Experiment No. 7

Determination of K_La

Objective:

To determine K_La in water

Introduction:

In the model system used for the experiment to determine K_La in water i.e., in the case where no reaction is taking place, the following simplifications are valid:

- $R_0 = 0$ because there is no O_2 sink in the system
- Only data for uptake will be considered in the following equation:

$$\frac{dC_0}{dt} = OTR - OUR = K_L a\left(C_0^* - C_0\right) - R_0$$

The concentration C_0 can be achieved by flushing nitrogen in the system. At time t_0 the degassing with nitrogen is stopped and from time t_0 there is constant aeration. The next phase is one of uptake. The curve obtained for $C_0 = f(t)$ is followed until there are sufficient constant values at the upper end of the curve. For this event following equation is valid:

$$\frac{dC_0}{dt} = OTR = K_L a\left(C_0^* - C_0\right)$$

Solving the above differential equation for the starting conditions $C_0\ (t_0 - t) = C_0^{\ 0}$ results in equation:

$$C_0(t) = C_0^* - \left(C_0^* - C_0^0\right)\exp\left[-K_L a\left(t - t_0\right)\right]$$

To determine the K_La value by the dynamic method, short bursts of measurement with an electrode are necessary so that measurement time with the electrode has no influence on the value of K_La.

Media and materials:

Tap water is used as the medium. Aeration is provided by an aeration system below the stirrer. Compressed air or nitrogen to be used for aeration or degassing the system. The fermenter is thermostatically controlled.

Procedure:

1. Calibrate the DO probe according to the manufacturers' instruction
2. Set the temperature of the fermenter to 20^{o}C
3. Position the DO probe so that the membrane is at the height of the stirrer. Set the probe to measure the percent DO level and allow the probe to reach the temperature of the fermenter.
4. Switch on and set data collector to measure every 5 seconds.
5. Perform the experiment with 1.5 l of medium (water) at 250 rpm
6. Repeat the experiment at various agitation rates of 500, 750 and 1,000 rpm.

Task Required

Calculation of $K_L a$ as a function of agitator speed.