V EXPERIMENT RESULTS AND DISCUSSIONS

5.1 Using synthetic Wastewater

The concentrated synthetic wastewater was diluted with tap water in order to obtain different dilutions of influent. The influent of each concentration was, then, fed to the aeration tank until steady state was reached.

The chloride and arease contents of the actual wastewater were not simulated. Pearson et al. reported that only when the chloride content was over 9,000 mg/l, inhibition of biological activities would occurred.[14] Consequently, the negligence of the content in the synthetic was unlikely to effect the biological performance one way or another.

Furthermore, the chance of a considerable amount of grease wound up in an aeration tank after primary treatment generally seemed to be approaching nil.

From Table 4.1 attention might be drawn to:

5.1.1 Temperature of the wastewater was in a range between 24°-29°c which was a normal range of ambient temperature in Thailand.

5.1.2 The pH of the wastewater ranging from 6.2-6.7 was approaching neutral. Adjustment of the pH of raw wastewater was, then, not necessary.

5.1.3 The BOD, COD ratio was on the average about 1 : 1.46

5.1.4 Helmers et al. recommended the BOD: N:P of 100:5:1 and critical requirement BOD:P of 100: 0.6[17] The ratio in the system was on the average, 100: 13: 0.75 and satisfactorily accommodated biological activities. Phosphorus was adequately supplemented by KH_2PO_4 and K_2HPO_4 in the buffer solution.

5.2 Maximum rate of substrate utilization per unit weight of microorganism; day^{-1}(k)

Half velocity coefficient, mg/l (Ks)

$$\frac{ds}{dt} = \frac{k X S}{K_s + S} \text{ ---- Monod equation}$$

The procedure to find k and K_s shown in Figure 5.3 and Table A.2

$$k = 1.15 \quad day^{-1}$$

$$K_s = 40 \quad mg/l$$

Benedex, et al. presented k and K_s value of domestic waste 5.0 and 22 respectively.(8) Relative to the domestic waste the substrate removal rate of the fish cannery wastewater seemed to be considerably hindered.

5.3 Solids Yield Coefficient (Y),Kg MLSS/Kg BOD

$$Y = \text{MLSS produced/BOD removed}$$

The procedure to find Y was shown in Figure 5.4 and Table A.3

Coefficient Y of fish cannery wastewater in this experiment was found to be 0.415

Heukelkian, et al. and Middlebrooks, et al. reported Y of domestic waste 0.5 and 0.67, respectively.(8)

