



## Reuse of sewage treated effluent in agricultural practices: An alarming presence of *Giardia* spp. cysts

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### ABSTRACT

It was evaluated the removal efficiencies of *Giardia* spp. cysts and helminth eggs by a simplified system of wastewater treatment. The treated effluent was destined to be reused in agricultural practices. The system was composed by anaerobic filter and intermittent sand filter. Final effluent concentration was: COD of  $52 \pm 24 \text{ mg L}^{-1}$ , TSS of  $17 \pm 20 \text{ mg L}^{-1}$  and low turbidity values ( $3 \pm 4 \text{ NTU}$ ). The anaerobic filter could remove  $99.7 \pm 28.7\%$  of estimated cysts concentration in the raw sewage. The sand filter removed  $38.0 \pm 31.6\%$  of *Giardia* spp. cysts from the anaerobic effluent, indicating the total efficiency of the system to  $99.0\%$ . The system could also remove  $100\%$  of helminth eggs. However, we also identified  $93 \pm 92$  cysts  $\text{L}^{-1}$  in the final effluent. Thus, there is a necessity to further study these decentralized systems in order to prevent the spread of infectious parasites from in agricultural practices.

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### 1. Introduction

The lack of wastewater treatment is an environmental and public health problem. Among the pathogenic agents that cause waterborne diseases, protozoa and helminths are more prominent (Quintero-Betancourt et al., 2003; Macpherson, 2005). These parasites have great resistance to adverse environmental conditions and the ingestion of small numbers of cysts and eggs is enough to cause infection. These characteristics enable them to be responsible for most of the parasitic diseases that affect humans and animals worldwide, especially in rural areas (Kondrachine, 1954; Avall et al., 2000).

*Giardia duodenalis* is the most isolated parasite in the human gastrointestinal system. Approximately 20% of world population is parasitized by this protozoan (Nasser et al., 2012). The amount of people parasitized by helminths is also high. It is estimated that 1.2 billion people worldwide are infected by *Ascaris lumbricoides*, 800 million by *Ancylostoma duodenale* and *Necator americanus*, and 700 million by *Trichuris trichiura* (Sengupta et al., 2011).

A significantly higher morbidity and mortality are observed in developing countries, particularly among children, where many communities still lack access to improved sanitation facilities

(Harhay et al., 2010; David et al., 2015). Acquisition of giardiasis occurs through a faecal-oral route, which can be person-to-person, foodborne, or through contaminated water (drinking water or during recreational activities), with the last being the most significant means of transmission of this infection (Ali and HBI, 2000; Hansen et al., 2012; Santos et al., 2013).

The prevalence of diseases caused by these parasites is even greater in developing countries and in rural areas, where there are substandard conditions of basic sanitation services. Thus, proper treatment of wastewater is part of the solution to this problem. However, the population of these countries has little technical knowledge and low financial resources (Parashar et al., 2002), which hinders the installation of sophisticated and expensive wastewater treatment systems.

Due to limited availability of resources in these regions, the technologies to be employed should be appropriate to the economy of these countries. They should be inexpensive and adaptable to structural and economic conditions of small towns and economically disadvantaged areas.

In response to this sanitary condition, the Brazilian government launched the Basic Sanitation Research Program (PROSANB). One of its primary objectives was the development of research for rural areas sanitation. Anaerobic filters filled with bamboo rings (Camargo and Nowe, 2000), coconut shells of *Cocos nucifera* (De Oliveira-Cruz et al., 2013; Tonon et al., 2015) or ceramic bricks (Chernicharo, 2006) were among the researched reactors. Their

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# Reuse Of Sewage Effluent Proceedings Of A Symposium

**Michael Rajnik**



## **Reuse Of Sewage Effluent Proceedings Of A Symposium:**

*Proceedings of the Water Reuse Symposium II*, 1981      **Proceedings of the Water Reuse Symposium, March 25-30, 1979, Washington, D.C.**, 1979      **Industrial Reuse and Recycle of Wastewaters** John E. Matthews, 1980      *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

*Guidelines for Water Reuse*, 2004      EPA-600/2, 1980      *Wastewater Irrigation, 1979-86* Karl Schneider, 1986      *Reuse of Sewage Effluent*, 1985      EPA-600/8, 1980-08      *Selected Water Resources Abstracts*, 1991

*Process Design Manual for Land Treatment of Municipal Wastewater*, 1977      *Wastewater Irrigation, 1983-March 1988* Karl Schneider, 1988      **Wastewater Irrigation** Karl Schneider, 1990      **Water Reuse** Water Resources Scientific Information Center, 1973      **African Economic Development, 1979-January 1988** Mary E. Lassanyi, 1988      **Manual, Guidelines for Water Reuse** United States. Environmental Protection Agency, 1992      *Guidance Manual for Sewerless Sanitary Devices and Recycling Methods*, 1983      *Bibliographies and Literature of Agriculture*, 1978      Indexes United States. Environmental Protection Agency, 1983      *Reuse of Sewage Effluent*, 1985

The reuse of sewage effluent in one form or another is common in all parts of the world this volume reviews information on current and projected forms of reuse of sewage effluent as a water resource Topics covered include the potential need for reuse reuse for industry agriculture amenity and recharge fish farming health aspects project appraisal and economics advanced treatment and research and ideas for the future are considered contributions come from many parts of the world including the UK Nigeria Australia South Africa the Netherlands and the USA and from a variety of fields local and central government water authorities consultants polytechnics universities and research establishments

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