ChE 400 Applied Chemical Engineering Calculations
Fall 2008
HW-2
Due 09/24/08 (at the beginning of the class)

Problem Solving Methodology Homework

Reminder: Follow the Homework presentation guidelines given in the syllabus. There will be a quiz associate with the content of the material covered in chapter one the same day this homework is due (last 15 minutes of class)

Gas leak in a lab. A gas leak has led to the presence of 1.00 mole% carbon monoxide in a 350-m^3 laboratory. The leak was discovered and sealed, and the laboratory is to be purged with clean air to a point at which the air contains less than the OSHA (Occupational Safety and Health Administration specified Permissible Exposure Level (PEL) of 35 ppm (molar basis). Assume that the clean air and the air in the laboratory are at the same temperature and pressure and that the laboratory air is perfectly mixed throughout the purging process.

a. Let t_r(h) be the time required for the specified reduction in the carbon monoxide concentration. Write an equation to solve for the CO moles in the lab as a function of time, letting N equal the total moles of gas in the room (assume constant), x the mole fraction of CO in the room air, and vp(m^3/h) the flow rate of purge air entering the room (and also the flow rate of laboratory air leaving the room).

b. Integrate the balance to derive an equation for t_r in terms of vp.

c. Plot the profile of the contaminant concentration vs. time. Discuss the results shown in the graph.

d. If the volumetric flow rate is 700 m^3/h (representing a turnover of two room volumes per hour), how long will the purge take? What would the volumetric flow rate have to be to cut the purge time in half?

e. Give several reasons why it might not be safe to resume work in the laboratory after the calculated purge time has elapsed? What precautionary steps would you advise taking at this point?