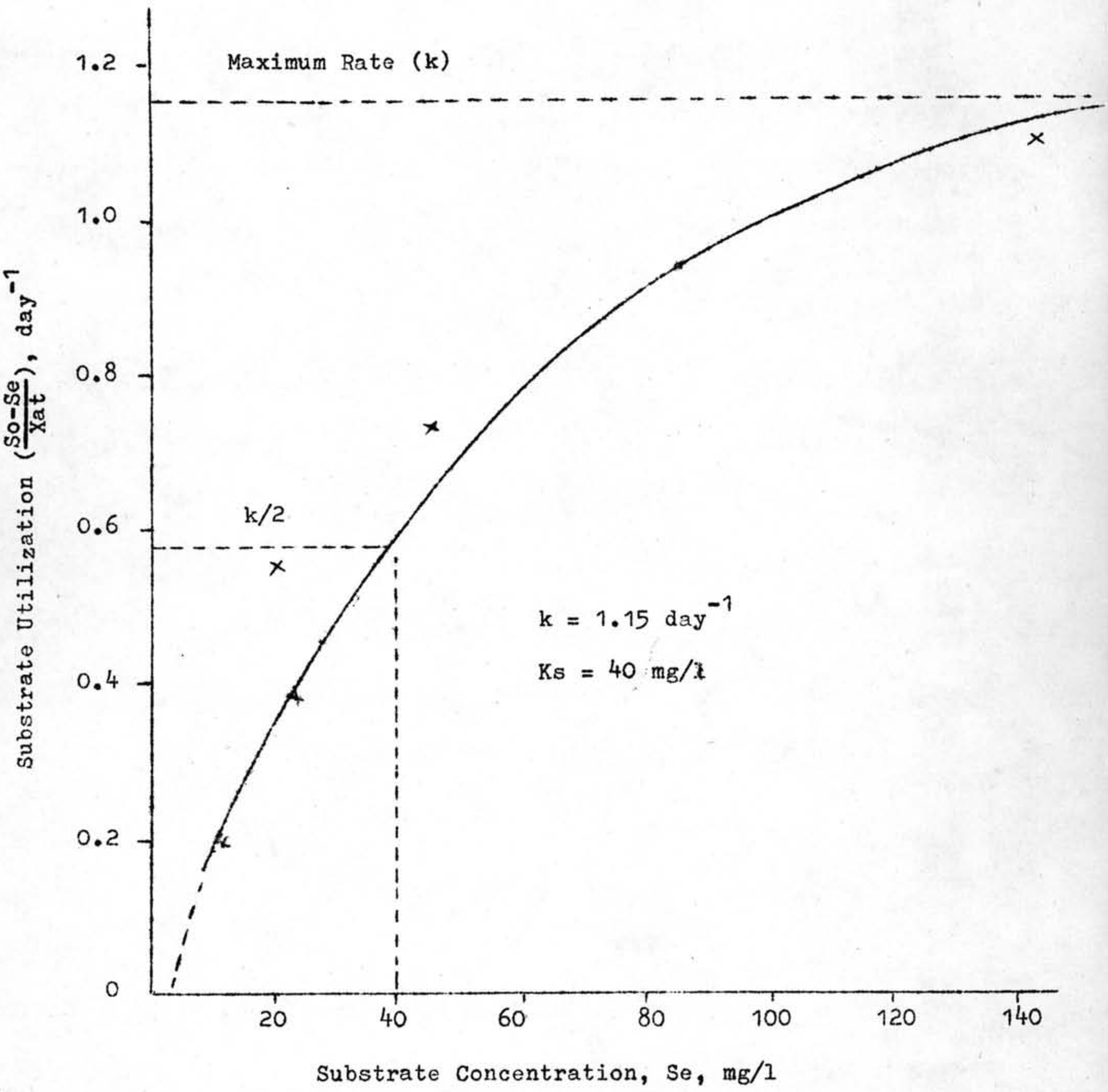

Figure 5.1 Rate of waste utilization per unit mass of micro organism versus concentration of a limiting nutrient

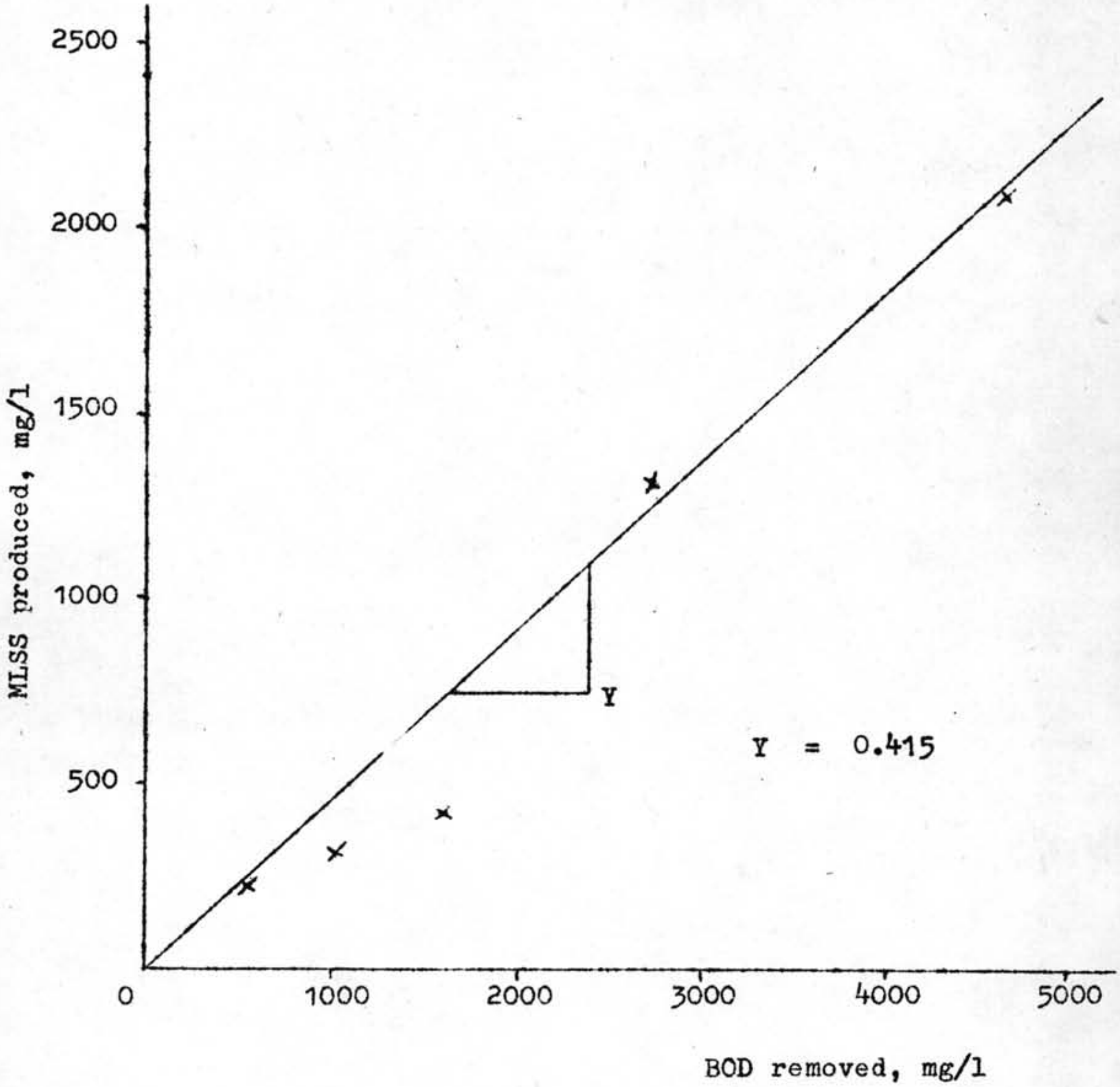

Figure 5.2 Solids Yield Coefficient, Y

The amount of solids was directly proportional to the Y value. The yield would be significant in size selection of an aeration tank and sludge disposal unit in any treatment facilities.

5.4 Microorganism decay coefficient (b), $time^{-1}$

Microorganism decay coefficient was determined by the following procedure:

1. a batch unit of big glass cylinder was set up, and filled with two litres of 3,500 mg/l mixed liquor,

2. the mixed liquor was aerated for 5 days, suspended solids concentrations of the liquor were examined daily,

3. the suspended solids concentrations were plotted against aeration times, the microorganism decay coefficient was determined from the graph.

