

CHAPTER IVCALCULATION OF RESULTS

There are two methods for the determination of an overall transfer coefficient (K_{La}) under non-steady state aeration of a deoxygenated water, which can be made by:

1. the graphical method and
2. the method of least squares.

By the graphical method, K_{La} is considered from the slope of plotting dissolved oxygen deficit ($C_s - C_1$) against time of aeration in a semi-logarithmic paper as illustrated in Appendix B.

$$K_{La} = \frac{\log_{10} \frac{(C_s - C_1)_{t1}}{(C_s - C_1)_{t2}}}{t2 - t1} \quad \text{min}^{-1}$$

Fair and Geyer (1954) expressed the computation of K_{La} from the data by the method of least squares as follows:

$$n.A + \sum x.B = \sum y \quad \text{----- (1)}$$

$$x.A + \sum x^2.B = \sum xy \quad \text{----- (2)}$$

where :-

- n = number of sample taken
 x = elapsed time in minutes
 y = $\log (C_s - C_L)$
 $(C_s - C_L)$ = dissolved oxygen deficit at any time
 B = overall oxygen transfer rate constant
 with base 10
 K_{La} = $\frac{B}{0.4343}$ = overall oxygen transfer coefficient

K_{La} is corrected to standard conditions of 20°C temperature and one atmospheric pressure.

$$K_{La}(20^\circ\text{C}) = K_{La}(T) \cdot \theta^{(20 - T)}$$

The value of θ varying from 1.016 to 1.047 was found by Jones and his co-worker (1969), and a value of 1.024 was suggested.

In the determination of K_{La} where relationship between $\log(C_s - C_L)$ and time (t) was tested by Pearson (r) value and the significance of Pearson r,

$$\text{Pearson } (r) = \frac{n \cdot \sum xy - (\sum x)(\sum y)}{\sqrt{[n \cdot \sum x^2 - (\sum x)^2] [n \cdot \sum y^2 - (\sum y)^2]}}$$

The significant of Pearson (r) was tested by using, t equal to $\frac{r}{(1 - r)^{\frac{1}{2}}} \times (n - 2)^{\frac{1}{2}}$ with (n - 2) degree of freedom. Downie and Heath

(1970), presented values of (r) for different levels of significance and degrees of freedom to simplify significance test for Pearson (r).

The correction of dissolved oxygen of 0.008 mg/l at 25°C per 100 mg/l chloride in water as suggested by Fair and Geyer (1954) is negligible, this is due to the fact that the present of chloride in tap water is very small.

Determination of oxygen transfer rate.

From $\frac{dc}{dt} = K_{La}(C_s - C_L)$

or $\frac{dC}{dt} = K_{La}(C_s - C_L)V$

where $\frac{dc}{dt} =$ rate of oxygen concentration change, mg/l/hr

$\frac{dC}{dt} =$ rate of oxygen concentration change, mg/hr

$K_{La} =$ overall oxygen transfer coefficient, hr⁻¹

$V =$ volume of aerated water, l.

If $hp =$ power consumption in horse-power

$Kw =$ power consumption in kilo-watt.

Therefore

$$lb O_2/hr/hp = 2.2046 K_{La} (C_s - C_2)V/10^6/hp$$

$$Kg O_2/hr/Kw = K_{La} (C_s - C_2)V/10^6/Kw$$

