Chapter V

ANALYSIS OF OBSERVATIONS

There are two ways to analyse the data observed in the experiments to determine over-all oxygen transfer rate constant (K_{1a}), in aeration tanks without activated sludge:

(1) by graphical method and

(2) by the method of least squares

With the graphical method the overall oxygen transfer rate constant(K_{La}) is computed as the slope of an experimental plot of ($C_s - C_1$) against time of aeration in semi-log paper after fitting by eye a straight line of best fit from the plotted points.

The overall oxygen transfer rate constant (K_{La}) was computed from the data by the method of least **squares.** (FAIR AND GEYER, 1954)

$$N.A + \Sigma X.B = \Sigma Y \qquad (1)$$

$$\Sigma X.A + \Sigma X^2.B = \Sigma XY \qquad (2)$$

where N = number of samples taken

note: samples where C_L is greater than 0.90 C_s are not included in the computation because small deviation have relatively large effect on K_{La} value(FAIR AND GEYER, 1954). However, at least 5 samples should be obtained before 90% saturation is reached (ECKENFELDER, 1966)

X = time elapsed in minutes from the start of aeration rotor.

$Y = \log (C_s - C_1)$

C_s = Saturation value of oxygen (mg/L)

C_1 = dissolved oxygen at time t (mg/L)

B = overall oxygen transfer rate constant with base 10 (i.e. 10^{-Bt})

$K_{La} = \frac{B}{0.4343}$ = overall oxygen transfer rate constant.

K_{La} is corrected to standard conditions of 20°C temperature and one atmosphere pressure i.e. $K_{La(20)}$ for comparision with various rotors under specific conditions of operation by mean of the equation

$$K_{La(20°C)} = K_{La(T)}\theta^{(20-T)}$$

The value of θ range from 1.016 to 1.047 and for this study, a value of 1.024 as suggested by Jones and his Co-Worker, (1969) was used in this study.

In the computation of K_{La}, the correlation between $\log(C_S - C_L)$ and t was computed according to the equation (Downie and Heath, 1970):

$$r \text{ (pearson)} = \frac{N. \Sigma X.Y - (\Sigma X)(\Sigma Y)}{\sqrt{\left[N. \Sigma X^2 - (\Sigma X)^2\right]\left[N. \Sigma Y^2 - (\Sigma Y)^2\right]}}$$

The significance of Pearson r was tested using,

$t = \frac{r}{(1-r)^{\frac{1}{2}}} \times (N-2)^{\frac{1}{2}}$ with (N-2) degrees for freedom. Dowine and Heath, (1970) presented values of r for different levels of significance and degrees of freedom to simplify significance test for Pearson r. For 0.1 percent level of significance r should at least be equal 0.9916 when 5 sets of $\log(C_s - C_l)$ and t are included (or 5 samples), with (5-2) = 3 degrees of freedom.

The correction for C_L due to reagents added during analysis for dissolved oxygen equals $\frac{203}{200}$ = 1.015 (STANDARD METHODS, 1970)

C_s is corrected for chloride equal 0.008 mg/L at temperature 25°C per 100 mg/L chloride in water as suggested by Fair and Geyer, (1954)

In this study the total correction for chloride was taken as 0.02 mg/L in the oxygen saturation value.

Sample calculation for the overall oxygen transfer rate constant by Graphical Method and Least Square Method were shown in Appendix B.

Pearson r and levels of significance for the overall oxygen transfer rate constant were show in Appendix C.