The result was shown in Figure 5.3 and Table A.4.

Coefficient b of fish cannery wastewater from this experiment was 0.0415 day^{-1}

Heukelekian, et al. and Middlebrooks et al. pressented b of domestic waste was 0.055 and 0.048, respectively.[8]

The solids decay exerted its oxgygen demand on the system.

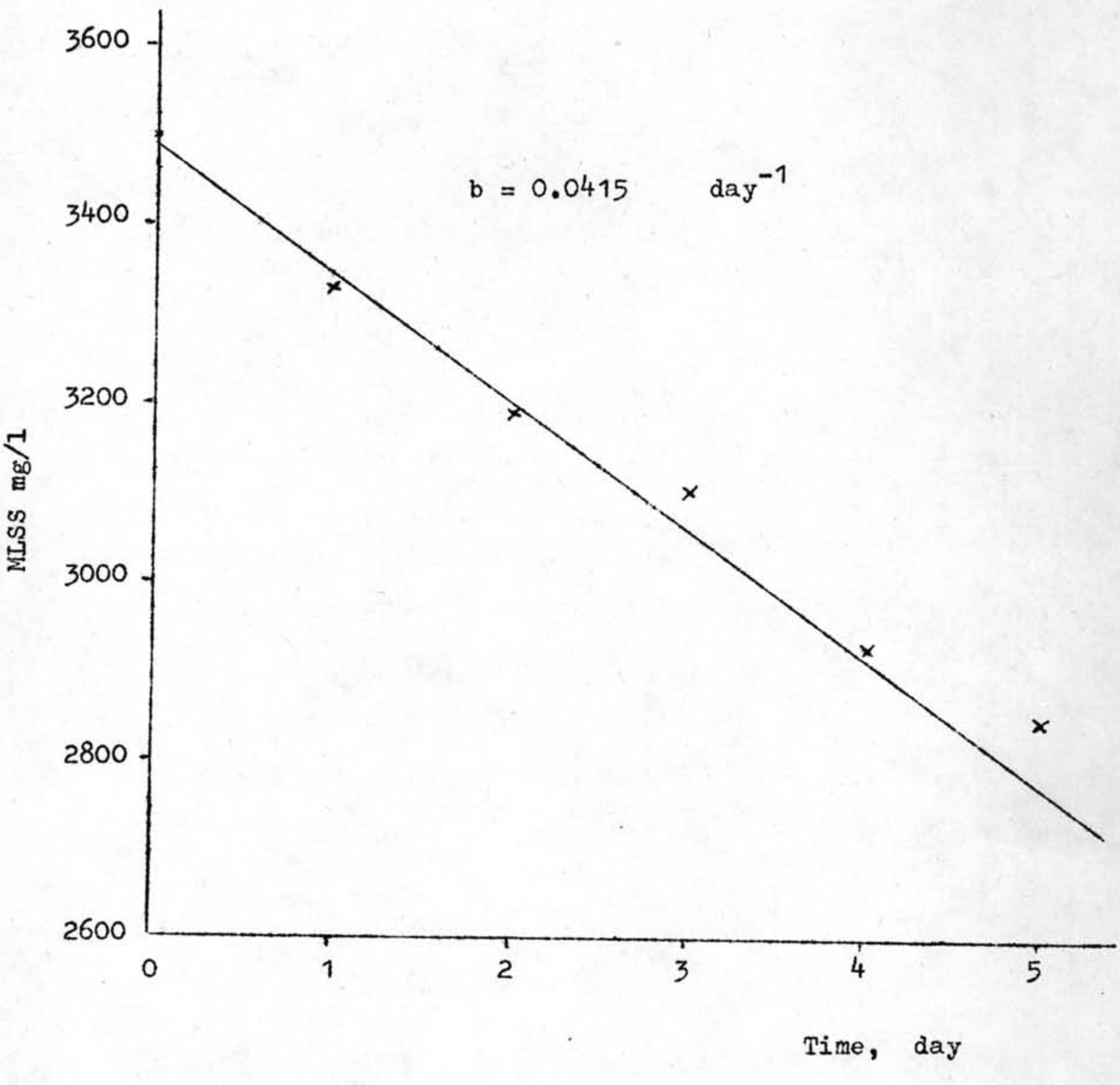

Figure 5.3 Microorganism Decay coefficient (b)

