

# Problem Set #2

## Solutions

1. Using %I, calculation for intermediate value (USEPA Method 5, Eq. 5-8)

$$\%I = 100 \frac{T_s V_m(std) P_{std}}{T_{std} v_s P_s \theta 60 A_n (1 - B_{ws})}$$

$$\%I = 100 \frac{(460 + 296)(38.8)(29.92)}{(460 + 68)(49.8)(30.3 + \frac{(-0.25)}{13.6})(60)(60) \left[ \pi \left( \frac{(0.248)}{2(12)} \right)^2 \right] (1 - 0.065)}$$

$$\%I = 100 \frac{(756)(38.8)(29.92)}{(528)(49.8)(30.28)(60)(60)(3.142)(1.0678 \times 10^{-4})(0.935)}$$

$$\%I = 96.4\%$$

2. From the first problem:

$$\%I = 97.5\% \frac{(0.935)}{(1 - 0.073)}$$

$$\%I = 97.5 \frac{0.935}{0.927}$$

$$\%I = 97.2\%$$

3. Using %I, calculation for final: (USEPA Method 5, Eq. 5-7)

$$\%I = 100 \frac{T_s \left[ V_{lc} K_4 + \left( \frac{V_m \gamma}{T_m} \right) \left( P_{BAR} + \left( \frac{\Delta H}{13.6} \right) \right) \right]}{60 \theta v_s P_s A_n}$$

$$\%I = 100 \frac{(460 + 300) \left[ 100(0.002669) + \left( \frac{(40)(1)}{(460 + 70)} \right) \right] \left[ 30.26 + \frac{1.5}{13.6} \right]}{(60)(60)(50) \left( 30.26 + \frac{0.2}{13.6} \right) \pi \left( \frac{0.25}{(2)(12)} \right)^2}$$

$$\%I = 100 \frac{(760)(2.559)}{1857.35}$$

$$\%I = 104.7\%$$

4. Stack Moisture:

$\rho_w$  (Rho) = Density of water = 1 g/ml  
Convert to lbs (454g/lb)  
 $1/454 = 0.002201$

R = Ideal gas constant

$$V_{wc(std)} = \frac{(V_f - V_i)}{P_{std} M_w} \rho_w R T_{std}$$

$$V_{wc(std)} = \frac{(125)}{(29.92)(18)} (0.002201)(21.85)(460 + 68)$$

$$V_{wc(std)} = 5.8936 \text{ ft}^3$$

$$V_{wsg(std)} = \frac{(W_f - W_i) R T_{std}}{P_{std} M_w K_2}$$

$$V_{wsg(std)} = \frac{(20.6)(21.85)(460 + 68)}{(29.92)(18)(453.6)}$$

$$V_{wsg(std)} = 0.97285 \text{ ft}^3$$

$$V_{m(std)} = V_m Y \left[ \frac{P_m T_{std}}{P_{std} T_m} \right]$$

$$V_{m(std)} = (45)(1) \left( \frac{(30.25)(460 + 68)}{(29.92)(460 + 90)} \right)$$

$$V_{m(std)} = 43.6747 \text{ ft}^3$$

$$B_{ws} = \frac{V_{wc(std)} + V_{wsg(std)}}{V_{m(std)} + V_{wc(std)} + V_{wsg(std)}}$$

$$B_{ws} = \frac{(5.8936) + (0.97285)}{(43.6747) + (5.8936) + (0.97285)}$$

$$B_{ws} = 13.58\%$$