



FIGURE 9 Water adsorption curves generated from desiccator method and DVC methods.

greater than 75%, which is common under a noncontrolled laboratory environment during a wet day, the moisture content could increase to as high as 17%. This suggests how important it is to control the environmental relative humidity during the moisture testing. Another tool for determining water sorption is Dynamic Vapor Sorption (DVS, Surface Measurement System, London, U.K.). It measures weight changes due to moisture gain at different relative humidity conditions. This instrument also provides information on water sorption kinetics. Figure 9 also includes the results from the DVS method. The DVS data were comparable to those obtained by incubating the material in desiccators and indicate that moisture could be removed rapidly during secondary drying.

OPTIMIZE MOISTURE CONTENT

Lyophilization is a process to remove water so that the water activity, or the mobility of the water, in the dried product can be reduced to an optimal level. This is achieved by using a secondary drying cycle. As a result, fully understanding the effects of the moisture content on product stability becomes the most important information necessary to develop a secondary drying. Generally speaking, for any formulation there is an optimal range of moisture content that would result in the best stability of the lyophilized product. Hsu et al. reported that there is an optimum residual moisture range for a lyophilized recombinant protein (25). Overdrying may result in opalescence in the product upon reconstitution, while underdrying leads to a greater protein activity loss upon storage under temperature stress conditions. Greiff (26) and Liu et al. (27) revealed that aggregation or insoluble proteins can be induced by a moisture content that was higher than the optimal range.