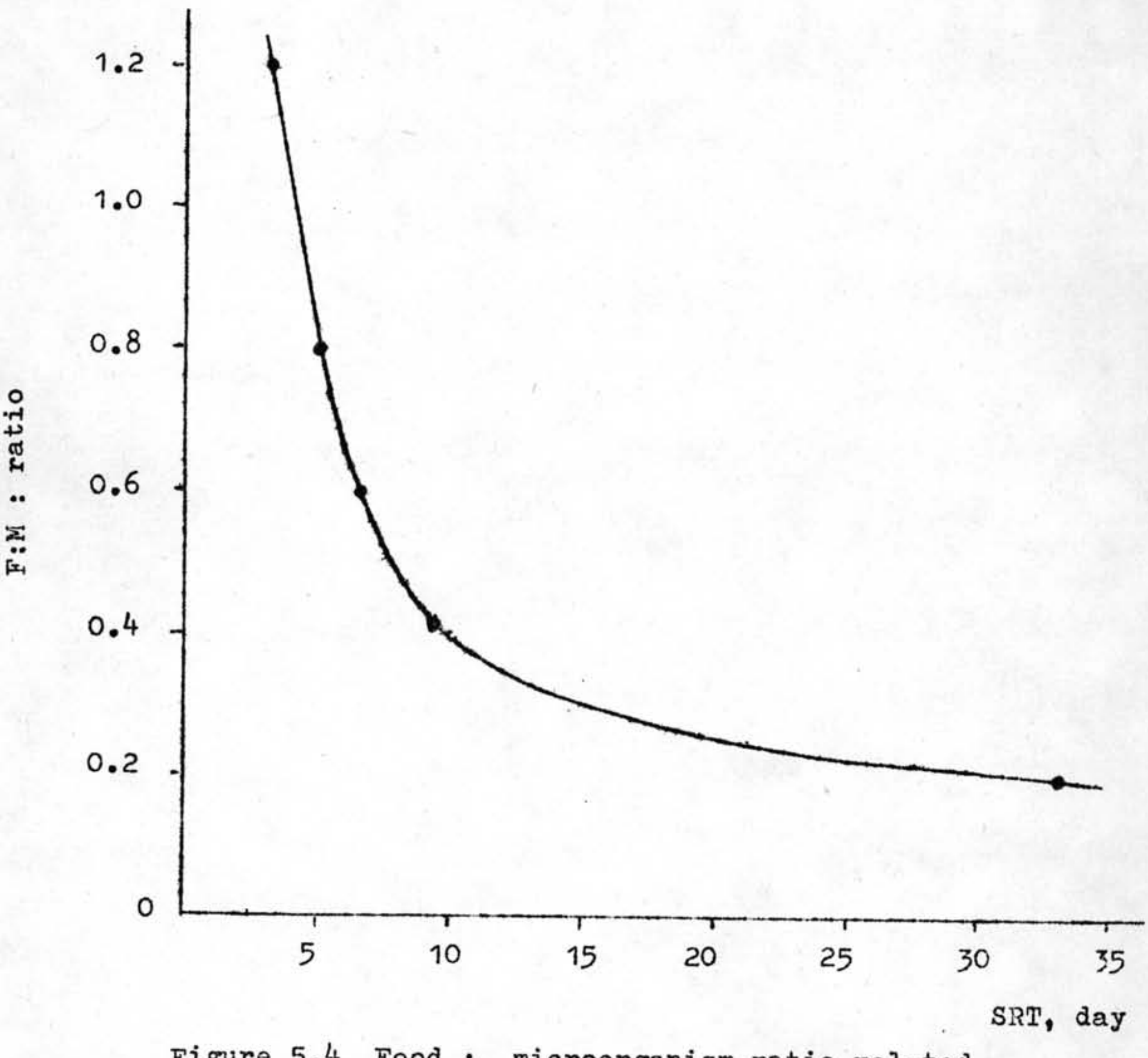

Figure 5.4 Food : microorganism ratio related to Solids retention time

Furthermore, a know decay coefficient (b) in a mass balance of solids in an aeration tank system would be beneficial in tank-size selection.

5.5 Relationship of F/M ratio and SRT

SRT : At steady state conditions the SRT was inversely proportional to the biological growth rate.

F/M : The amount of bio-degradable organic applied to a biological system affected the microorganism metabolic rate.

When organic loading increases F/M ratio will also increase but SRT will decrease.

Figure 5.6 and Table A.5 showed the relationship between F/M ratio and SRT.

5.6 Sludge Volume Index (SVI)

From this experiment

Table 5.1 Relationship between F/M ratio and SVI

Group	F/M ratio	SVI
1	0.2	41
2	0.4	70
3	0.6	60
4	0.8	147
5	1.2	114

It has been found that sludge showing SVI under 50 settled excellenctly, those under 100 settled quite well, while those up to 150 settled reasonably well.

When the F/M ratio was higher than 0.6 (or SRT lower than 7 days) bubbles of gas readily carried the sludge up. The composition of the gas was not examined.

5.7 Treatment Efficiency

Correlations of percent BOD and percent COD removal VS F:M ratio and SRT were examined.

5.7.1 Figure 5.5 and Table A.1 showed percent BOD removal and effluent BOD related to F:M ratio and SRT loading. Any F/M ratios varying from 0.2 to 1.2 (or SRT of 33 days to 3.2 days) was found to render BOD removal of over 95%. When loading was higher than F/M 1.2 or SRT lower than 3.2 days, efficiency of activated sludge was still high. At F/M ratio 0.8 or higher (SRT 5 days or lower), the BOD concentrations in the effluent were higher than what specified in the effluent standard of the Ministry of Industry. Activated sludge system, the F/M ratio of less than 0.6 (SRT over 7 days) seemed to be most favorable. For F/M ratio 0.6 (SRT 7 days) effluent BOD still complied to the effluent quality standard, yet pH control seemed to be critical. It was once dropped to 5.0. High organic acid and CO_2 production were likely to be two among a number of possible explanations.

