CHAPTER 1

INTRODUCTION

1.1 Rationale

Several environmental pollution aspects have existed in terms of water quality problem. Nutrients (Nitrogen and Phosphorus) discharged to aquatic system can lead to eutrophication or algae bloom. After algae die and decomposed, dissolved oxygen (DO) can be consumed from the water and results to the reduction of dissolved oxygen until it is insufficient to sustain aquatic life. Besides, the improper design to solve the water pollution problem can also causes an effect to atmospheric environment by green house gases emission. The most powerful of green house gases is nitrous oxide (N_2O) of which concentration is actually 314 ppbv and globally increasing at the alarming rate of 0.31% per year [1]. Therefore there is an increase of requirement to reduce and to identify the factors that control the greenhouse gas (GHG) emissions from wastewater treatment plants (WWTPs). The N_2O emissions are associated with several processes in wastewater treatment plants and the emission fluxes are extremely variable and depend on many operational parameters and environmental conditions.

Biological wastewater treatment processes have higher efficiency and lower drawback than chemical ones [2]. The conventional biological nitrogen removal process consists of aerobic and anaerobic phase that are autotrophic nitrification and heterotrophic denitrification [3]. It has been verified that under the condition of low dissolved oxygen and low influent COD/N ratio, N_2O could be produced during both nitrification and denitrification in activated sludge and released to the atmosphere. Several types of wastewater contain high NH_4^+ but low carbon content (or low COD/N ratio) for example the anaerobically treated swine wastewater, Thai domestic wastewater in which carbon content is about half that recommended for conventional biological nitrogen removal [4].

Recently, approaches for biological nitrogen removal have been proposed which bypass the formation of NO_3^- and convert NO_2^- to N_2 gas with NH_4^+ as the electron donor and NO_2^- as the electron acceptor under anaerobic conditions (ANaerobic AMMonium Oxidation or anammox). Bock et al. (1995) [5] and Strous et al. (1997) [6] reported that both pure and mixed ammonium oxidizing bacteria and anammox bacteria under anaerobic conditions were able to use nitrite as an electron acceptor and ammonium as an electron donor. In principle, anammox bacteria could make use of the regular denitrification pathway to produce dinitrogen gas, but previous research [7] showed that N_2O had no effect on the anammox reaction .This can imply that N_2O production may not exist in the anammox mechanism. In recent year, there are several researchers try to study how to improve the nitrogen removal by using anammox process. To evaluate the N_2O production by anammox process can ensure the benefit use of this process over the conventional one not only reducing the operating costs but also the environmental protection aspects

1.2 Research objectives

1. To evaluate the N_2O production by anammox process.
2. To study parameters tend to reduce N_2O emissions by varying NH_4^+/ NO_2^- ratios in anammox process.

1.3 Methodology

1. Developing the enrichment of ammonium oxidizing microorganisms in sequencing batch reactor (SBR) under anaerobic condition.
2. Using synthetic wastewater vary NH_4^+/ NO_2^- ratios by varying both ammonia and nitrite concentrations.
3. To analyse:
    a. Ammonium and nitrite concentrations by a spectrophotometer.
    b. Biomass concentrations by using Standard method (1998) as described.
    c. Gas volumes by using a displacement technique of water out and gas produced in the cylinders of reactor and using Gas Chromatography (GC) to measure N_2O concentrations.