IV EXPERIMENTAL INVESTIGATION

4.1 Experimental Apparatus

A laboratory scale anaerobic filter was constructed and used in the experimental study. Figure 13 shows a general view of the experimental set-up and Figure 14 presents detailed design of the filter. The filter made of methyl methacrylate acrylic commercially known as polyglas, was a 2.10 m high square column having a uniform cross-sectional area of 22.4 cm. x 22.4 cm. The top and bottom were covered with a 6 mm. thick polyglas sheet. A gas vent pipe was fitted to the cover for collecting gas samples. The volume of the filter was approximately 90 liters at the effective depth of 1.80 m.

A media supporter was placed at about 10 cm. above the column bottom thus forming an inlet distribution chamber. The media supporter was made from 10 mm. thick polyglas sheet with perforations of 1 - in.diameter at 2 - in. centre. The design was to give uniform distribution of the influent over the cross-section of the column. The column was baffled at every 30-cm. interval with 4-cm. wide rubber sheet attached horizontally with the column walls. The baffles were to elimimate short-circuiting of the influent through large void spaces formed between the media and the column walls .

The column was filted at every 30-cm. intervals with 1/4-in. PVC pipes extending into the column center to collect truly representative samples. The joints between the sampling pipe and the column walls were tightly sealed to prevent leakage. The media used were 1-2 in. crushed stone filled to a depth of 1.8-m. The filter filled with the media was found to have a liquid volume of 42 liters. The porosity was therefore equal to 42/90 or 0.47.

To prevent the gases from escaping with the effluent, the outlet pipe at the column top must be submerged at all time. Therefore a siphon technique was employed as shown in Figure 14 to keep the liquid

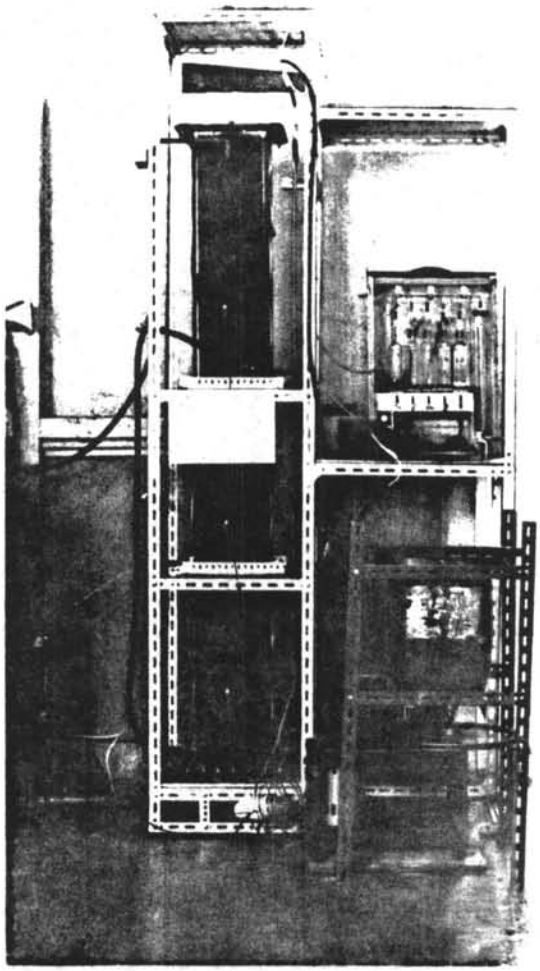

Figure 13. General View of the Experimental Set-Up.

