CHAPTER 3

MATERIALS AND METHODS

3.1 INTRODUCTION

This chapter gives the information on the materials and methods used in this thesis.

3.2 MATERIALS

3.2.1 Sludge

Waste sludge samples used in the study were collected from sewage treatment plant, INDAH WATER in Kuantan, Malaysia. The temperature during collection of the raw sewage sludge was 32 ^{o}C. The wastewater was stored in a cold room at 4 ^{o}C prior to use. Maximum storage period of sludge was one week to minimize microbial degradation. Samples analysed for chemical oxygen demand (COD), biochemical oxygen demand (BOD), total suspended solids (TSS), pH, volatile suspended solids (VSS), volatile fatty acid, and nitrogen contents. The characteristics of the raw sewage are presented in Table 3.1.

3.2.2 Ultrasonicated-Membrane Anaerobic System (UMAS):

The ultrasonicated-membrane anaerobic system (UMAS), consists of a cross flow ultra-filtration membrane (CUF) apparatus, a centrifugal pump, and an anaerobic reactor. The membrane was attached with ultrasonic.

3.2.2.1 Reactor

The reactor was composed of a heavy duty reactor. The reactor is made up from clear PVC with an inner of 15 cm and a total height of 100 cm. The volume of the reactor is 200liter, and connected with centrifugal pump.

3.2.2.2 Pump

A one phase 0.63 kW, 4.6 Amps, 220/250 voltage pump model no. 5130 one R Motor type 353 was used to pump the digester content into cross flow ultrafiltration (CUF) and recycle the retentate back into the reactor.

3.2.2.3 Ultrasonic

The 25 KHz multi frequency ultrasonic transducers connected into the MAS system. The ultrasonic frequency is 25 KHz, with 6 units of permanent transducers and bonded to the two (2) sided of the tank chamber and connected to one (1) unit of 250 watts 25 KHz Crest's Genesis Generator.

3.2.2.4 Cross Flow Ultrafiltration Membrane (CFUM) Unit

The (FCUM) consists of two tubular PCI model FP200 Polyulphone membranes, which put inside steel membrane housing. The length of polysulphone is 30 cm and its diameter was 1.25 cm. The total areas of the two membranes were 0.024 m^2 and the average pore size of 0.1 µm. The molecular cut-off weight of 200000. The membrane can be operated at a maximum pressure of 55 bars at 70 ^oC or at 70 bars at 20 ^oC. The operating pressure in this study was maintained at 1.5 - 2 bars, by manipulating the gate valve at the retentate line after the CFUM unit.

3.3 METHODS

To accomplish objectives of the research, a laboratory digester of ultrasonicated membrane anaerobic system (UMAS) with an effective 200-litres volume used to treat raw sewage sludge. In order to avoid the clogging and pump damage, First the sewage sludge was screened through strainer, before being added to the digester. After that seed sludge was poured in to a 200 litres of ultrasonicated membrane anaerobic system (UMAS). The reactor was covered with an aluminium foil, which prevent the reactor from any direct of sun light. Enrichment cultures of methanogenic bacteria were developed in digester for four days. In day five we on the system. Operating pressure was maintained at 1.5 - 2 bars, Temperature was in the range between 25 - 45 ^{o}C.

pH of the sludge in the reactor content was maintained the range of 6.8 - 7.5,The digester was completely mixed-semi continuously under different steady state operations. The system was operated every day five hours .after five hours Samples from reactor and permeate analysed for chemical oxygen demand (COD), biochemical oxygen demand (BOD), total suspended solids (TSS), pH, volatile suspended solids (VSS), volatile fatty acid, and nitrogen contents, so that the experimental results could be used to investigate the performance of ultrasonicated membrane anaerobic system (UMAS) under steady state conditions. The volume of biogas produced is measured by using a 20 litres water displacement bottle. A schematic representation of laboratory of ultrasonicated membrane anaerobic system (UMAS) which consists of cross flow ultrafiltration membrane (CUF) apparatus, a centrifugal pump, and an anaerobic reactor is shown in Figure. 3.1. The feed system was designed to provide continuous addition of feed solution (Raw sewage sludge) by gravity flow, from feeder tank which is on top of the reactor.