component. Unstructured models cannot describe transient behavior very well. Some models are *segregated*; they recognize that not all members of the population are identical, and the distribution of properties among individual cells is important. *Nonsegregated models* ignore these distributions and assume that population-average parameters are adequate.

These models apply not only to batch culture but also to continuous culture. The primary form of continuous culture is a steady-state CFSTR or *chemostat*. A chemostat ensures a time-invariant growth environment. The net growth rate is equal to the dilution rate, which is determined by the flow rate to the chemostat. Thus, the growth rate can be manipulated by the investigator. A *turbidostat* adjusts flow rate to maintain a constant cell density. A turbidostat operates well at high flow rates (near the washout point) and is useful in selecting cellular subpopulations that have adapted to a particular stress.

SUGGESTIONS FOR FURTHER READING

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PROBLEMS

6.1. A simple, batch fermentation of an aerobic bacterium growing on methanol gave the results shown in the table. Calculate:

- **a.** Maximum growth rate (μ_{max})
- **b.** Yield on substrate ($Y_{X/S}$)
- **c.** Mass doubling time (t_d)
- **d.** Saturation constant (K_s)
- **e.** Specific growth rate (μ_{net}) at $t = 10$ h