

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

**MASTER OF SCIENCE**



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**UNIVERSITY OF MORATUWA**

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

**By**

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## 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<sub>0</sub>-R<sub>9</sub>) were conducted with varying HRTs (5 days to 1 day), ratios of COD:SO<sub>4</sub><sup>2-</sup> (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<sub>4</sub><sup>2-</sup> 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<sub>2</sub>S 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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