2.15: Gas Mixtures - Amagat's Law of Partial Volums

Amagat's law of partial volumes asserts that the volume of a mixture is equal to the sum of the partial volumes of its components. For a mixture of components A, B, C, etc., Amagat's law gives the volume as

$$V_{mixture} = V_A + V_B + V_C + \ldots$$

For real gases, Amagat's law is usually an even better approximation than Dalton's law[6]. Again, for mixtures of ideal gases, it is exact. For an ideal gas, the partial volume is

$$V_A = \frac{n_A RT}{P_{mixture}}$$

Since $n_{mixture} = n_A + n_B + n_C + \ldots$, we have, for a mixture of ideal gases,

$$\begin{aligned} V_{mixture} &= \frac{n_{mixture}\, RT}{P_{mixture}} \\ &= \frac{(n_A + n_B + n_C + \ldots)\, RT}{P_{mixture}} \\ &= V_A + V_B + V_C + \ldots \end{aligned}$$

Applied to the mixture, the ideal-gas equation yields Amagat's law. Also, we have $V_A = x_A V_{mixture}$.