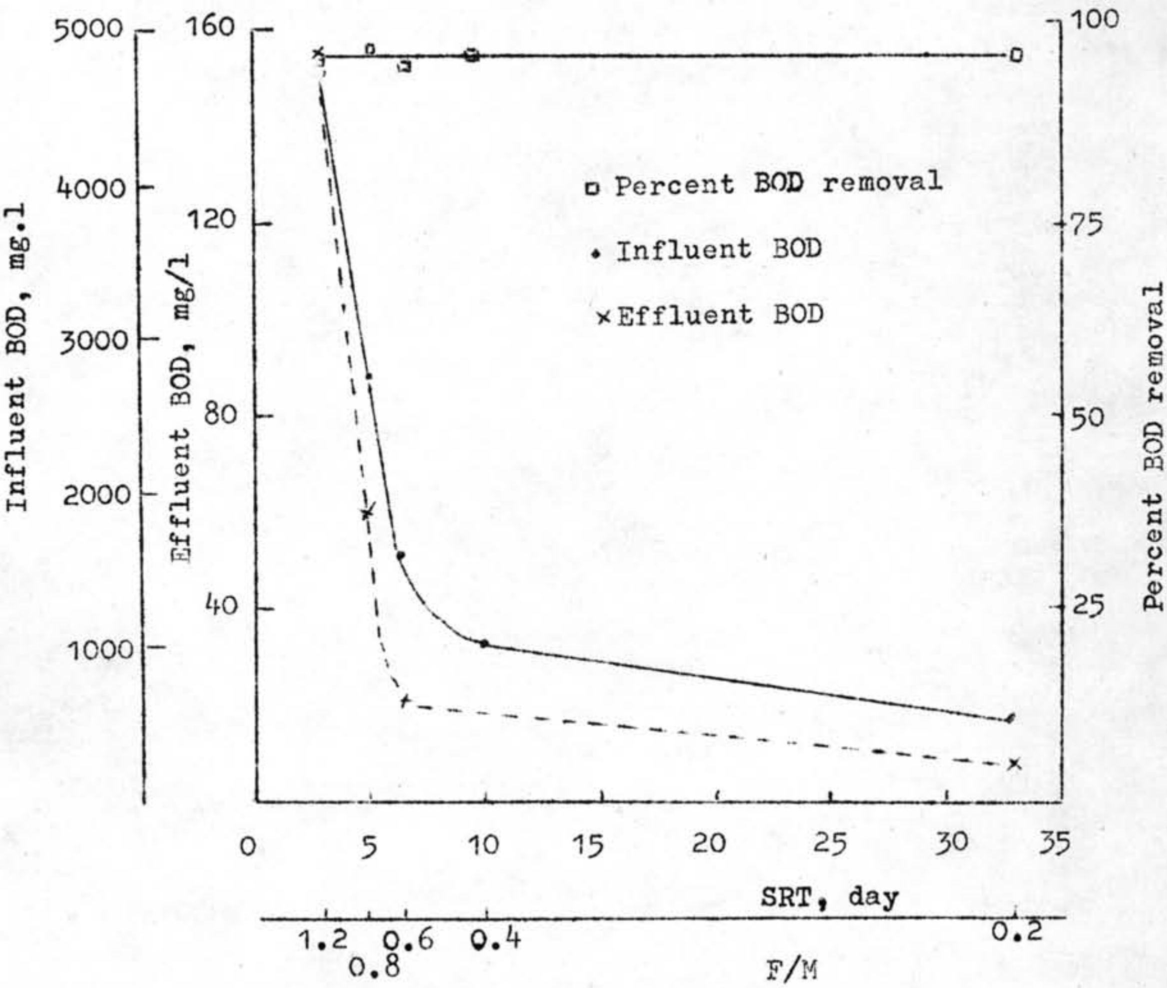

Figure 5.5 Effect of food : microorganism or the solids retention time on the biological oxygen demand removal efficiency and influent, effluent BOD

