1128
B. E. (Biotechnology)
Fifth Semester
BIO-512: Bio-Processes Engineering

Time allowed: 3 Hours   Max. Marks: 50

NOTE: *Attempt five questions in all, including Question No. 1 which is compulsory and selecting two questions from each Section. Assume any missing data.*

x-x-x

1.

    a. Why is the measured value of $Y_{x/s}$ not necessarily constant across the growth phase of a yeast process?

    b. What are the distinct advantages of fed-batch systems in bioprocessing?

    c. Define aseptic operation and containment.

    d. What is meant by specific oxygen uptake rate?

    e. What is the significance of critical oxygen concentration during fermentations.

    f. Draw a relationship between shear stress and shear strain?

    g. What are the various complexities one comes across in the case of biochemical reactions?

    h. Define yield factor.

    i. Define limiting substrate.

    j. How do you describe the effect of T on sterilization?

SECTION-A

2. What is Newton's law of viscosity? Define coefficient of viscosity. Explain the rheology of non-Newtonian fluids.   (10)

3. A) Estimate the dilution rate which gives maximum biomass in a continuous bioreactor 10 tonnes/day of microbial cells. If $S_0 = 100$ kg m^{-3}; $\mu_{max} = 0.15$ h^{-1}; $k_s = 1$ kg m^{-3} and $Y_{x/s} = 0.5$ kg kg^{-1}. Also, estimate the reactor volume.

    B) Describe the criteria for the choice of a bioreactor for immobilized systems. What are the various types of bioreactor suitable?   (6,4)

4. To scale up an aerobic microbial culture from the well-characterized 50L pilot scale to the 1500 L process scale, calculate the following ratios based on the constant Reynold's number where

scale II is 1500 L and scale I is 50 L. if you are not able to answer one or more parts, at least state whether the ratio will be greater than less than or equal to one. A) Stirring speed N_{II}/N_I B) Power imparted per volume fluid $(P/V)_{II}/(P/V)_I$ C) state reasons whether scaling up in this manner is a good or bad idea.

(10)

SECTION-B

5. Consider an air-sparged, strirred-tank bioreactor. It is large volume process, and you have data suggesting that dissolved oxygen is unacceptably heterogeneous within the reactor. In an attempt to shorten the blend time, you increase the stirring speed of the impeller by a factor of 2. a) Estimate the factor by which power imparted by the impeller changes b) estimate the factor by which the value of k_La changes c) Give reasons why this change may be detrimental.

(10)

6. A) What are the essential attributes of an industrial medium in the fermentation medium? Describe the simple and complex media with examples.

B) Describe the process of oxygen transfer from the air bubble to the cell or cell cluster in fermentation broths.

(6,4)

7. A)What is the importance of sterilization in bioprocessing?Describe the process of batch sterilization / continuous sterilization.Write short note on sterilization of the fermenter.

B) Describe the various methods for measuring k_La. Compare and contrast the static method and dynamic method for the measurement of k_La.

(6,4)

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