Experiment –7

OBJECTIVE:
Estimation of volumetric oxygen transfer coefficient (K_La) in a fermentor by static method.

INTRODUCTION
In aerobic fermentation processes, the oxygen transfer is met by sparging air, which comes out from sparger as air bubbles in the liquid bulk. The bubbles are then broken down to tiny air bubbles by the action of rotating impellers. This results in increased interfacial area per unit volume for oxygen transfer from the air bubbles to the liquid bulk. In many aerobic fermentation processes, productivity is limited availability of dissolved oxygen. Therefore, it becomes important to estimate K_La in order to determine oxygen transfer capabilities of the fermentor under permissible aeration and agitation conditions.

MATERIALS
a) Bioreactor with agitation and aeration system
b) Dissolved oxygen probe
c) Nitrogen cylinder and air supply
d) Stop watch

THEORY
In this method cells are not present in the fermentor. To begin with, the air supply is cut off, and the dissolved oxygen (DO) in medium is displaced by sparging nitrogen in the medium. Subsequently when the DO falls to zero, agitation is fixed at desired level and nitrogen supply is cut off. Now air supply is started at desired rate. Consequently, oxygen transfer from air bubbles to liquid bulk starts and the DO begins to rise. A trace of DO with time is obtained. Since cells are not present, mass balance for dissolved oxygen, when air supply is resumed following nitrogen shut off, can be written as:

Accumulation = Oxygen supply

i.e., $dC_L/dt = K_La\,(C^* - C_L)$ ………………. (1)

where:
K_La = volumetric oxygen transfer coefficient (h^{-1})
C_L = dissolved oxygen concentration at any time t, (mg O_2/l)
C^* = saturation level of dissolved oxygen in culture medium in the fermentor, (mg O_2/l)

On integration of equation (1),

we get: $\ln [(C^* - C_L)/ C^*] = - K_La.t$ ………………(2)

Then from a plot of $\ln [(C^* - C_L)/ C^*]$ Vs. t, K_La can be estimated from the slope of the line.

OBSERVATION

Table-1: DO vs time data after air supply is resumed

Aeration rate : 0.1 VVM
Agitation : 200 RPM

Time(sec)								
DO(%)								

Table-2: DO vs time data after air supply is resumed
Aeration rate : 0.1 VVM
Agitation : 400 RPM

Time(sec)								
DO(%)								

Table-3: DO vs time data after air supply is resumed
Aeration rate : 0.5 VVM
Agitation : 400 RPM

Time(sec)								
DO(%)								

Table-4: DO vs time data after air supply is resumed
Aeration rate : 0.5 VVM
Agitation : 800 RPM

Time(sec)								
DO(%)								

RESULTS Attach graphs and report the values of K_La in h^{-1} for each set

DISCUSSION Write a discussion on your results.