

## **CHAPTER 3**

### **MATERIALS AND METHODS**

#### **3.1 INTRODUCTION**

In this chapter, specific focus will be given on describing the experimental design, the operational methods used and the procedures of different experiments, which needed to be done for this research. It is also together with sample collection and preservation, the analytical methods and calculations for the sewage sludge samples.

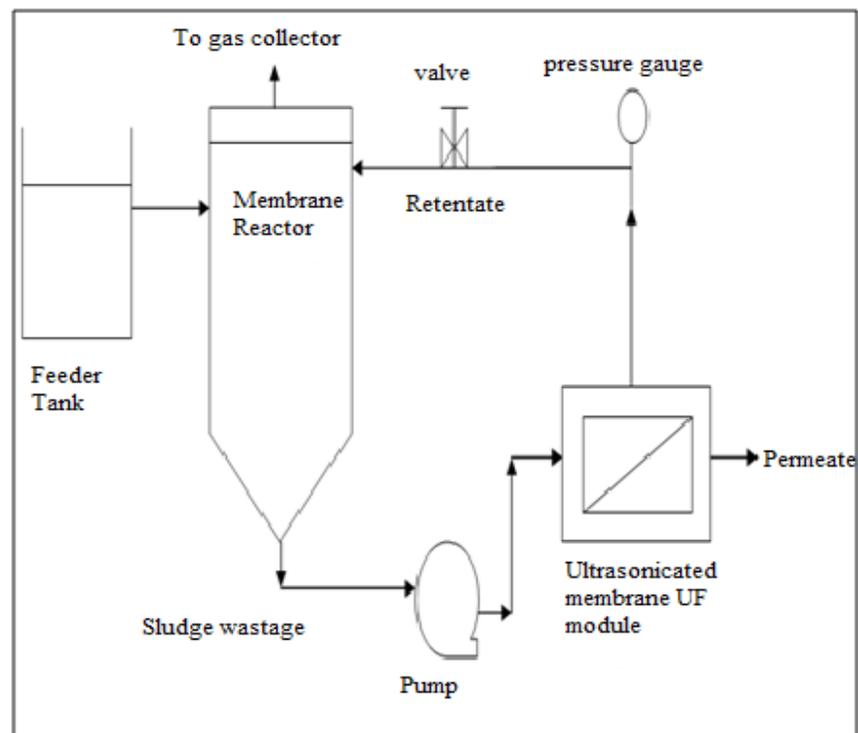
#### **3.2 SAMPLE COLLECTION AND MONITORING**

Sewage sludge samples were gathered from the anaerobic tank in the wastewater treatment plant, which belongs to Indah Water Consortium Kuantan in the state of Pahang, Malaysia, with 1500 PE capacity. Samples were kept in PVC vessels at a temperature of around 4°C, but higher than freezing point, for the reason of controlling the sludge from subjecting to biodegradation due to microbial reaction. The conservation of samples and the experimental work was implemented in the Environment Laboratory, Faculty of Chemical and Natural Resources Engineering, UMP, Malaysia.

#### **3.3 EXPERIMENT PILOT SCALE**

The Ultrasonicated membrane Anaerobic System (UMAS) consisted of a cross flow ultra-filtration membrane (CUF) with a number of four membranes, a centrifugal

pump, an anaerobic digester of effective volume of 50 L and 6 ultrasonic transducers that were fasten to the membrane unit holder and linked to one unit of 250 watts 25 KHz Crest's Genesis Generator as shown in Figure 3.1 and Figure 3.2. The UF have 2000 Daltons of molecular weight cut-off (MWCO), a mean pore size of 0.1  $\mu\text{m}$  with each tube was 30 cm at length and a diameter of 1.25 cm. The overall area of the membrane was 0.048  $\text{m}^2$ . The ultimate operating pressure on the membrane was 55 bar at 70°C, and it works at all pH ranges. The reactor was consisting of a heavy duty reactor with 15 cm inner diameter and 100 cm length. The operating pressure in this research was preserved in the range of 1.5 bar and 2 bar by tampering on the gate valve at the retentate line after the CUF unit.



**Figure 3.1:** A schematic diagram for the ultrasonicated membrane anaerobic system.



**Figure 3.2:** Ultrasonicated membrane anaerobic system.

### **3.3.1 The Anaerobic Reactor Set up**

The reactor which was made of PVC, was covered with aluminium foil to prevent the direct light. The reactor volume was 50 L with inner of 15 cm and it was a 100 cm of total height.