

THE UNIVERSITY OF CHICAGO PRESS
50 EAST LEXINGTON AVENUE
NEW YORK, NY 10017-2473
TEL: 212 850 6640
WWW.CHICAGO.PRESS.COM

THE UNIVERSITY OF CHICAGO PRESS

LP
12
FASM
1
2009

**TREATMENT OF AQUACULTURE WASTEWATER EFFLUENTS USING
SLOW FILTRATION**

ENDAH SAMA BINTI MAMA

**Research report submitted in partial fulfillment of the requirements for the
award of the degree of Bachelor of Agrotechnology Science (Aquaculture)**

**Department of Fisheries Science and Aquaculture
FACULTY OF AGROTECHNOLOGY AND FOOD SCIENCE
UNIVERSITI MALAYSIA TERENGGANU**

2009

1100076165

This project report should be cited as:

Endah, S.M. 2009. Treatment of Aquaculture Wastewater Effluents using Slow Filtration. Undergraduate thesis, Bachelor Science in Agrotechnology (Aquaculture), Faculty of Agrotechnology and Food Science, Universiti Malaysia Terengganu, Terengganu. 54p.

No part of project report may be reproduced by any mechanical, photographic, or electronic process, or in the form of photographic recording, nor may it be stored in a retrieval system, transmitted, or otherwise copied for public or private use, without written permission from the author and supervisor (s) of the project.



**FAKULTI AGROTEKNOLOGI DAN SAINS MAKANAN
UNIVERSITI MALAYSIA TERENGGANU**

**PENGAKUAN DAN PENGESAHAN LAPORAN
PROJEK ILMIAH I DAN II**

Adalah ini diakui dan disahkan bahawa laporan ilmiah bertajuk:

Treatment of Aquaculture Wastewater Effluents using Slow Filtration oleh Endah Sama Binti Mama., No.Matrik UK 12931 telah diperiksa dan semua pembedaan yang disarankan telah dilakukan. Laporan ini dikemukakan kepada Jabatan Sains Perikanan dan Akuakultur sebagai memenuhi sebahagian daripada keperluan memperoleh Ijazah Sarjana Muda Sains Agroteknologi (Akuakultur), Fakulti Agroteknologi dan Sains Makanan, Universiti Malaysia Terengganu.

Disahkan oleh:

Penyelia Utama ^{PROF. MADYA IR. AHMAD BIN JUSOH}
Pensyarah
Nama: Jabatan Sains Kejuruteraan
Fakulti Sains dan Teknologi
Cop Rasmi: Universiti Malaysia Terengganu
21030 Kuala Terengganu

Tarikh: 14-05-09

Penyelia Kedua (jika ada)

Nama:

Cop Rasmi

Tarikh:

DECLARATION

I hereby declare that this work of thesis is my own except for quotations and summaries which have been duly acknowledgement.

Signature :

Name : Endah Sama Binti Mama

Matrix No : UK 12931

Date : 19th MAY 2009

ACKNOWLEDGEMENT

Alhamdulillah and thanks for Most Gracious and Most Merciful, Allah S.W.T.

I would like to thank my supervisor, Associate Prof. Ir. Ahmad bin Jusoh for his supervision, courage, advices and guidance that enable this project finished up successfully. Highly appreciation is expressing to my Co-Supervisor, Dr. Hamid Khoda Bakhsh for giving an opportunity to conduct a research under his supervision. I have been given a chance to be exposed, learned and experienced a real research.

Unforgotten, thanks to Dr. Nur Asma bt Ariffin as our Final Year Project Coordinator for her guidance, patient and help in this project. Sincere thanks also for staff at Thermodynamic Laboratory and Anatomy and Physiology Laboratory for provided place and all the instruments needed in this study. Special thank to my family and friend supported and concern.

Finally, my appreciate goes to those who have contributed in this project directly and indirectly. Thank you very much.

ABSTRACT

Aquaculture wastewater effluents may cause many environmental problems to the receiving water. Therefore, wastewater from aquaculture facilities must be effectively manage to remove dissolved wastes and suspended solids that can be pollute receiving bodies of water. Effective technologies and low cost medium filters are needed to treat the effluents from fish farm. The study was conducted to evaluate the effectiveness of slow filtration as treatment option for removing total ammonia nitrogen, nitrite, total suspended solids (TSS), turbidity and biological oxygen demand (BOD5) from aquaculture wastewater effluents. Malaysia has a great potential in palm oil plantation (29.8 million tones are produced annually). Industrial wastes such as burnt oil palm shells can be utilize as a media option to reduce production cost with higher profit for aquaculture wastewater management. In this study, sand and burnt oil palm shells (BOPS) were used as dual media at constant effective size (*i.e.* ES of 0.5 mm for sand and ES of 1.0 mm for BOPS) with same uniformity coefficient of 1.5. BOPS are a solid waste derived from the final processing of local oil palm industry while sand media is a well known effective media for slow filtration. The performance of slow filtration was evaluated using two different flow rates that 0.2 m³/m²/hr and 2.0m³/m²/hr. Greater removal of TAN, nitrite, turbidity and suspended solids was obtained for both flow rates evaluation. However, the slow filters are not effective on reducing the BOD5 from the water inlet since there is no pre-filtered of aquaculture wastewater prior to treatment. The slow filters removed 82.40% and 79.97% of TAN for flow rates of 0.2 m³/m²/hr and 2.0m³/m²/hr, respectively. Outlet nitrite-nitrogen was reduced to 0.139±0.010 mg/L for 0.2m³/m²/hr and 0.185±0.012 mg/L for 2.0m³/m²/hr. The highest percentage of removing suspended solids was recorded on flow rate of 0.2 m³/m²/hr with 90.53% compared to 2.0m³/m²/hr with 86.24%. Turbidity for outlet of both flow rates reduced to 41.65±5.68 NTU and 139.03±22.16 NTU, respectively. Meanwhile, all of water quality measured except BOD5 showed a significantly different between inlet and outlet for both flow rates. Results also indicate that 0.2 m³/m²/hr is more effective for removing the dissolved waste and suspended solids from inlet compared to flow rate of 2.0m³/m²/hr.

