data and the structural and chemical factors that influence the surface properties, thereby achieving predictive knowledge regarding powder behavior during processing. In this type of study, a range of nonpolar and polar adsorbates (probes) is used, for example, alkanes, from hexane to decane; acetone; diethyl ether; and ethyl acetate. The retention volume, that is, the net volume of carrier gas (nitrogen) required to elute the probe, is then measured.

The IGC is a gas-phase technique for characterizing the surface and bulk properties of solid materials. The principles of IGC are very simple, being the reverse of a conventional GC experiment. A cylindrical column is uniformly packed with the solid material of interest, typically a powder, fiber, or film. A pulse or constant concentration of gas is then injected down the column at a fixed carrier gas flow rate, and the time taken for the pulse or concentration front to elute down the column is measured by a detector. A series of IGC measurements with different gas-phase probe molecules then allows access to a wide range of physicochemical properties of the solid sample. The flow and retention of gas are shown in Figure 7.3.

The injected gas molecules passing over the material adsorb on the surface with a partition coefficient K_s:

$$K_s = V_N/W_s \tag{7.1}$$

where V_N is the net retention volume—the volume of carrier gas required for eluting the injection through the column, and W_s is the mass of the sample. V_N is a measure of extent of the interaction of the probe gas with the solid sample and is the fundamental data obtained from an IGC experiment. A wide range of surface and bulk properties can be calculated from it. The surface partition coefficient (K_s) of the probes between carrier gas and surfaces of test powder particles can then be calculated. From this, a free energy can be calculated, which can show that one batch may favorably adsorb the probes when compared with another, implying a difference in the surface energetics. The experimental parameter measured in IGC experiments is the net retention volume, V_N. This parameter is related to the surface partition coefficient, K_s,

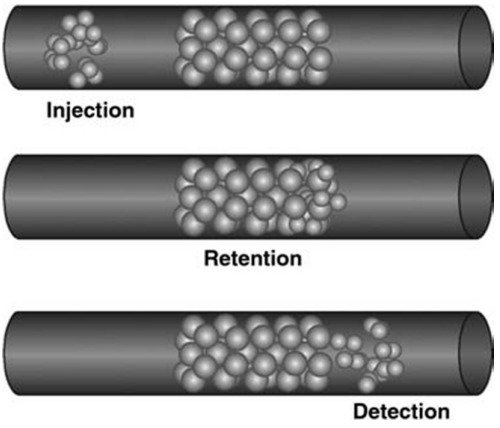

FIGURE 7.3 Inverse gas chromatography principles.