humidity in the same increments. The kinetics of absorption can also be studied by subjecting samples to the same incremental humidity changes but by varying the times spent by different samples at each percentage of RH. In addition, the percentage of RH at which a transition occurs between an amorphous structure and a crystalline structure can be determined. An API may be more stable, more processable, or more soluble (giving the impression of different pharmacological activity) in one form or another and hence must be formulated, packaged, and handled to maintain that form. In general, four possible basic vapor sorption profiles are observed—the compound can be found to be nonhygroscopic, vapor sorption is reproducible, vapor sorption curves demonstrate a degree of hysteresis, or the vapor sorption is nonreproducible because of deliquescence, development of nonreversible hydrates, or other reasons.

Vapor sorption is reproducible when the rate at which a compound acquires moisture during humidity increases is matched by the rate at which it loses moisture during humidity decreases. If the rates are the same, then scientists can control the moisture-compound ratio simply by controlling the humidity levels, without having to consider the specific history of the material. Hence, if a batch of material has a certain water-compound ratio in facility A and acquires more water as it is moved across a humid environment to facility B, one can restore the original ratio by insuring that B's humidity level is the same as A's (and waiting for an adequate amount of time). If vapor sorption is not reproducible, then one will need to know how the absorption rate differs from the desorption rate and the precise humidity conditions that the material undergoes as it is transported from A to B, as the history of the material will affect the amount of moisture present in the material. Of course, whether vapor sorption is reproducible or not, it takes time to raise or lower the water content under certain humidity and temperature conditions. What is considered to be an adequate time can be ascertained experimentally by preformulation studies of the kinetics of vapor sorption for a particular compound, which focus not only on the amount of water absorbed or released but also on the time it takes for the processes to occur.

While the moisture content of the sample at any given RH is dependent on the history of the sample, all the moisture gained by the sample in the adsorption phase is eventually lost in the desorption phase.

While most experiments conducted using the vapor sorption analyzer involve monitoring weight changes at constant temperatures and varying humidity levels, the instrument can also be used to measure changes in weight when incrementally altering temperature, while maintaining a constant humidity.

Other methods and instruments to test the effects of temperature include the DSC and the TGA. The DSC measures the amount of energy (as heat) absorbed or released as a sample is heated, cooled, or held at constant temperature. These measurements provide information on effects such as glass transition, crystallization, and melting point and provide quantitative insight into the composition of a sample. When the sample is heated, inorganic salts first split off their water of crystallization, and then, other volatile components evaporate. The weight loss indicates the amount of water or volatile components in the sample. The TGA also helps formulators understand the decomposition behavior. Although some similar information can be obtained with the vapor sorption analyzer, the TGA is a specialized instrument that allows users to measure effects at much higher temperatures. They can even set the starting and ending temperatures and control the speed at which the temperature rises or falls.