IRON AND MANGANESE REMOVAL FROM TEXTILE EFFLUENTS IN ANAEROBIC ATTACHED GROWTH BIOREACTORS

MASTER OF SCIENCE

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UNIVERSITY OF MORATUWA

MAY 2006

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By

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THIS THESIS WAS SUBMITTED TO THE DEPARTMENT OF CIVIL ENGINEERING OF THE UNIVERSITY OF MORATUWA IN PARTIAL FULFILLMENT OF THE REQUIREMNET FOR DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF CIVIL ENGINEERING
UNIVERSITY OF MORATUWA
MORATUWA
SRI LANKA

MAY 2006

ACKNOWLEDGEMENT

First of all I express my gratitude and sincere thanks to Dr. M. W. Jayaweera, Senior Lecturer, Department of Civil Engineering, University of Moratuwa working as the joint supervisor in this research and helping in all sort of aspects specially making arrangements to allocate necessary resources both physical and personnel when ever necessary without any delay.

I also thank Dr. S. Wijekoon, Senior Lecturer, Department of Chemical and Process Engineering, University of Moratuwa for being my joint supervisor and guiding specially in theoretical aspects.

I wish to express my gratitude to Head, Department of Civil Engineering, Prof. (Mrs.) N. Ratnayake acting as the Chairperson for my MSc. and reacting positively for all necessary requests, specially allocating her time to attend progress review proceedings even with her tight schedule.

I thank Mr. S. Pathinather, Head Environmental Engineering Division for his valuable advising, which help to direct the research in the correct path.

I express my appreciation to Dr. Nimal Gamage giving me the opportunity to follow modules in the Masters course offered by the Hydraulic Engineering Division, Department of Civil Engineering, University of Moratuwa.

I thank Ms. B. Gunewardane, Lecturer, Department of Civil Engineering for her rending hand.

I also thank Swedish International Donation Agency (SIDA) for funding the research.

I value the work done by Dr. C. Harendranath of Indian Institute of Technology, Bombay, India for undertaking the microbial analysis.

With a special consideration I would like to thank my colleagues Mr. K. P. S. Randeniya, Mr. S. Gunesekara, Mr. R. Kularathne, Ms. A. Kankanamge, Ms. D. Jayawardena, and Ms. Champika for their fullest corporation.

Credit must be given to the technical staff headed by Mrs. Nilanthi Gunathilake and Mr Justin Silva for their kind support and Mr. Kithsiri Perera for his support in the reactor fabrication process.

I also thank Analytical Chemist of the Environmental Engineering Laboratory, Mrs Manjula Ranasinghe for the chemical analysis.

All Research Assistants, namely Rukma, Amila, Gayani, Amali, Sulochana, Manura of the ARRPET Phase-II, very especially Ms. Enoka Uragoda for their hard work. Mr. Prasanna Perera for managing the transportation component.

Abstract

At present several primary and secondary treatment techniques have been used to remove iron (Fe) and manganese (Mn) from low polluting textile wastewaters. However past surveys and studies carried out in the industrial areas of Sri Lanka have revealed that contamination of waterways and groundwater with Fe and Mn has been still high indicating that proper methods are neither in existence nor efficient to remove them from low polluting wastewaters. Therefore in this article we discuss the performance of an upflow anaerobic bioreactor, which is used to remove Fe and Mn from textile wastewaters.

A laboratory scale study on Fe and Mn removal in upflow anaerobic bioreactor of a working volume of 20 litres with coir fibre as the filter medium was investigated for a period of 312 days using a synthetic wastewater with similar physical and chemical characteristics of a typical textile effluent. The usage of coir fibre can be justified considering its high surface area per unit volume, hence providing more area for the biofilm formation. The maximum Fe and Mn levels considered were 10 mg/l and 5 mg/l respectively, which are the typical average values of textile effluents subsequent to the primary and secondary treatments in Sri Lanka.

Ten sub experimental runs (R_0-R_9) were conducted with varying HRTs (5 days to 1 day), ratios of COD:SO_4^{2-} (20 to 3.5), Fe levels (0.005 to 10 mg/l) and Mn levels (0 to 5 mg/l). During initial stages good gas production, high COD removal and relatively low sulphate reduction were observed, indicating major proliferation of methane producing bacteria (MPBs). COD:SO_4^{2-} of 3.5 was identified as the optimum point at which sulphate reducing bacteria (SRBs) out competed MPBs and further reduction of this ratio caused total and/or significant inhibition of MPBs, thus making conditions favourable for bacterial immobilisation of Fe and Mn. After this point the gas production ceased while the system started giving rotten egg smell, as a result of H_2S production taking place due to the metabolism of SRBs.

The results indicated highly satisfactory percentage of Fe and Mn removal, in which the effluent contained Fe and Mn below the permissible levels (1.6 mg/l and 1.1 mg/l for Fe and Mn respectively) stipulated by US National Pollution Discharge Elimination System (NPDES) for inland surface waters at HRTs higher than 3 days. Results of the mass balance showed more Fe accumulation (65%) in sediments whereas 27% in the filter media. On the other hand out of the accumulated Mn, sediments contained only 26%, where as 65% were found to be attached to the filter media. Both metals in sediments mainly consist in the form of sulphides, indicating a sulphate reduction being the major mechanism of removal. Most of metal ions attached on the filter media too seem to be a direct consequence of sulphate reduction. The high removal efficiencies suggested that the bioreactors consisting coirfibres are a very good low-cost method of removal of Fe and Mn from the textile effluents.

Keywords: Bioreactor; Fe; methane producing bacteria; Mn; sulphate reducing bacteria; Textile effluents

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