CHAPTER 6

EXPERIMENTAL INVESTIGATIONS

Collecting Sample

The study essentially consisted of two parts - one on raw activated sludge characterization and the other on treatment of this sludge by aerobic digesting under laboratory conditions.

The raw activated sludge samples used in this study were obtained from the settling tank and sludge sump tank of a soft drink water treatment plant in Bangkok.

The study was initiated in September 1971 and contined until October 1972. During this period chemical, physical and biological analysis were made for the purpose of preliminary characterization of raw sludges Single samples were collected on four different plant visits for these characterization studies. Such grab samples served as spot check and although the analytical results from a grab sample may be of limited value, they are useful in investigating abnormal waste characteristic.

The 6-hour composite samples were collected instead of 24-hour composites. Composite samples are more representative of the waste than grab samples. They show the average condition and give results which are useful in computing average quantities of waste materials discharged. Individual samples comprising each composite were collected every 30 minutes during each 6-hour sampling period.

Analyses were initiated immediately upon delivery to the laboratory. Those analysis not made immediately were carried out on the day following collection, with the samples store at 4°C.

The sludge was blended and homogenized before being ramdomly distributed into digester units. The moisture content of the sludge was determined and adjusted to yield approximately 1%, 2% and 3% total solids.

Materials and Equipment Utilized.

Fig. 7 shows the set-up of the laboratory scale digesters. The digesters were made of 10-litrecylindrical glass bottle with an inside diameter of 20 cm and 35 cm high.

The constant temperatur water bath was made of a rectangular basin. The temperature was controlled by means of a 1000 w heating coil regulated by a precise temperature sensing element and relay. These controls held the temperature fluctuations in the bath to approximately plus or minus 0.5 C

Air for aeration of the sludge was introduced in excess of oxygen requirements, but provided for the satisfactory mixing of the mass. An air flow rate of approximately 6 liters per min was supplied to the digester by a S=Lonı tube. These tubes produced air bubbles large enough to keep the digester content well mixed in addition to supply oxygen to the microbial population.

Procedure and Analytical Methods.

Standard methods (APHA, 1970) were followed for measuring

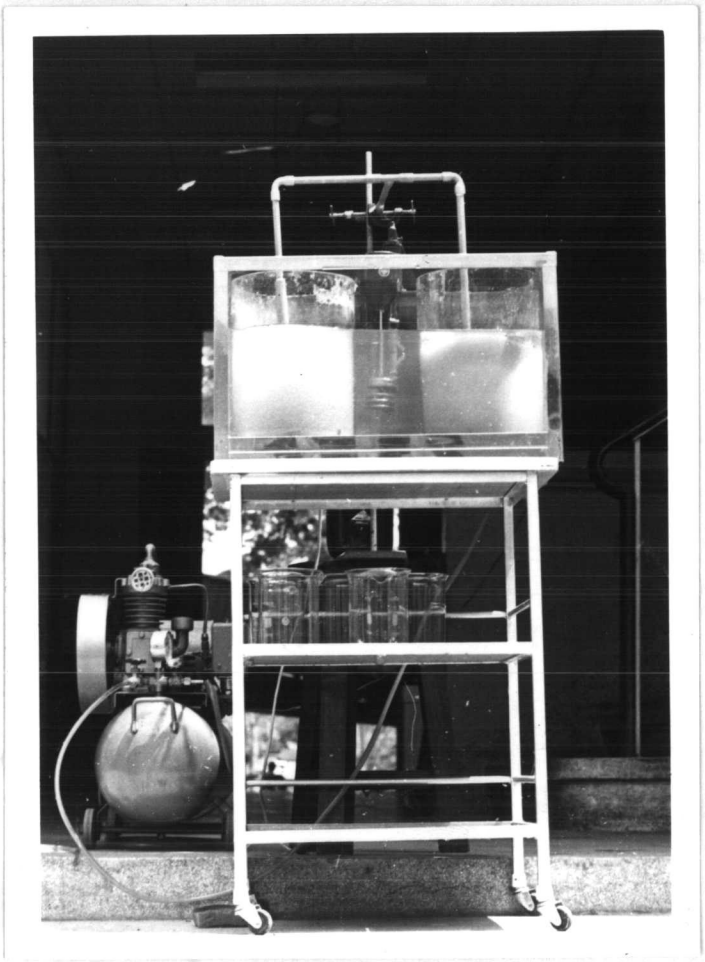

FIG. 7 THE LABORATORY-SCALE AEROBIC DIGESTION SET-UP

volatile solid (V.S.) and fixed solid (F.S.) in the sludge undergoing aerobic digestion. Representative samples of the sludge are difficult to obtain. Therefore, in order to have a sufficient number of analysis for statistical manipulation, at least four replicate samples of 2 ml to 7 ml volume were withdrawn from each digester at prescribed intervals of time. These data were used in studying the volatile solid reduction.

The commonly used formula for volatile solid reduction was rearranged some what to the following form:

$$\text{Reduction in VS (in\%)} = \left[\frac{\frac{\text{VS start}}{\text{FS start}} - \frac{\text{VS end}}{\text{FS end}}}{\frac{\text{VS start}}{\text{FS start}}} \right] 100$$

Burley (1960) has developed a chart for calcultating volatile solid reduction in percentage, but the assumption has been made that the fixed residue does not significantly change during digestion. A graphical procedure conveniently permitted the examination of variability of the fixed solid. Volatile solid was plotted against the fixed solid for each time peroid and, because of varying sample size, permitted fitting by least squares to a line represented by

$$y = a + bx$$

The slopes b (that is, the ratios of volatile solid to fixed solid) decreased with the days of digestion from which

volatile matter reduction could be calculated.

Reyes (1962) reported that the lines of best fit of the plotted data did not always pass through the origin and the values of fixed solid when volatile solid equaled zero could deviate from zero from his 134 determinations for the digestion experiments.

The supernatant determinations carried out in this investigation were not in the STANDARD METHODS (1970). The condition known as bulking made it difficult to get enough quantities of supernatant. If the sludges were left to settle, by gravity, it took about 4 to 5 hours to get required volumes. To shorten the time, centrifugation, one of the recent methods applied to dewater sludges was used. The sludges were centrifuged for 10 minutes and the supernatants were obtained.

Aerobic Digestion Studies.

The sludge was aerated 30 minutes before it was sampling to find its characteristics. The air - flow and temperature were kept constant during each run.

Six runs were made on the laboratory - scale digesters. The air was supplied from a compressor to the digesters without the addition of nutrients. Preliminary investigation on laboratory scales showed that evaporation was one of the serious problems in doing this research, because the volume of the aerated sludge reduced about 20% a day. To overcome this problem distilled water was added twice a day to maintain the volume.

The solid loadings varied from 1, 2 and 3 per cent. The temperatures were 30°C and 35°C. The sludges were extended aerated and studied for a 15 - day period. All operating conditions were the same in all six runs.

Dissolved Oxygen, pH, chemical Oxygen demand and various kinds of solids were determined every three days. Microorganisms in sludge were studied each day by means of microscope to find out their predominance.

Besides Sphaerotilus natans which was the predominance microorganisms found in this investigation, others organisms have been found occasionally eg, Zooglea ramigera, worms, rotifer, etc.