



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

Lays Paulino Leonel, Adriano Luiz Tonetti^{a,*}, Jenifer Clarisse Pereira da Silva, Ellen Aparecida Nunes, Francisco Ananias Filho

^a School of Civil Engineering, Architecture and Urban Design – FBC, at UFOPAMP (University of Campinas), Avenida Albert Einstein, 962, Cidade Universitária “Zapopan 100”, P.O. Box 6071, 13063-852 Campinas, SP, Brazil



ARTICLE INFO

Article history:

Received 23 March 2016

Received in revised form 24 May 2016

Accepted 28 June 2016

Available online 5 August 2016

Keywords:

Small communities

Anaerobic treatment

Reuse

Health parasitology

Sand filter

Anaerobic filter

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 ± 92 cysts 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.

© 2016 Elsevier B.V. All rights reserved.

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 (Kierszenbaum, 1994; 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-Cruzeiro et al., 2013; Tonon et al., 2015) or ceramic bricks (Chernicharo, 2006) were among the researched reactors. Their

* Corresponding author.

E-mail address: attonetti@fbc.unicamp.br (A.L. Tonetti).

Reuse Of Sewage Effluent Proceedings Of A Symposium

Sheldon Cheney



Reuse Of Sewage Effluent Proceedings Of A Symposium:

Fuel your quest for knowledge with Authored by is thought-provoking masterpiece, Dive into the World of **Reuse Of Sewage Effluent Proceedings Of A Symposium** . This educational ebook, conveniently sized in PDF (*), is a gateway to personal growth and intellectual stimulation. Immerse yourself in the enriching content curated to cater to every eager mind. Download now and embark on a learning journey that promises to expand your horizons. .

https://pinsupreme.com/files/uploaded-files/Documents/selected_poems_of_andrei_voznesensky.pdf

Table of Contents Reuse Of Sewage Effluent Proceedings Of A Symposium

1. Understanding the eBook Reuse Of Sewage Effluent Proceedings Of A Symposium
 - The Rise of Digital Reading Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Advantages of eBooks Over Traditional Books
2. Identifying Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Reuse Of Sewage Effluent Proceedings Of A Symposium
 - User-Friendly Interface
4. Exploring eBook Recommendations from Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Personalized Recommendations
 - Reuse Of Sewage Effluent Proceedings Of A Symposium User Reviews and Ratings
 - Reuse Of Sewage Effluent Proceedings Of A Symposium and Bestseller Lists
5. Accessing Reuse Of Sewage Effluent Proceedings Of A Symposium Free and Paid eBooks
 - Reuse Of Sewage Effluent Proceedings Of A Symposium Public Domain eBooks
 - Reuse Of Sewage Effluent Proceedings Of A Symposium eBook Subscription Services
 - Reuse Of Sewage Effluent Proceedings Of A Symposium Budget-Friendly Options

6. Navigating Reuse Of Sewage Effluent Proceedings Of A Symposium eBook Formats
 - ePub, PDF, MOBI, and More
 - Reuse Of Sewage Effluent Proceedings Of A Symposium Compatibility with Devices
 - Reuse Of Sewage Effluent Proceedings Of A Symposium Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Highlighting and Note-Taking Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Interactive Elements Reuse Of Sewage Effluent Proceedings Of A Symposium
8. Staying Engaged with Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Reuse Of Sewage Effluent Proceedings Of A Symposium
9. Balancing eBooks and Physical Books Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Reuse Of Sewage Effluent Proceedings Of A Symposium
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Setting Reading Goals Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Fact-Checking eBook Content of Reuse Of Sewage Effluent Proceedings Of A Symposium
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning
 - Utilizing eBooks for Skill Development
 - Exploring Educational eBooks
14. Embracing eBook Trends
 - Integration of Multimedia Elements

