TABLE 16.2 Typical Monod Model Parameters for the Activated-sludge Process

Waste-water composition	Kinetic coefficients				
	μ_m (h^{-1})	K_s (mg/l)	$Y^M_{X/S}\left(\frac{\text{mg M}}{\text{mg waste}}\right)$	k_d (h^{-1})	Basis
Domestic	0.4–0.55	50–120	0.5–0.67	$2.0–3.0 \times 10^{-3}$	BOD_5
Shellfish processing	0.43	96	0.58	5.8×10^{-2}	BOD_5
Yeast processing	0.038	680	0.88	3.3×10^{-3}	BOD_5
Phenol	0.46	1.66 $K_i = 380$	0.85		Phenol
Plastic processing	0.83	167	0.30	3.3×10^{-3}	COD

With permission, from D. W. Sundstrom and H. E. Klei, *Wastewater Treatment,* Pearson Education, Upper Saddle River, NJ, 1979, p. 146.

Thus, these operating parameters provide more than adequate BOD_5 removal, as 3.57 mg/l is significantly less than 20 mg/l.

A value for X can be found from eq. 16.39.

$$V = \frac{Y^M_{X/S}\theta_c F(S_0 - S)}{X(1 + k_d\theta_c)} \tag{16.39}$$

$$X = \frac{Y^M_{X/S}\theta_c F(S_0 - S)}{V(1 + k_d\theta_c)}$$

$$X = \frac{(0.5)(120\ \text{h})(400\ \text{m}^3/\text{h})(800 - 3.57)\ \text{mg/l}}{3200\ \text{m}^3(1 + 0.005\ \text{h}^{-1}\ 120\ \text{h})}$$

$$X = 3733\ \text{mg/l}$$

The amount of sludge produced is, from either eq. 16.36 or 16.37,

$$\theta_H = V/F = \frac{(1-\gamma)X_e + \gamma X_r}{\mu_{\text{net}} X} \tag{16.37}$$

Since $1/\mu_{\text{net}} = \theta_c$ and $X_e = 0$,

$$F\gamma X_r = \frac{VX}{\theta_c} = \text{sludge production rate}$$

$$F\gamma X_r = \frac{(3200\ \text{m}^3)(3733\ \text{mg/l})(1000\ \text{l}/1\ \text{m}^3)}{120\ \text{h}}$$

or

$$F\gamma X_r = 9.95 \times 10^7\ \text{mg/h}$$
$$= 99.5\ \text{kg/h}$$

Although not required by the question, we could use eq. 16.40 to get a value of X_r, since $\alpha = 0.40$. Once X_r is known, γ can then be calculated if needed.