**Topic 910**

**Compressions: Isothermal: Solutes: Partial Molar Compressions**

A given aqueous solution at temperature $T$ and near ambient pressure $p$ contains a solute $j$ at molality $m_j$. The chemical potential $\mu_j(aq)$ is related to the molality $m_j$ using equation (a).

$$\mu_j(aq) = \mu_j^0(aq) + R \cdot T \cdot \ln(m_j / m^0) + R \cdot T \cdot \ln(\gamma_j)$$ (a)

Then $V_j(aq) = V_j^\infty(aq) + R \cdot T \cdot [\partial \ln(\gamma_j) / \partial p]_T$ (b)

By definition, the partial molar isothermal compression of solute $j$,[1]

$$K_{Tj}(aq) = -\left(\frac{\partial V_j(aq)}{\partial p}\right)_T$$ (c)

Then $K_{Tj}(aq) = K_{Tj}^\infty(aq) - R \cdot T \cdot [\partial^2 \ln(\gamma_j) / \partial p^2]_T$ (d)

Thus by definition, $\lim_{m_j \to 0} K_{Tj}(aq) = K_{Tj}^\infty(aq)$ (e)

Hence the difference between $K_{Tj}(aq)$ and $K_{Tj}^\infty(aq)$ depends on the second differential of $\ln(\gamma_j)$ with respect to pressure.

**Footnotes**

[1] The formal definition of $K_{Tj}(aq)$ is given by equation (a).

$$K_{Tj}(aq) = \left(\frac{\partial K_T}{\partial n_j}\right)_{T,p,n(\neq j)}$$ (a)

However, $K_T = -(\partial V / \partial p)_{T,n(j)}$ (b)

Then, $K_{Tj}(aq) = -\left(\frac{\partial(\partial V / \partial n_j)}{\partial p}\right)_{T,p,n(\neq j)}$ (c)

Or, $K_{Tj}(aq) = -\left(\frac{\partial V_j(aq)}{\partial p}\right)_T$ (d)

In other words, equation (c) shows that $K_{Tj}(aq)$ is a Lewisian partial molar property.