fugacities of the gas species in the gas phases and in the solution. From eq. (13.12), the solubility of the gas in the liquid is

$$x_i = \frac{y_i P}{k_i^H}.$$ (13.13)

This result states that the solubility (mol fraction of gas in the liquid) is proportional to the partial pressure of the gas above the liquid and inversely proportional to the value of k_i^H. That is, a high value of Henry's law constant indicates low solubility, and vice versa.

   If Henry's law constant is known, eqs. (13.11) and (13.12) may be used to calculate the composition of phases at equilibrium. In many cases of practical interest the solubility of the gas in the liquid is so low that the liquid phase is nearly the pure solvent. This allows us to write $\gamma_s \approx 1$, which eliminates the need for an activity coefficient model and simplifies the VLE equations to

$$y_s P = x_s P_s^{\text{sat}},$$ (13.14)

$$y_i P = x_i k_i^H.$$ [13.12]

Any of the standard VLE calculations can be performed but the simplest one is the bubble-P calculation. First, we add the above equations to eliminate the gas-phase compositions,

$$P = x_s P_s + x_i k_i^H.$$ superscript "sat"

Next we set $x_s = 1 - x_i$ and solve for the concentration of the solute in the liquid:

$$x_i = \frac{P - P_s^{\text{sat}}}{k_i^H - P_s^{\text{sat}}}.$$ (13.15)

This gives the solubility of the gas at total pressure P. The remaining compositions are calculated easily by back substitution.

Other Units for Henry's Law Constant

Solving eq. (13.12) for k_i^H we have

$$k_i^H = \frac{y_i P}{x_i} = \frac{P_i}{x_i},$$ (13.16)

where P_i is the partial pressure of the gas above the saturated liquid and x_i is the mol fraction of the gas in the liquid. This equation expresses Henry's law constant as the ratio of the partial pressure of the gas to the solubility of the gas in the liquid. Henry's law constant can be measured experimentally by application of this