- Interactive and Gamified eBooks

Reuse Of Sewage Effluent Proceedings Of A Symposium Introduction

Reuse Of Sewage Effluent Proceedings Of A Symposium Offers over 60,000 free eBooks, including many classics that are in the public domain. Open Library: Provides access to over 1 million free eBooks, including classic literature and contemporary works. Reuse Of Sewage Effluent Proceedings Of A Symposium Offers a vast collection of books, some of which are available for free as PDF downloads, particularly older books in the public domain. Reuse Of Sewage Effluent Proceedings Of A Symposium : This website hosts a vast collection of scientific articles, books, and textbooks. While it operates in a legal gray area due to copyright issues, its a popular resource for finding various publications. Internet Archive for Reuse Of Sewage Effluent Proceedings Of A Symposium : Has an extensive collection of digital content, including books, articles, videos, and more. It has a massive library of free downloadable books. Free-eBooks Reuse Of Sewage Effluent Proceedings Of A Symposium Offers a diverse range of free eBooks across various genres. Reuse Of Sewage Effluent Proceedings Of A Symposium Focuses mainly on educational books, textbooks, and business books. It offers free PDF downloads for educational purposes. Reuse Of Sewage Effluent Proceedings Of A Symposium Provides a large selection of free eBooks in different genres, which are available for download in various formats, including PDF. Finding specific Reuse Of Sewage Effluent Proceedings Of A Symposium, especially related to Reuse Of Sewage Effluent Proceedings Of A Symposium, might be challenging as theyre often artistic creations rather than practical blueprints. However, you can explore the following steps to search for or create your own Online Searches: Look for websites, forums, or blogs dedicated to Reuse Of Sewage Effluent Proceedings Of A Symposium, Sometimes enthusiasts share their designs or concepts in PDF format. Books and Magazines Some Reuse Of Sewage Effluent Proceedings Of A Symposium books or magazines might include. Look for these in online stores or libraries. Remember that while Reuse Of Sewage Effluent Proceedings Of A Symposium, sharing copyrighted material without permission is not legal. Always ensure youre either creating your own or obtaining them from legitimate sources that allow sharing and downloading. Library Check if your local library offers eBook lending services. Many libraries have digital catalogs where you can borrow Reuse Of Sewage Effluent Proceedings Of A Symposium eBooks for free, including popular titles. Online Retailers: Websites like Amazon, Google Books, or Apple Books often sell eBooks. Sometimes, authors or publishers offer promotions or free periods for certain books. Authors Website Occasionally, authors provide excerpts or short stories for free on their websites. While this might not be the Reuse Of Sewage Effluent Proceedings Of A Symposium full book , it can give you a taste of the authors writing style. Subscription Services Platforms like Kindle Unlimited or Scribd offer subscription-based access to a wide range of Reuse Of Sewage Effluent Proceedings Of A Symposium eBooks, including some popular titles.

FAQs About Reuse Of Sewage Effluent Proceedings Of A Symposium Books

1. Where can I buy Reuse Of Sewage Effluent Proceedings Of A Symposium books? Bookstores: Physical bookstores like Barnes & Noble, Waterstones, and independent local stores. Online Retailers: Amazon, Book Depository, and various online bookstores offer a wide range of books in physical and digital formats.
2. What are the different book formats available? Hardcover: Sturdy and durable, usually more expensive. Paperback: Cheaper, lighter, and more portable than hardcovers. E-books: Digital books available for e-readers like Kindle or software like Apple Books, Kindle, and Google Play Books.
3. How do I choose a Reuse Of Sewage Effluent Proceedings Of A Symposium book to read? Genres: Consider the genre you enjoy (fiction, non-fiction, mystery, sci-fi, etc.). Recommendations: Ask friends, join book clubs, or explore online reviews and recommendations. Author: If you like a particular author, you might enjoy more of their work.
4. How do I take care of Reuse Of Sewage Effluent Proceedings Of A Symposium books? Storage: Keep them away from direct sunlight and in a dry environment. Handling: Avoid folding pages, use bookmarks, and handle them with clean hands. Cleaning: Gently dust the covers and pages occasionally.
5. Can I borrow books without buying them? Public Libraries: Local libraries offer a wide range of books for borrowing. Book Swaps: Community book exchanges or online platforms where people exchange books.
6. How can I track my reading progress or manage my book collection? Book Tracking Apps: Goodreads, LibraryThing, and Book Catalogue are popular apps for tracking your reading progress and managing book collections. Spreadsheets: You can create your own spreadsheet to track books read, ratings, and other details.
7. What are Reuse Of Sewage Effluent Proceedings Of A Symposium audiobooks, and where can I find them? Audiobooks: Audio recordings of books, perfect for listening while commuting or multitasking. Platforms: Audible, LibriVox, and Google Play Books offer a wide selection of audiobooks.
8. How do I support authors or the book industry? Buy Books: Purchase books from authors or independent bookstores. Reviews: Leave reviews on platforms like Goodreads or Amazon. Promotion: Share your favorite books on social media or recommend them to friends.
9. Are there book clubs or reading communities I can join? Local Clubs: Check for local book clubs in libraries or community centers. Online Communities: Platforms like Goodreads have virtual book clubs and discussion groups.
10. Can I read Reuse Of Sewage Effluent Proceedings Of A Symposium books for free? Public Domain Books: Many classic books are available for free as they're in the public domain. Free E-books: Some websites offer free e-books legally, like Project Gutenberg or Open Library.

