$$y_w P = x_w P_w^{\text{sat}},$$

$$y_c P = x_c k^H,$$

where the subscript c stands for carbon dioxide. We add the two equations and solve for the mol fraction of carbon dioxide in the liquid:

$$x_c = \frac{P - P_w^{\text{sat}}}{k^H - P_w^{\text{sat}}}.$$

remove extraneous "-2" denominator should read "809.229-0.00706"

At 2 °C the value of Henry's constant is 809.229 bar and from the steam tables the saturation pressure of water is 0.00706 bar. By numerical substitution,

$$x_c = \frac{2 - 0.00706}{809.229 - 2 - 0.00706} = 2.46 \times 10^{-3}.$$

Comments As long as the can contains some gas above the liquid, the assumption of equilibrium is valid, provided that the can has been stored at 10 °C for a sufficient period of time.

Example 13.9: Henry's Law Constant From an Equation of State

Calculate Henry's law constant for carbon dioxide in n-pentane at 10 bar, 250 K using the SRK equation of state with $k_{12} = 0.12$.

Solution The fugacity coefficients are calculated from eq. (10.21) with all the necessary parameters given in Table 9-2. With $T = 250$ K, $P = 10$ bar, $x_1 = 0$, $x_2 = 1$, we calculate the following values for the various parameters of pure component and mixture:

	Mixture	CO_2	n-pentane
a	2.94591	0.43021	2.94591
b	0.000100397	0.0000297156	0.000100397
da/dT	−0.00602914	−0.00119522	−0.00602914
C_i'		5.31651	14.1173

The parameter A' and B' of the mixture are

$$A' = 0.681898, \quad B' = 0.0483024.$$

The cubic equation for the compressibility factor is

$$Z^3 - Z^2 + 0.631263Z - 0.0329373 = 0,$$

which has one real root:

$$Z = 0.0570364.$$