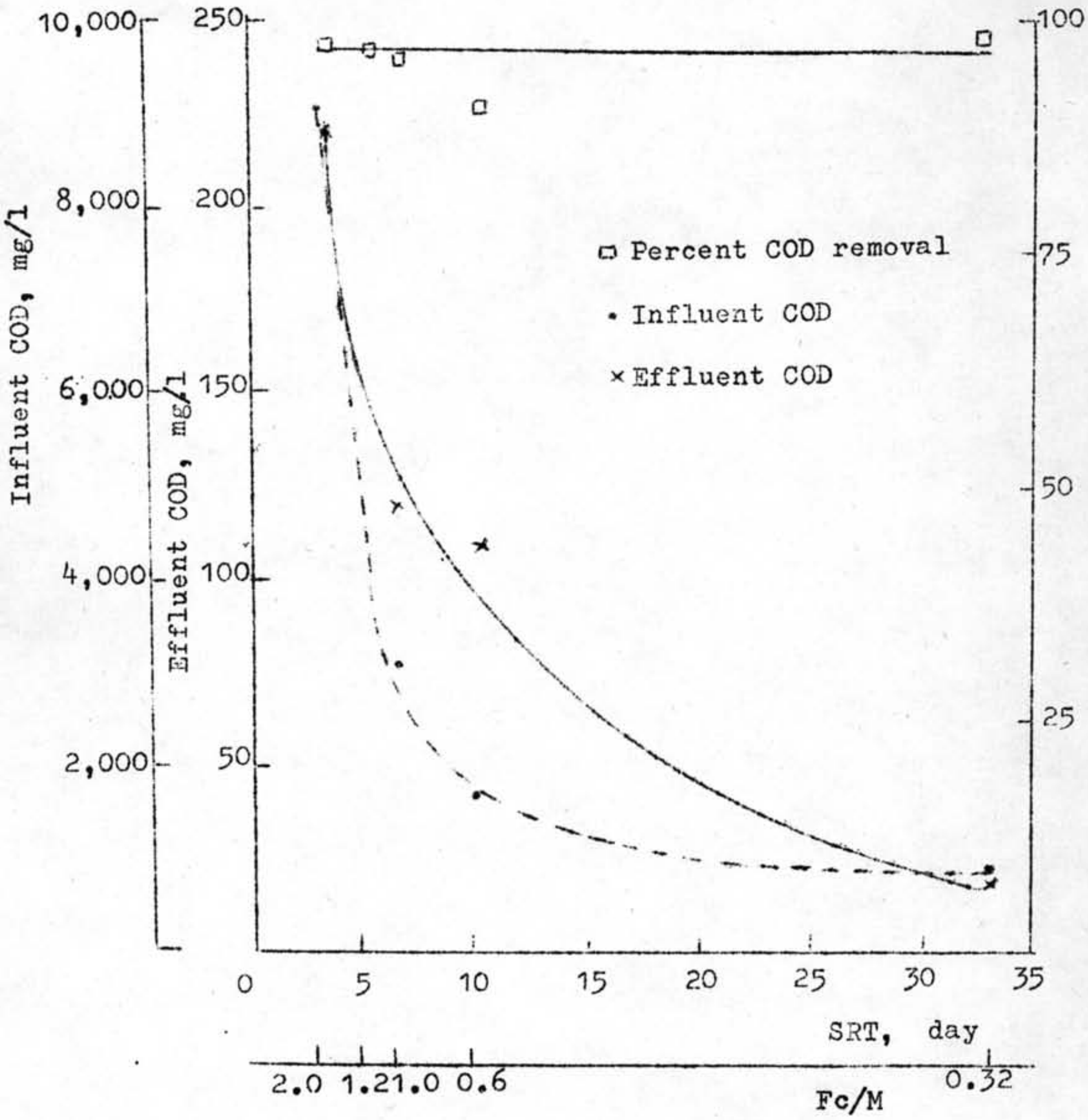

Figure 5.6 Effect of food : microorganism or the solids retention time on the chemical oxygen demand removal efficiency and influent, effluent COD

When the F/M ratio was over 0.8 the BOD concentrations in the effluent would be unacceptable because settling of sludge was fairy poor. The sludge production in system was high, aludge handling would then, be difficult. If sludge handling was inadequate, sludge rising in settle tank might be expected immidiately.

5.7.2 Figure 5.2 and Table A.1 showed percent COD removal and effluent COD related to F/M ratio (or SRT). Percent COD removal was over 90% for any F/M ratios ranging 0.2 to 1.2 (or SRT 33 days to 3.2 days).

The COD removal in the system showed similar trend to the BOD.

5.7.3 Theoretically, the coefficients yielded from the experiment can be applied to the kinetic reaction to predict failure of the system. Accordingly, when the F/M ratio exceeds 1.4 (or SRT less than 2.1 days) the MLSS would be washed out from the system, so the efficiency would be drastically dropped.

Calculation:

