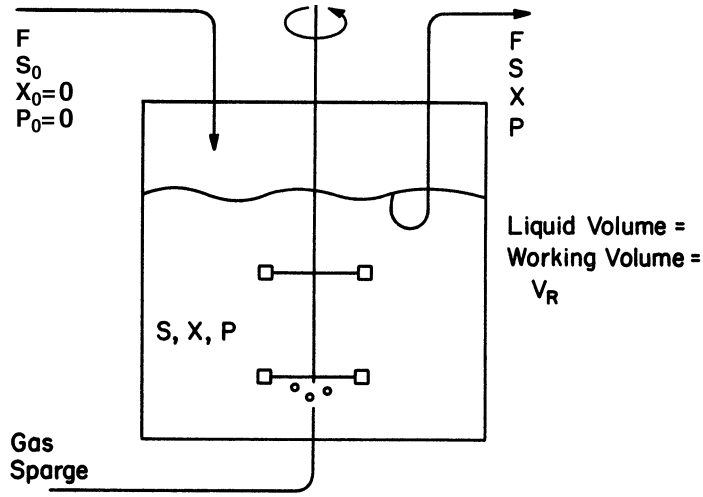

Figure 6.18. Simplified schematic of a chemostat.

where F is the flow rate of nutrient solution (l/h), V_R is the culture volume (l) (assumed constant), X is the cell concentration (g/l), and μ_g and k_d are growth and endogenous (or death) rate constants, respectively (h^{-1}). The reader should note that if cell mass is the primary parameter, it is difficult to differentiate cell death from endogenous metabolism. When we use k_d, we imply that endogenous metabolism is the primary mechanism for cell mass decrease. With k'_d, we imply that cell death and lysis are the primary mechanisms of decrease in mass. The reader should also note that, if eq. 6.64 had been written in terms of cell number, k_d could only be a cell death rate. When balances are written in terms of cell number, the influence of endogenous metabolism can appear only in the substrate balance equation. Since most experiments are done by measuring total cell mass rather than number, we write our examples based on X. However, the reader should be aware of the ambiguity introduced when equations are written in terms of X.

Equation 6.64 can be rearranged as

$$\frac{dX}{dt} = DX_0 + (\mu_g - k_d - D)X \tag{6.65}$$

where D is *dilution rate* and $D = F/V_R$. D is the reciprocal of residence time.

Usually, the feed media are sterile, $X_0 = 0$, and if the endogenous metabolism or death rate is negligible compared to the growth rate ($k_d << \mu_g$) and if the system is at steady state ($dX/dt = 0$), then

$$\mu_g = D \quad (\text{if } k_d = 0) \tag{6.66}$$

In a chemostat, cells are removed at a rate equal to their growth rate, and the growth rate of cells is equal to the dilution rate. *This property allows the investigator to manipulate growth rate as an independent parameter* and makes the chemostat a powerful experimental tool.