

Example Calculation:

1000 acfm of air contains 50 ppm of benzene. You wish to remove this benzene in a bed of activated carbon. How many pounds of carbon should be in the bed, if a lifetime of 2 months is acceptable?  
2 weeks

$$Qct = WM_{bed}$$

$$Q = 1000 \frac{ft^3}{min} \times \left( \frac{0.305 m}{ft} \right)^3 = \frac{28.4 m^3}{min}$$

$$MW_{benzene} = \frac{12 \times 6 = 72}{78}$$

$$C = \frac{50 \frac{mols}{10^6 \text{ mol air}} \times 78 \frac{g C_6H_6}{mole C_6H_6}}{29 \frac{g air}{mole air}} = 1.34 \times 10^{-4} \frac{g C_6H_6}{g air}$$

$$t = \frac{2 \text{ mos} \times 30 \text{ d} \times 24 \text{ hr} \times 60 \text{ min}}{1 \text{ day} \times 7 \text{ mo} \times 2} = \frac{129600 \text{ min}}{20160}$$

$$c = \frac{50 \text{ mols } C_6H_6}{10^6 \text{ mols air}} \times \frac{78 \text{ g } C_6H_6 / \text{mole } C_6H_6}{29 \text{ L air / mole air}} \times \frac{1000 \text{ L}}{m^3} = \frac{0.15 \text{ g } C_6H_6}{m^3}$$

$$M_{bed} = \frac{Qct}{W} = \frac{\left[ \frac{28.4 \frac{m^3 air}{min}}{m^3 air} \right] \left[ \frac{0.15 \text{ g } C_6H_6}{m^3 air} \right] \left[ \frac{129600 \text{ min}}{20160} \right]}{W}$$

$$= \frac{85801}{W} \text{ g } C_6H_6 \text{ or } \frac{85.9 \text{ kg}}{W} \text{ Kg } C_6H_6$$

$$\text{If } W \sim 0.35,$$

$$M_{bed} = 1529 \text{ Kg } \text{ or } 245 \text{ kg } \text{ or } 540 \text{ lb.}$$

$$\text{If } \rho_c \sim 1 \text{ g/cm}^3, = \frac{1000 \text{ kg}}{m^3} \text{ If } \rho_c \sim 60 \frac{lb}{ft^3}, \text{ then } \sim 9 \text{ ft}^3 \text{ carbon}$$

$$\text{If depth is } 3'', \text{ need surface of } 36 \text{ ft}^2 \text{ or } 9 \text{ panels, } 2 \times 2 \times 3''$$