ABSTRAK

Air sisa buangan akuakultur akan menyebabkan pelbagai masalah kepada persekitaran air yang menerima air sisa buangan tersebut. Oleh itu, air sisa daripada pusat akuakultur mesti diurus dengan berkesan untuk menyingkirkan sisa terlarut dan pepejal terampai yang boleh mencemarkan persekitaran air tersebut. Teknologi yang efektif dan media penuras yang murah diperlukan untuk merawat sisa buangan dari tapak ternakan ikan. Kajian ini dijalankan untuk mengkaji keberkesanan penuras perlahan sebagai pilihan rawatan dalam menyingkirkan nitrogen ammonia, nitrit, pepejal terampai, kekeruhan air dan keperluan oksigen biokimia daripada air sisa buangan akuakultur. Malaysia memiliki keupayaan yang baik dalam perladangan minyak kelapa sawit (29.8% juta tan dihasilkan setiap tahun). Sisa industri seperti tempurung kelapa sawit boleh digunakan sebaiknya sebagai media dalam mengurangkan kos pengeluaran serta kadar untung yang lumayan terhadap pengurusan sisa air akuakultur. Dalam kajian ini, pasir dan arang tempurung kelapa sawit (BOPS) digunakan sebagai media berganda pada saiz berkesan, ES yang tetap iaitu 0.5 mm bagi pasir dan 1.0 mm bagi BOPS dengan pekali keseragaman yang sama iaitu 1.5. BOPS adalah sisa pepejal yang terhasil daripada pemprosesan akhir industri minyak sawit tempatan manakala pasir adalah salah satu media yang berkesan digunakan dalam penurasan perlahan. Keberkesanan penuras perlahan dikaji menggunakan dua kadar alir yang berbeza iaitu 0.2 m³/m²/jam dan 2.0m³/m²/jam. Penyingkiran nitrogen ammonia, nitrit, kekeruhan air dan pepejal terampai yang baik telah direkodkan bagi kedua-dua kadar alir yang diuji. Walaubagaimanapun, penuras perlahan didapati tidak berkesan dalam mengurangkan kadar keperluan oksigen biokimia kerana tiada proses pra penurasan dilakukan terlebih dahulu sebelum rawatan dijalankan. Penuras perlahan berjaya menyingkirkan nitrogen ammonia sehingga 82.40% untuk kadar alir 0.2 m³/m²/jam dan 79.97% untuk kadar alir 2.0m³/m²/jam. Kepekatan nitrit pula dikurangkan sehingga 0.139±0.010 mg/L untuk kadar alir 0.2 m³/m²/jam dan 0.185±0.012 mg/L untuk kadar alir 2.0m³/m²/jam. Peratus yang tinggi terhadap pengurangan pepejal terampai dicatatkan bagi kadar alir 0.2 m³/m²/jam dengan bacaan 90.53% berbanding dengan kadar alir pada 2.0m³/m²/jam mencatatkan 86.24%. Kekeruhan air pada sumber air keluar dikurangkan sehingga 41.65±5.68 NTU untuk kadar alir 0.2 m³/m²/jam dan 139.03±22.16 NTU untuk 2.0m³/m²/jam. Dalam pada itu, kesemua parameter kualiti air yang dikaji kecuali keperluan oksigen biokimia mencatatkan perbezaan yang signifikan di antara sumber air masuk dengan sumber air keluar bagi kedua-dua kadar alir yang dijalankan. Keputusan juga menunjukkan bahawa kadar alir 0.2 m³/m²/jam lebih berkesan dalam merawat air sisa akuakultur berbanding kadar alir pada 2.0m³/m²/jam.

TABLE OF CONTENTS

DECLARATION	i
ACKNOWLEDGEMENT	ii
ABSTRACT	iii
ABSTRAK	iv
TABLE OF CONTENT	v
LIST OF TABLE	vii
LIST OF FIGURE	viii
LIST OF SYMBOLS	ix
LIST OF APPENDICES	x
CHAPTER 1 INTRODUCTION	
1.1 Background study	1
1.2 Problems statement	4
1.3 Significant of study	4
1.4 Objectives	5
CHAPTER 2 LITERATURE REVIEW	
2.1 Nitrification Filter Principle	6
2.2 Aquaculture Wastewater Effluent	7
2.2.1 BOD ₅	8
2.2.2 TAN	8
2.2.3 Nitrite	9
2.2.4 TSS	10
2.2.5 Turbidity	10
2.3 Filtration	11
2.3.1 Slow Filtration	11
2.3.2 The advantages and disadvantages of slow filtration	11
2.4 Filter Media	12
2.4.1 Sand	12
2.4.2 BOPS	13
2.5 Filter Media Size Distribution	14
2.6 Filtration Rate	14
2.7 Filter Head Loss	15
2.7.1 Initial Head Loss	15
2.7.2 Terminal Head Loss	16
CHAPTER 3 MATERIAL AND METHODS	
3.1 System design	17
3.2 Media preparation	19
3.2.1 Sand	19
3.2.2 BOPS	19
3.3 Size media distribution	20
3.4 Aquaculture wastewater effluents	20
3.5 Water quality	21
3.6 Cleaning mechanism of filter	21
3.7 Data analysis	21