Maximum substrate removal, k = 1.15 day^{-1}

Solids yield coefficient, Y = 0.415

Maximum growth rate = 1.15 x 0.415 = 0.4772 day^{-1}

Minimum sludge age $= \frac{1}{0.4772}$ = 21 days

From Figure 5.3 F/M = 1.4

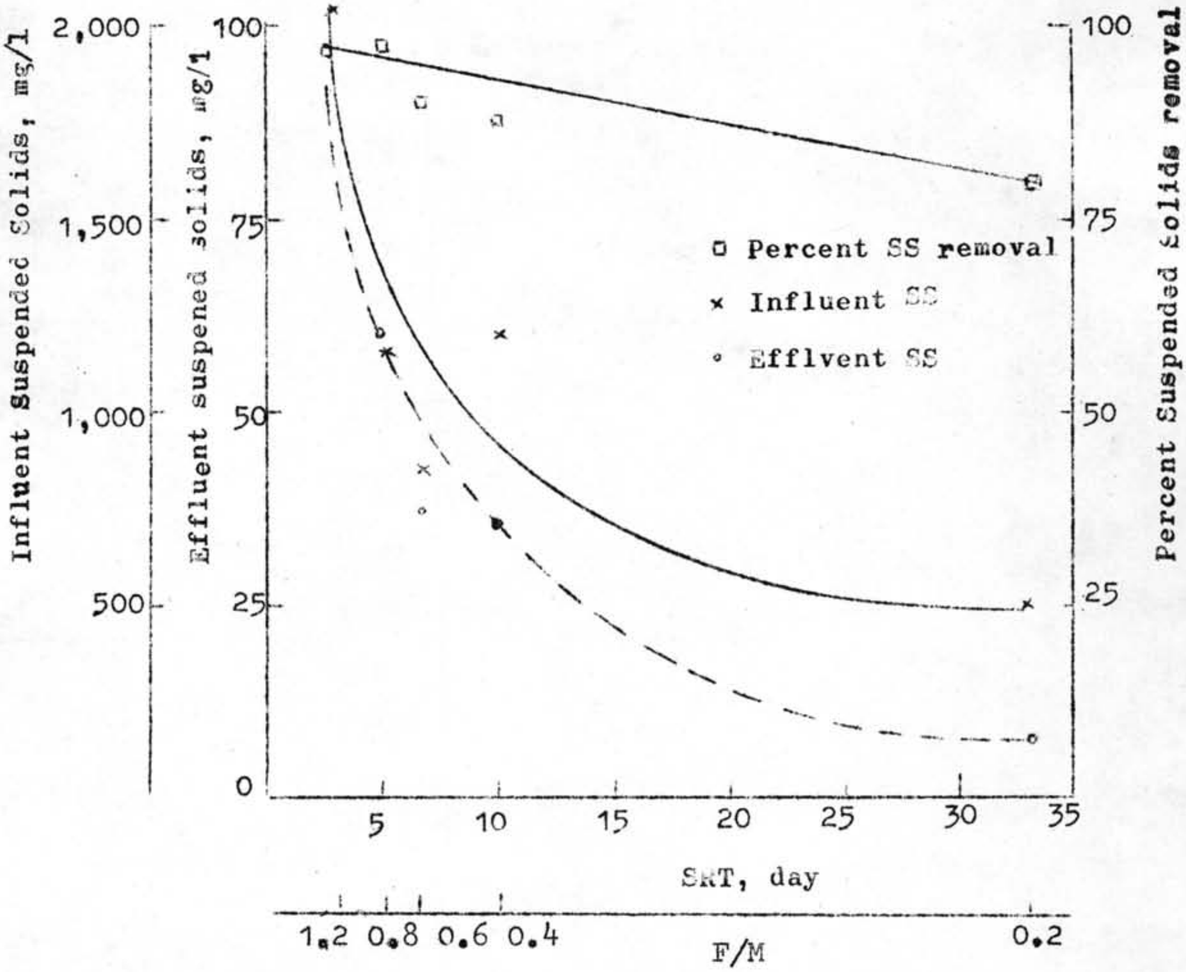

Figure 5.7 Effect of food: microorganism or the Solids retention time on the suspended solids removal efficiency and influent, effluent suspended solids

5.8 Suspended Solids and Total Solids

Figure 5.7 and Table A6 showed percent suspended solids removed related to F/M ratio (or SRT loading) 82 - 92% removal of suspended solids were corresponding with the F/M ratio of 0.2-1.2 (or SRT 33 days - 3.2 days). When the F/M ratio was higher than 0.8 (or SRT 5 days), the SS concentration in the effluent was higher than the specified limit in the standard of the Ministry of Industry.

5.9 Nitrogen

Fish cannery wastewater was mainly composed of nitrogeneous compounds which ensured an excess supply of nitrogen. Table A.7 showed quantity of organic nitrogen and ammonia nitrogen of raw wastewater and effluent wastewater.

5.10 Oxygen Concentration

Eckenfelder suggested that when the oxygen concentration in the mixed liquor was greater than 0.2 - 0.5 mg/l, the rate of baterial respiration was independent of oxygen concentration, but when the oxygen concentration was below this value, the system becomed oxygen dependent and the rate of BOD removal was decreased.(7) When an aeration process is operated below the

