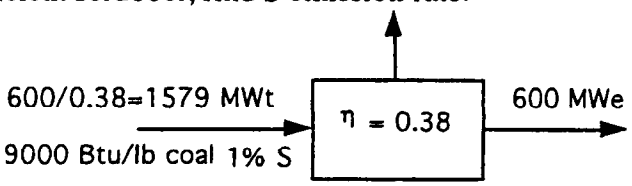
7.1 From (1.8), $mg/m^3 = \frac{ppm \times mol\ wt}{24.465}$ (at 1 atm and 25°C)

a. $CO_2 mg/m^3 = \frac{5000ppm \times (12+2x16)}{24.465} = 8992mg/m^3 \approx 9000mg/m^3$

b. $HCHO\ ppm = \frac{24.465 \times 3.6\ mg/m^3}{(2x1 + 12 + 16)} = 2.94ppm$

c. $NO\ mg/m^3 = \frac{25ppm \times (14+16)}{24.465} = 30.7mg/m^3$

7.2 70% efficient scrubber, find S emission rate:



$$\text{Input} = \frac{600{,}000\ kWe}{0.38} \times \frac{3412\ Btu}{kWhr} \times \frac{lb\ coal}{9000Btu} \times \frac{0.01\ lb\ S}{lb\ coal} = 5986\ lb\ S/hr$$

70% efficient, says release 0.3 x 5986 lbS/hr = 1796 lb S/hr ≈1800 lbS/hr

7.3 If all S converted to SO_2 and now using a 90% efficient scrubber:

$$SO_2 = 0.1 \times \frac{5986\ lbS}{hr} \times \frac{(32+2x16)\ lb\ SO_2}{32\ lb\ S} = 1197\ lb\ SO_2/hr \approx 1200\ lb\ SO_2/hr$$

7.4 70% scrubber, 0.6 lb $SO_2/10^6$ Btu in, find % S allowable:

a. $$\frac{X\ lbs\ S}{lbs\ coal} \times \frac{0.3\ lbs\ S\ out}{1\ lb\ S\ in} \times \frac{2\ lbs\ SO_2}{lb\ S} \times \frac{lb\ coal}{15{,}000Btu} = \frac{0.6\ lb\ SO_2}{10^6 Btu}$$

$$X = \frac{15{,}000 x 0.6}{0.3x2x10^6} = 0.015 = 1.5\%\ S\ fuel$$

b. $$\frac{X\ lbs\ S}{lbs\ coal} \times \frac{0.3\ lbs\ S\ out}{1\ lb\ S\ in} \times \frac{2\ lbs\ SO_2}{lb\ S} \times \frac{lb\ coal}{9{,}000Btu} = \frac{0.6\ lb\ SO_2}{10^6 Btu}$$

$$X = \frac{9{,}000 x 0.6}{0.3x2x10^6} = 0.009 = 0.9\%\ S\ fuel$$

7.5 Compliance coal:

$$\frac{1.2 \text{ lbs } SO_2}{10^6 \text{ Btu}} = \frac{\text{lb coal}}{12{,}000 \text{ Btu}} \times \frac{X \text{ lb S}}{\text{lb coal}} \times \frac{2 \text{ lb } SO_2}{\text{lb S}}$$

$$X = \frac{1.2 \times 12{,}000}{2 \times 10^6} = 0.0072 = 0.7\%S$$

7.6 Pollutant Standards Index:

Pollutant	Standard	Day 1 (index)	Day 2 (index)	Day 3 (index)
O_3 (1hr)	0.12	0.15 (>100)	0.18 (>100)	0.12 (=100)
CO (8hr)	9	12 (>100)	9 (=100)	14 (>100)
PM 10	150	150 (=100)	350 (=200)	90 (<100)
SO_2	0.14	0.12 (<100)	0.28 (<200)	0.14 (=100)
NO_2	0.6 alert	0.4 none	0.3 none	0.5 none

a. Day 1, both O_3 and CO are above 100:

$$O_3 \text{ subindex} = 100 + \frac{(0.15 - 0.12)x100}{(0.20 - 0.12)} = 137.5$$

so PSI = 150 Unhealthful

$$\text{CO subindex} = 100 + \frac{(12 - 9)x100}{(15 - 9)} = 150$$

b. Day 2, highest is PM 10 at 200, so PSI = 200, Very Unhealthful

c. Day 3, CO is the highest, so

$$\text{PSI (CO)} = 100 + \frac{(14 - 9)x100}{(15 - 9)} = 183$$

7.7 8 hrs of CO at 50.ppm, from (7.6):

$$\%\text{COHb} = 0.15\%\left(1 - e^{-0.402 \text{ hrs } 8\text{hr}}\right)x50 = 7.2\%$$

7.8 $$\%\text{COHb} = 0.15\%\left(1 - e^{-0.402t}\right)(\text{ppm}) = 0.15\%\left(1 - e^{-0.402x1}\right)x436 = 21.6\%$$

To reach 10% COHb,

$$10 = 0.15\left(1 - e^{-0.402t}\right)x436 = 65.4 - 65.4e^{-0.402t}$$

$$e^{-0.402t} = \frac{55.4}{65.4} = 0.871 \qquad \text{so } t = -\frac{1}{0.402}\ln(0.871) = 0.41 \text{ hr}$$