in planning water reuse systems types of reuse applications water reuse regulations and guidelines in the U S legal and institutional issues funding alternatives for water reuse systems public information programs and water reuse outside the U S Appendix provides a complete list of state reuse regulations and guidelines Over 80 charts and tables Extensive bibliography

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Industrial Reuse and Recycle of Wastewaters John E. Matthews,1980

Natural Wastewater Treatment Systems Ronald W. Crites,E. Joe Middlebrooks,Robert K. Bastian,2014-03-14 Calling for ecologically and economically sound wastewater treatment systems the authors of Natural Wastewater Treatment Systems explore the use of wetlands sprinkler or deep irrigation groundwater recharge and other natural systems as sustainable methods for the treatment and management of wastewater Based on work by prominent experts in natu

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