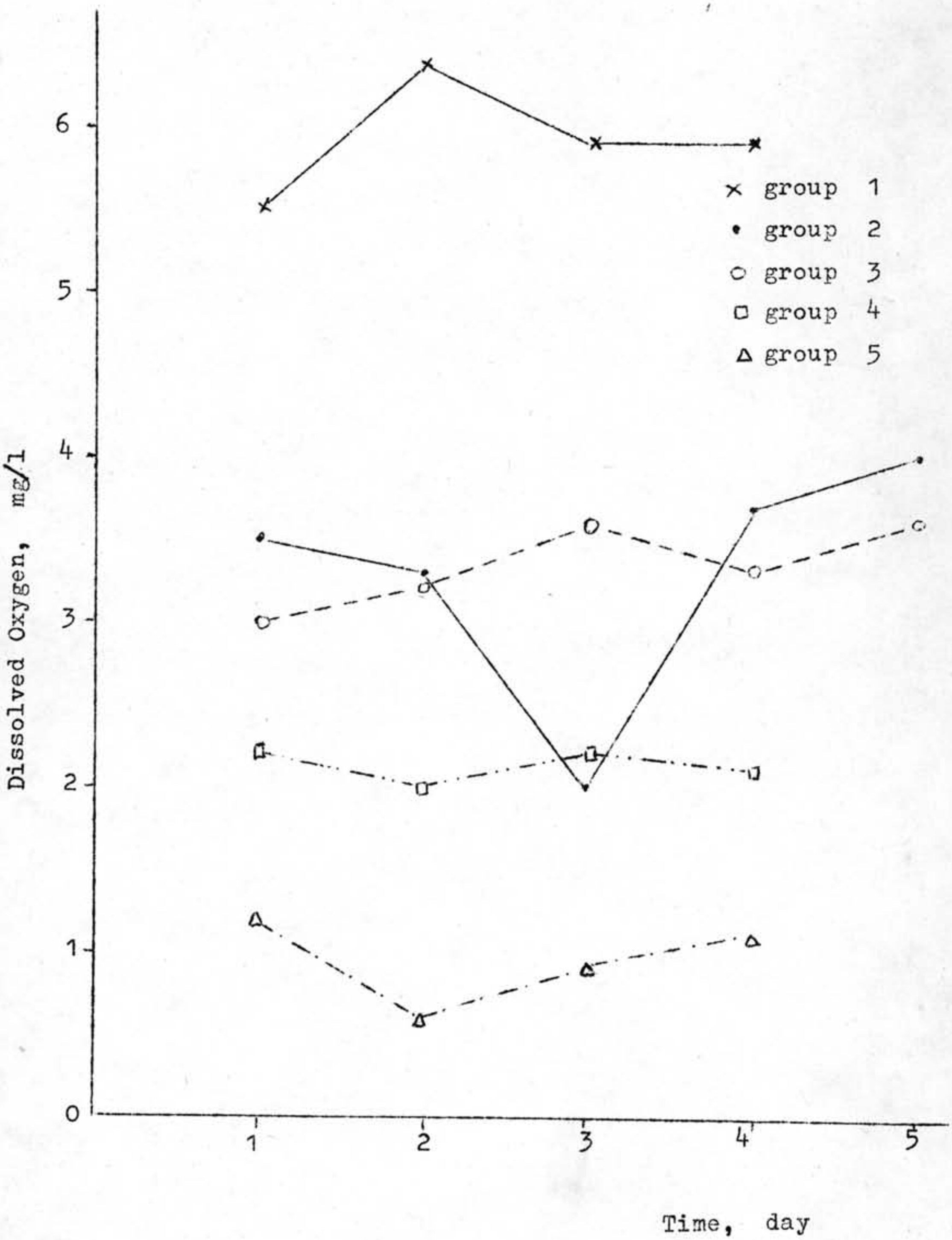

Figure 5.8 Dissolved oxygen in aeration during experiment

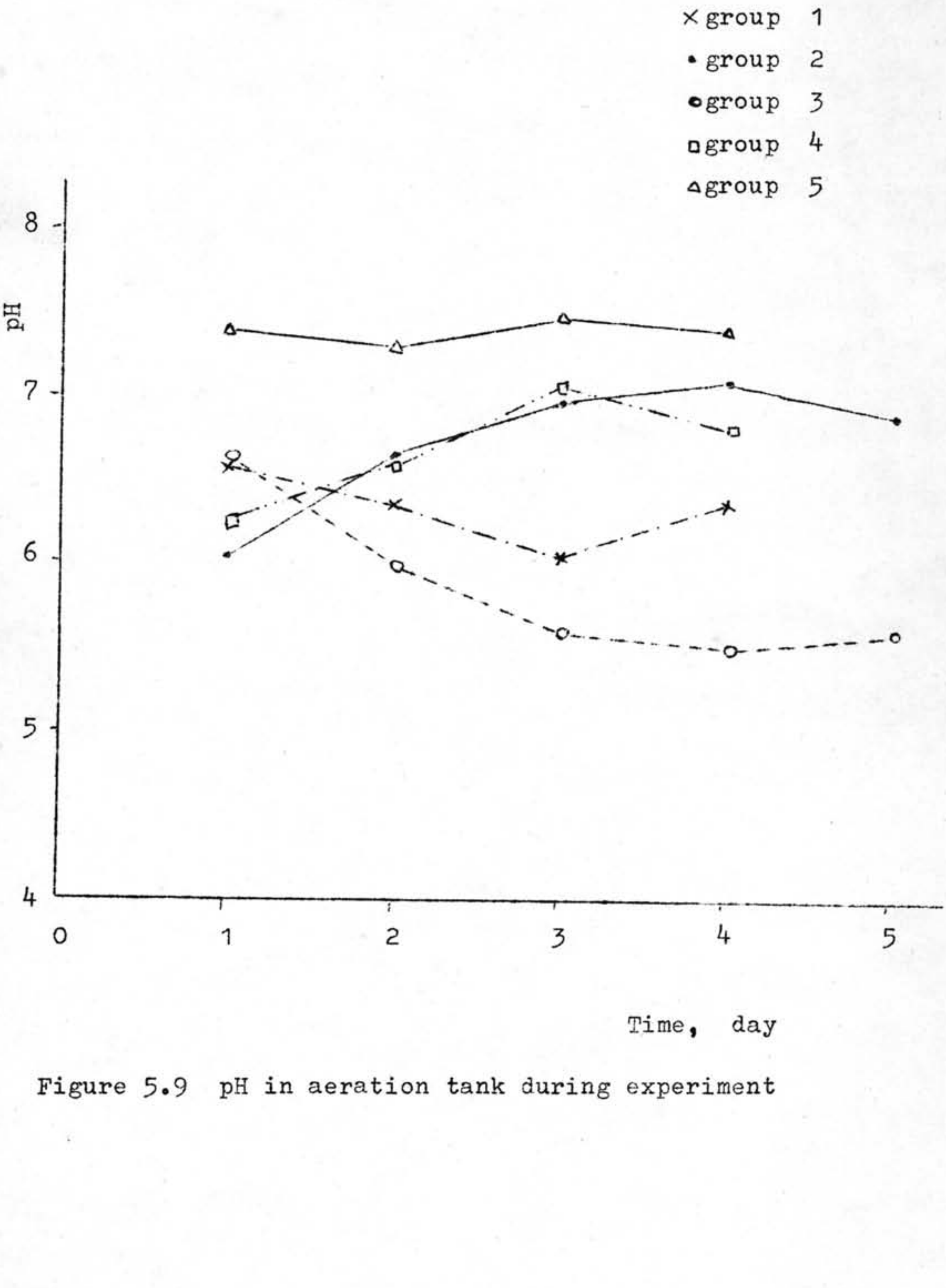

Figure 5.9 pH in aeration tank during experiment

minimum oxygen concentration, the sludge would undergo degradation which would subsequently imposed an oxygen demand on the aeration system.

As the DO of mixed liquor in this experiment was maintained in the range of 2.0 - 6.0 mg/l, the rate of bacterial respiration seemed to be independent of oxygen concentration.

5.11 pH

Influent raw wastewater, mixed liquor, and effluent treated wastewater were examined at the beginning of each day.

The pH of mixed liquor was controlled to be in the range of 6.6 - 7.2 by K_2HPO_4 and KH_2PO_4 solution.

The pH was fluctuating around 5.5 to 7.5 but the removal efficiency of the process was not influenced.

5.12 Error

In this experiment, all the samples were not filtered before BOD and COD analysis, and the MLVSS values were assumed to be constantly 0.9 of the MLSS.

Some errors were duly expected.