Guidelines For Selecting The Appropriate Adsorptive

The type of adsorptive gas selected for a surface area analysis depends upon the objective of the analysis. The gas chosen to characterize the surface may not be the best gas to use if the objective is to study adsorption phenomenon. Guidelines for selecting the appropriate adsorptive are offered here. The bases of these guidelines may involve the gas-solid interaction, the instrument system, or the data reduction method.

Krypton or Nitrogen?

Some materials, such as organic materials, powdered metals, and certain geological samples have surface areas below 1 m^2/g and adsorb a very small quantity of gas. When working with these materials, it is advantageous to increase the difference between the quantity of gas dosed and the quantity of gas remaining after equilibrium. Krypton has a saturation pressure approximately 1/300 that of nitrogen at liquid nitrogen temperature (krypton: 2.5 torr; nitrogen: 760 torr). Therefore, compared to nitrogen, there is in the free space above the sample about 1/300 the number of krypton molecules present at the same relative pressure. Since about the same number of krypton and nitrogen molecules are required to form a monolayer, this number represents a far greater proportion of the quantity dosed than in the case of nitrogen.

Nitrogen or Argon for Micropore Analysis?

Argon is inert, and its molecule is spherical, monatomic, and nonpolar. Nitrogen is diatomic, nonspherical, and has a quadrupole moment which may lead to localized adsorption, particularly on adsorbents with polar sites. Argon and nitrogen molecules are similar in size and, other than for nitrogen adsorption on polar sites, adsorb with similar heats of adsorption. The boiling point of argon at standard pressure is 87.29 K and of nitrogen is 77.35 K.

Argon at liquid argon temperature is preferable to nitrogen or argon at LN_2 temperature as a probe molecule in studies of microporosity. Being inert is an advantageous attribute in regard to the solid-surface interaction because there are fewer specific interactions. Being at a higher temperature provides the experimental advantage of shorter equilibrium times. In addition, the argon pressure at which a given pore width fills is higher than with nitrogen and therefore is easier to measure accurately.