STUDY WATER SORPTION

Water sorption, including desorption and adsorption, provides the degree of "hygroscopicity" of the formulation by plotting the increase in water content of a dry cake as a function of relative humidity to which the sample has been exposed at a given temperature. The curve indicates water vapor sorption characteristics; in other words, the degree of ease in secondary drying. Although the desorption process is not a straightforward reversal of the adsorption, the trends are predictive. In general, the easier the water adsorption, the easier the water desorption.

To conduct a water sorption study, the product was stored in desiccators with solid salt or saturated salt solutions for 48 hours of equilibration at an ambient temperature (Fig. 8). The salts included phosphorus pentoxide, lithium chloride, potassium acetate, magnesium chloride, potassium carbonate, and sodium chloride, which generated relative humidities of approximately 0%, 11%, 23%, 33%, 43%, and 75%, respectively. The vials were sealed immediately after equilibration. The moisture in the lyophilized product was determined by the Karl Fischer method.

Figure 9 shows a typical water adsorption, curve for a typical crystalline matrix-type formulation. Such characteristics of a freeze-dried formulation provide information on the affinity of water for a dried product. It illustrates a progressive increase in water content as the relative humidity is increased. When samples were exposed to relative humidities from 6% to 75%, the resultant moisture content ranged from approximately 1.2% to 17%. This indicated that the lyophilized product was moderately hygroscopic in the relative humidity range of 6% to 43%, and more hygroscopic at relative humidities above 43%. The crystalline material is often "drying friendly" because only the surface of crystals is available for water vapor sorption. In addition, the degree of hygroscopicity of the formulation also provides guidance for product handling, for example in the case of measuring moisture content for product release. Figure 9 also shows that in an environment where the relative humidity was

FIGURE 8 A demonstration of conducting a moisture sorption study with desiccators.