ME 485 CH4 - Hw Sol. S.S. D. Jula

4.15 Concentrations yielding acceptable risks:

a. benzene, oral, 10^{-5} risk, potency = 2.9×10^{-2} $(mg/kg\text{-}d)^{-1}$

Risk = CDI x Potency

$$10^{-5} = \frac{2\,L/d \times C\ mg/L \times 350\ d/yr \times 30\ yr}{70\ kg \times 365\ d/yr \times 70\ yr} \times \frac{2.9\times10^{-2}}{mg/kg\text{-}d}$$

$$C = \frac{10^{-5} \times 70 \times 365 \times 70}{2 \times 350 \times 30 \times 2.9\times10^{-2}} = 0.03\ mg/L$$

b. trichloroethylene in air, risk 10^{-6}, inhalation potency 1.3×10^{-2}:

$$10^{-6} = \frac{20\ m^3/d \times C\ mg/m^3 \times 350\ d/yr \times 30\ yr}{70\ kg \times 365\ d/yr \times 70\ yr} \times \frac{1.3\times10^{-2}}{mg/kg\text{-}d}$$

$$C = \frac{10^{-6} \times 70 \times 365 \times 70}{20 \times 350 \times 30 \times 1.3\times10^{-2}} = 6.6\times10^{-4}\ mg/m^3$$

c. benzene in air, risk 10^{-5}, potency 2.9×10^{-2}:

4.18 DDT in fish = C (mg/L) x BCF (L/kg); from Table 4.12, BCF = 54,000 L/kg

Risk = CDI x Potency

$$Risk = \frac{0.020\ mg/L \times 54{,}000\ L/kg \times 0.002\ kg/d}{70\ kg} \times \frac{0.34}{mg/kg\text{-}d} = 0.01$$

4.23 Infiltration of 120 m^3/hr, 0.1 mg BaP/cigarette, 1 cigarette per hour:

a. Find the steady-state concentration

Input rate = Output rate

1 cig/hr x 0.1 mg/cig = 120 m^3/hr x C mg/m^3

C = 0.1/120 = 0.00083 mg/m^3

b. living for a year with a smoker:

$$CDI = \frac{0.00083\frac{mg}{m^3} \times 20\frac{m^3}{day} \times \frac{1\ day}{24\ hr} \times 8\frac{hr}{day} \times 365\ day}{70\ kg \times 365\ d/yr \times 70\ yr} = 1.1\times10^{-6}\ mg/kg-d$$

Risk = CDI x Potency = 1.1×10^{-6} mg/kg-d x 6.11 $(mg/kg\text{-}d)^{-1}$ = 7×10^{-6}

4.24 260 million people, 2L/day, 360d/yr, 30yr, find risk and incremental cancers for,

a. trichloroethylene at 0.005 mg/L:

Risk = CDI x Potency

$$\text{Risk} = \frac{2\text{L/d} \times 0.005\ \text{mg/L} \times 360\ \text{d/yr} \times 30\ \text{yr}}{70\ \text{kg} \times 365\ \text{d/yr} \times 70\ \text{yr}} \times \frac{1.1\times10^{-2}}{\text{mg/kg - d}} = 6.6\times10^{-7}$$

$$\Delta\ \text{cancer} = \frac{260\times10^{6}\ \text{people} \times 6.6\times10^{-7}\ \text{cancer / person - life}}{70\ \text{yr/lifetime}} = 2.5\ \text{cancer/yr}$$

b. benzene at 0.005 mg/L:

$$\text{Risk} = \frac{2\text{L/d} \times 0.005\ \text{mg/L} \times 360\ \text{d/yr} \times 30\ \text{yr}}{70\ \text{kg} \times 365\ \text{d/yr} \times 70\ \text{yr}} \times \frac{2.9\times10^{-2}}{\text{mg/kg - d}} = 1.75\times10^{-6}$$

$$\Delta\ \text{cancer} = \frac{260\times10^{6}\ \text{people} \times 1.75\times10^{-6}\ \text{cancer / person - life}}{70\ \text{yr/lifetime}} = 6.5\ \text{cancer/yr}$$

c. arsenic at 0.05 mg/L:

$$\text{Risk} = \frac{2\text{L/d} \times 0.05\ \text{mg/L} \times 360\ \text{d/yr} \times 30\ \text{yr}}{70\ \text{kg} \times 365\ \text{d/yr} \times 70\ \text{yr}} \times \frac{1.75}{\text{mg/kg - d}} = 1.05\times10^{-3}$$

$$\Delta\ \text{cancer} = \frac{260\times10^{6}\ \text{people} \times 1.05\times10^{-3}\ \text{cancer / person - life}}{70\ \text{yr/lifetime}} = 3925\ \text{cancer/yr}$$

d. carbon tetrachloride at 0.005 mg/L:

$$\text{Risk} = \frac{2\text{L/d} \times 0.005\ \text{mg/L} \times 360\ \text{d/yr} \times 30\ \text{yr}}{70\ \text{kg} \times 365\ \text{d/yr} \times 70\ \text{yr}} \times \frac{0.13}{\text{mg/kg - d}} = 7.9\times10^{-6}$$

$$\Delta\ \text{cancer} = \frac{260\times10^{6}\ \text{people} \times 7.9\times10^{-6}\ \text{cancer / person - life}}{70\ \text{yr/lifetime}} = 29\ \text{cancer/yr}$$

e. vinyl chloride at 0.002 mg/L:

$$\text{Risk} = \frac{2\text{L/d} \times 0.002\ \text{mg/L} \times 360\ \text{d/yr} \times 30\ \text{yr}}{70\ \text{kg} \times 365\ \text{d/yr} \times 70\ \text{yr}} \times \frac{2.3}{\text{mg/kg - d}} = 5.6\times10^{-5}$$

$$\Delta\ \text{cancer} = \frac{260\times10^{6}\ \text{people} \times 5.6\times10^{-5}\ \text{cancer / person - life}}{70\ \text{yr/lifetime}} = 206\ \text{cancer/yr}$$

f. PCBs at 0.0005 mg/L:

$$\text{Risk} = \frac{2\text{L/d} \times 0.0005\ \text{mg/L} \times 360\ \text{d/yr} \times 30\ \text{yr}}{70\ \text{kg} \times 365\ \text{d/yr} \times 70\ \text{yr}} \times \frac{7.7}{\text{mg/kg - d}} = 4.6\times10^{-5}$$

$$\Delta\ \text{cancer} = \frac{260\times10^{6}\ \text{people} \times 4.6\times10^{-5}\ \text{cancer / person - life}}{70\ \text{yr/lifetime}} = 172\ \text{cancer/yr}$$