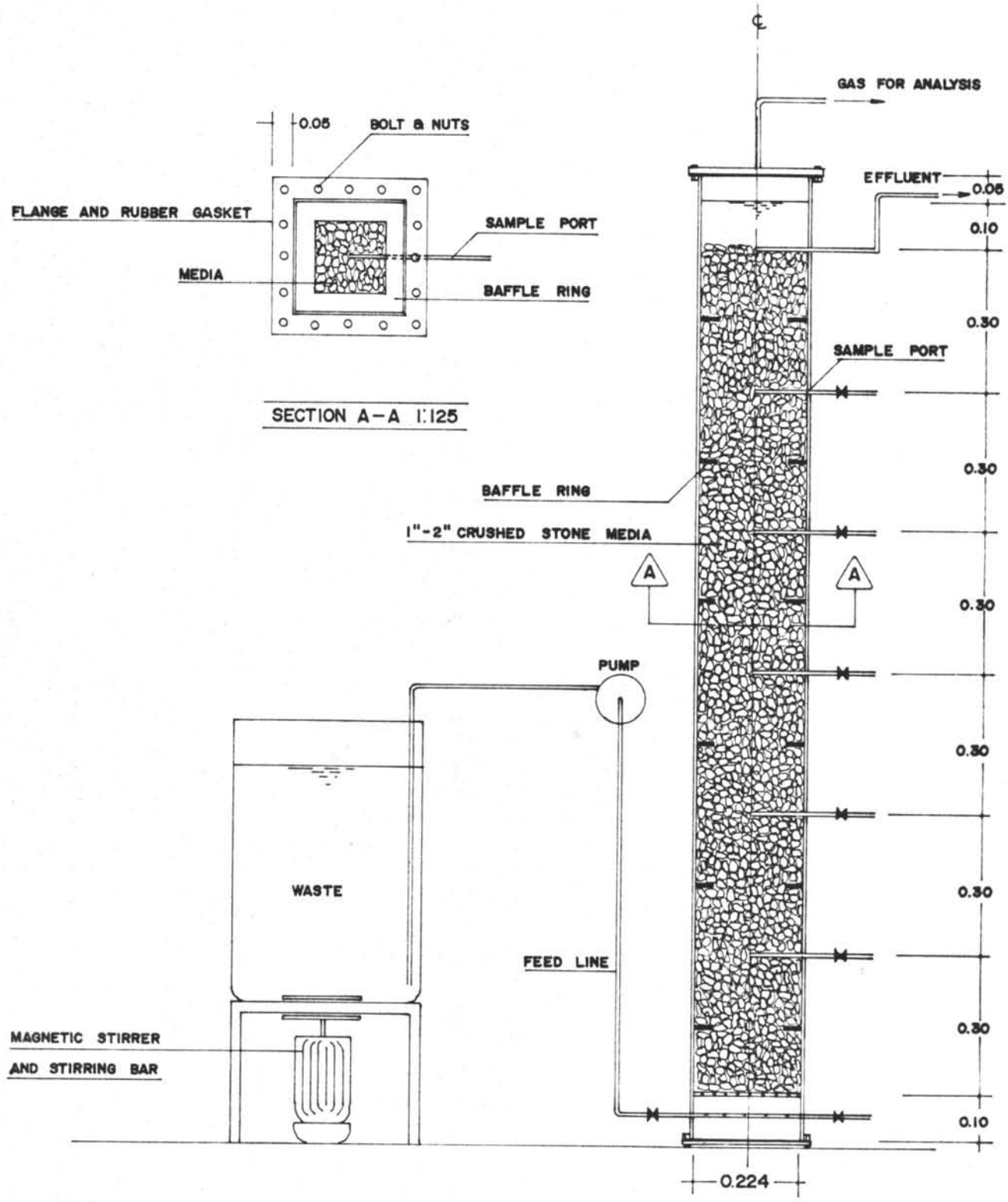

FIGURE 14. SCHEMATIC DIAGRAM OF ANAEROBIC FILTER AND FEED SYSTEM

level constant at about 10-cm. above the media top and the outlet pipe.

A diaphragm pump model C-660 manufactured by Blue-White Industries was employed to feed the influent into the distribution chamber at a rate of 42 liters/day. For a feed rate of 18 liters/day the diaphragm pump was replaced with a peristaltic pum model 371 manufactured by Sage Instruments.

