

$$C_{O_2}^* = \frac{pO_2}{H} = H(26^\circ C) = 24,6 \frac{\text{atm} * \text{m}^3}{\text{kg}} \rightarrow$$

$$C_{O_2}^* = \frac{0,2 \text{ atm} * \text{kg}}{24,6 \text{ atm} * \text{m}^3} = 0,0083 \frac{\text{kg}}{\text{m}^3} = 8,26 \frac{\text{g}}{\text{m}^3} = 0,0083 \frac{\text{g}}{\text{L}}$$

$$OTR = K_{La}(C_{O_2}^* - C_{O_2}) \quad (\text{assumption: } O_2 \text{ saturation is } 30\%)$$

$$OTR = 800 \text{ h}^{-1} \left( 0,0083 \frac{\text{kg}}{\text{m}^3} - \left( 0,3 * 0,0083 \frac{\text{kg}}{\text{m}^3} \right) \right) = 4,648 \frac{\text{kg}}{\text{m}^3 * \text{h}}$$

$$\text{assumption: } V_{\text{broth}} = V_{\text{tank}} = 26,16 * 10^5 \text{ L} = 2616 \text{ m}^3$$

$$\text{total } O_2 \text{ input} = V_T * OTR = 2616 \text{ m}^3 * 4,648 \frac{\text{kg}}{\text{m}^3 * \text{h}} = 12159,17 \frac{\text{kg } O_2}{\text{h}}$$

$$\text{maximal possible CDM production rate} = \frac{\text{total } O_2 \text{ input}}{O_2 \text{ demand}}$$

$$\text{max CDM production rate} = \frac{12159,17 \frac{\text{kg } O_2}{\text{h}}}{0,8 \frac{\text{kg } O_2}{\text{kg CDM}}} = 15,198,96 \frac{\text{kg CDM}}{\text{h}}$$

b) maximal CDM produced:

$$OTR = X * Y_{X/O_2} * \mu$$

$$X_{\text{max}} = \frac{OTR}{Y_{X/O_2} * \mu} = \frac{4,648 \frac{\text{kg } O_2}{\text{m}^3 * \text{h}}}{0,8 \frac{\text{kg } O_2}{\text{kg CDM}} * 0,12 \text{ h}^{-1}} = 48,42 \frac{\text{kg CDM}}{\text{m}^3} = 48,43 \frac{\text{g CDM}}{\text{L}}$$

$$\text{maximal CDM produced} = X_{\text{max}} * V_T = 48,42 \frac{\text{kg CDM}}{\text{m}^3} * 2616 \text{ m}^3 = 126.658 \text{ kg} = 127 \text{ t}$$