Find Reuse Of Sewage Effluent Proceedings Of A Symposium :

selected poems of andrei voznesensky

~~selections of traditional chinese painting~~

selected poems of saunders lewis

selected works of elinor wylie

self-determination and history in the third world

selforganization by nonlinear irreversible processes.

selected poems the vision tree

selected poems 1953-1973

selections the scribner library. lyceum editions. philosophy series

selected papers on remote sensing of env

self in social work

~~selected poems and new~~

self change social psychological and clinical perspectives

selection for industrial leadership

~~selected letters of rabindranath tagore~~

Reuse Of Sewage Effluent Proceedings Of A Symposium :

Economics. Michael Parkin 10th Edition Textbook Solutions Textbook solutions for Economics. Michael Parkin 10th Edition Michael Parkin and others in this series. View step-by-step homework solutions for your ... SOLUTION: Economics global edition 10th edition parkin ... Access over 20 million homework & study documents · Economics global edition 10th edition parkin solutions manual · Ongoing Conversations. Economics 10th Edition Textbook Solutions Textbook solutions for Economics 10th Edition Michael Parkin and others in this series. View step-by-step homework solutions for your homework. Macroeconomics Micheal Parkin 10th Edition Solution ... Review Quiz Answers-Chapter 4. 1. Define GDP and distinguish between a final good and an intermediate good. Provide examples. Economics Global Edition 10th Edition Parkin Solutions ... Economics Global Edition 10th Edition Parkin Solutions Manual | PDF | Tangent | Slope. Macroeconomics, Michael Parkin, 10th Edition, Solution- ... PARKIN MACROECONOMICS Solutions to Odd-numbered Problems CHAPTER 1 1. The opportunity cost of the extra 10 points is the... Macroeconomics 10th Edition Textbook Solutions - Chegg Access Macroeconomics 10th Edition solutions now. Our solutions are written by Chegg ... ISBN-13:9780131394452 ISBN:0131394452 Authors: Michael

Parkin Rent | Buy. Macroeconomics, Micheal Parkin, 10th Edition-Solution ... Review Quiz Answers-Chapter 4 1. Define GDP and distinguish between a final good and an intermediate good. Provide examp... Microeconomics With Study Guide 10th Edition Textbook ... Access Microeconomics with Study Guide 10th Edition solutions now. Our solutions are written by Chegg experts so you can be assured of the highest quality! economics Professor Parkin's research on macroeconomics, monetary economics, and international economics has resulted in over 160 publications in journals and edited ... A Practical Guide to Information Architecture ... Brilliant. The book takes the reader through what information architecture (IA) is and the skills you need to do it, how to do user research, how to plan and ... A practical guide to information architecture (2nd edition) This book is a very practical guide to information architecture and navigation design, for website and intranet design and redesign projects. If you're a ... A Practical Guide to Information Architecture —Steph Beath, Information Architect/Interaction Designer. Throughout this book I talk about information architecture primarily in terms of content-heavy ... A Practical Guide to Information Architecture (free ebook ... Donna Spencer's "A Practical Guide to Information Architecture" is freely available as a download right now for a limited time, seems like her ... A Practical Guide to Information Architecture Drawing on her many years experience of practising and teaching Information Architecture, Donna Spencer guides you through some simple steps to better IA and ... A Practical Guide to Information Architecture Drawing on her many years of teaching and practicing Information Architecture, Donna Spencer walks you through some simple steps to create better information ... A Practical Guide to Information Architecture Drawing on her many years experience of practising and teaching Information Architecture, Donna Spencer guides you through some simple steps to better IA and ... A Practical Guide to Information Architecture ... A Practical Guide to Information Architecture (Practical Guide Series) by Spencer, Donna - ISBN 10: 095617406X - ISBN 13: 9780956174062 - Five Simple Steps ... A Practical Guide to Information Architecture, Second Edition Jun 20, 2014 — A Practical Guide to Information Architecture, Second Edition, is an easy-to-read handbook for researching, creating, testing and communicating ... A Practical Guide to Information Architecture ... A Practical Guide to Information Architecture (Practical Guide Series). 263 ratings by Goodreads · Spencer, Donna. Published by Five Simple Steps LLP, 2010. NEBOSH Certificate Revision Guides RRC's essential Revision Guides are a really effective revision tool to help you achieve NEBOSH Exam Success. Key features Include: A concise overview of all ... RRC Revision Guides for NEBOSH Certificate and Diploma Essential NEBOSH Diploma Revision Guides combining concise revision notes with exam-style questions and model answers for a fully effective revision tool:. Health and Safety in Construction Revision Guide This companion to the bestselling Introduction to Health and Safety in Construction is an essential revision aid for students preparing for their written ... International Health and Safety at Work Revision Guide: for ... This companion to the bestselling International Health and Safety at Work is an essential revision aid for students preparing for their written assessments on ... RRC's NEBOSH Health and Safety Management for ... Online; Live Online; Classroom. Textbooks & Revision Guides also available.

Visit our website for more information on this course, as well as course dates and ... RRC International Studying RRC's NEBOSH Certificate in Fire Safety is a great way to expand your existing knowledge and is particularly useful for health and safety professionals ... RRC's NEBOSH Health and Safety ... - SHP Directory The NEBOSH Health and Safety Management for Construction (UK), is an essential qualification for all with safety responsibilities in the construction industry. International Certificate in Construction Health and Safety The NEBOSH Certificate in Construction Health and Safety will help you manage risk and improve safety in the construction industry. Health and Safety at Work Revision Guide ... Fully updated to the latest NEBOSH National General Certificate specifications (April 2015), the revision guide provides complete coverage of the syllabus in ...