4.2 Wastewater Used in the Study

The wastewaters used in the experimental study were grab samples collected from four modern tapioca-starch mills mamed Song Charoen (ทรงเจริญ) and Sahaperchphol Tawanok (สหพืชผลตะวันออก) in Chonburi, and Tai Wah (ไทวา) and Song Charoen (ทรงเจริญ) in Rayong. Depending on the waste strength requirement the combined waste sample was collected for the required COD of less than 5,000 mg/l and the wastewater from the first separator was used in the case of the COD greater, than 5,000 mg/l.

In each sampling about 240 liters of the wastewater were collected in 20 and 40 leter plastic container. The wastewater was immediately transported to the Sanitary Engineering Laboratory at Chulalongkorn University, and were stored in a refrigerator at 4°C.

4.3 Experimental Program

The experimental study was designed to evaluate performance of the anaerobic filter in treating tapioca starch wastes. The major operational variables studied included detention time, volumetric COD loading and filter depth. The process performance was evaluated from percent COD removal. The effects of pH and nutrients on the process efficiency were also investigated.

The detention period studied was selected at 24 and 56 hours. these detention periods were comparable to those commonly experienced in the anaerobic contact process. The organic loading was varied from 0.6 to 4.0 kg. COD/cu.m./day equivalent to 37 to 250 lb COD/1000 cu.ft./day. This range of organic loading was applicable to conventional biological treatment processes such as an activated sludge process, trickling filter, biological disc filter, etc. Therefore, it was possible to compare efficiency of the anaerobic filter process with that of the others.

Since the filter volumewas constant the organic loading applied to the filter depended entirely on the product of the feed rate and the waste strength. And because the detention time was primarily fixed the feed rate could be determined. Consequently, the organic loading was varied by adjusting the waste strength simply by dilution with distilled water. Table 9 shows the waste strength used in each experimental run,

Table 9 Organic Loadings Corresponding to Various Combinations of Hydraulic Flow Rates and the Waste Concentration Used in the Experimental Study.

	Influent COD mg/l	Flow Rate Liters/day	Theoretical Detention time, hours	Organic Loading kg/cu.m./day
Group I*	1250	42	24	0.58
	2500	42	24	0.17
	5000	42	24	2.33
	8500	42	24	3.96
Group II**	8500	42	24	3.96
	5000	42	24	2.33
	7000	18	56	1.4

* Under controlled conditions

** Under raw wastes condition

detention time and organic loading. It can be seen that the experimental runs were divided into two groups. In group one the settled influent was treated under favourable environmental conditions. The pH in the reactor was kept in a range between 6.6 to 7.2 using sodium bicarbonate. Since the wastewater was deficient in nitorgen and phosphorus, urea and di-potassium hydrogen phosphate (K_2HPO_4) were added to the raw wastes to have the minimum COD:N:P ratio at 1000:11:2 as recommended by Mc CARTY (1964). In another group of experimental runs the raw wastes was treated without control of pH and nutrient. All experimental runs were conducted at room temperatures in the range between 25°and 30°C.

4.4 Sampling and Analysis

In each experimental run the influent was kept in a container at room temperature. The volume used was sufficient for one day feeding. To determine the quality change due to bacterial activities COD of the influent was analysed at the beginning and the end of each feeding day. In addition, at the beginning of each feeding day, the fresh influent was analysed for pH, alkalinity, ammonia nitrogen.

During the experiment about 200 ml of sample was collected on a daily basis from every sampling port in succession from top to bottom. Using this technique of sampling representative samples at each particular depth would be obtained since the liquid in the filter was only slightly disturbed. The effluent samples were immediately analysed for COD,pH ammonia nitrogen, etc. All analysis except volatile acids were carried out as recommended in STANDARD METHODS (1974). The volatile acids concentration was determined using the direct titration method given by DILALLO and ALBERTSON (1961).