UNIVERSITI TEKNOLOGI MARA

TRANSFORMATION RATE OF NITROGEN AND SULPHUR COMPOUNDS UNDER CHANGING ANAEROBIC/ANOXIC CONDITIONS

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Dissertation submitted in partial fulfillment of the requirements for the degree of

Master of Science in Civil Engineering (Environmental)
Faculty of Civil Engineering

November 2008

ABSTRACT

Microbial transformations in sewer networks involving mass transfer occur simultaneously within and across the different phases of the sewer environment namely the bulk water phase, the sewer submerged biofilm , the sewer sediments, the sewer atmosphere and sewer wall. These transformation occur either under aerobic, anaerobic or anoxic conditions depending on the types of electron acceptor available in wastewater. At present, transformation of sulphur compounds in wastewater has become a serious problem in sewer systems. Anaerobic conditions in sewer systems normally result in sulphide formation. Several methods have been investigated in order to control the formation of sulphide. Many studies have reported on addition of nitrate as the inhibitor in the sulphate reduction process. Much of these studies have focused on wastewater in temperate countries. However, information on the transformation rate of sulphur compounds in the wastewater is lacking for hot-climate countries. Consequently, this study investigates the microbial transformation in sewer networks for hot climate countries under sewer conditions. Series of experiments were conducted to determine the transformation rates of sulphur and nitrogen compounds in municipal wastewater under changing anaerobic/anoxic/anaerobic condition and to establish the pathways for anoxic sulphur oxidation in municipal wastewater under sewer condition. The transformation rates of sulphate under anaerobic/anoxic/anaerobic conditions were found to be 0.127 mg S/(L h), 0.091 mg S/(L h) and 0.012 mg S/(L h) respectively while the utilization rate of nitrate under anaerobic/anoxic/anaerobic conditions are 0.014 mg N/(L h) ,1.185 mg N/(L h) and 0.003 mg N/(L h) respectively. A single step of sulphur oxidation process occurred during the anoxic condition. The lower oxidation state of sulphur compounds was oxidized directly to sulphate.

Candidate's Declaration

I declare that the work in this dissertation was carried out in accordance with the regulations of Universiti Teknologi MARA. It is original and is the result of my own work, unless otherwise indicated or acknowledge as referenced work. This topic has not been submitted to any other academic institution or non-academic institution for any other degree or qualification.

In the event that my dissertation be found to violate the conditions mentioned above, I voluntarily waive the right of conferment of my degree and agree be subjected to the disciplinary rules and regulations of Universiti Teknologi MARA.

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CHAPTER 1

INTRODUCTION

1.1 Background

Sewer systems perform as a transport function and serve as a reactor for microbial transformations of organic matter (Boon and Lister, 1975; Green *et al.*, 1985; Schmitt and Seyfried, 1992). Microbial transformations of wastewater organic matter in a sewer can be considered as biochemical processes as changes of chemical components are initiated by living organisms (Hvitved-Jacobsen *et al.*, 2000). Conceptually, microbial processes in sewer systems may occur under aerobic, anaerobic or anoxic conditions depending on the type and availability of electron acceptors (Nielsen *et al.*, 1992). The electron acceptors are utilized in a fixed sequence: oxygen for aerobic respiration, nitrate for denitrification, organic compounds for fermentation, sulphate for sulphate reduction and carbon dioxide for methanogenesis (Bentzen *et al.*, 1995).

At present, transformations of sulphur compounds in wastewater has become a serious problem in sewer systems. Anaerobic conditions in sewer systems normally result in sulphide formation (Æsøy *et al.*, 1997). The occurrence of sulphide in the sewer system is associated with an array of environmental problems including toxicity, foul odours and corrosion and reduced treatment efficiency (Boon, 1995; Hamilton and Lee, 1995; Pomeroy and Boon, 1990; Einarsen *et al.*, 2000).

In order to control odour and corrosion problems which are caused by the presence of sulphide, several methods have been investigated, namely, optimizing the sewer hydraulic design to minimize sulphide generation, sulphate source control