

The Concatenated Gas Saturation Apparatus for the Measurement of Low Vapor Pressures

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The measurement of vapor pressures of fluids and solids in the range of 0.05 to 10 Pa is particularly challenging. One cannot easily use direct techniques such as ebulliometry, or indirect techniques such as effusion. The best approach for this pressure range is probably the gas saturation method, in which a carrier gas stream is saturated with the vapor of a condensed phase. The vapor is then stripped from a measured volume of the saturated carrier gas, the amount of vapor is determined, and the vapor pressure is calculated by assuming ideal gas behavior. In our recently constructed apparatus, the carrier gas (SF_6) flows through a series of eighteen “concatenated” saturator-adsorber pairs. In this way it is possible to make eighteen simultaneous vapor pressure measurements, which greatly speeds data collection. After stopping the flow of carrier gas, the adsorbed material is eluted from each adsorber and analyzed by gas chromatography with flame ionization detection. The volume of carrier gas is determined by weighing the SF_6 supply cylinder before and after the flow of carrier gas, and then converting the mass of SF_6 to a volume with a high accuracy equation of state. An important advantage of the concatenated approach is that it allows for simultaneous measurements on a control sample with a well known vapor pressure curve. In this talk, we will focus on the development of the concatenated approach from single cell instruments, the major sources of uncertainty, and the scope and prospects for future measurements.