AquaSorp Isotherm Generator Method

A moisture sorption isotherm for a food product is the relationship between water activity (a_w) and moisture content at a given temperature. This relationship is complex and unique for each product due to different interactions between the water and the solid components at different moisture contents. Moisture sorption isotherms are sigmoidal in shape for most foods and J-shaped for crystalline material. Isotherms are important for new product development, ingredient research, shelf-life estimation and to fully understand the moisture within a product.

The traditional method to obtain a moisture sorption isotherm is to place a food, either dried (absorption), hydrated (desorption) or native (working), into controlled humidity chambers at constant temperature and then measure the weight until equilibrium, as measured by constant weight, is established. Six to nine different humidity levels are needed and vapor equilibration must be achieved, which may take one to three weeks. Due to the large amount of time and labor necessary to obtain an isotherm, they are not routinely made for food products.

The AquaSorp creates isotherms using a water activity and gravimetric analysis method called Dynamic Dew Point Isotherm (DDI). Decagon Devices' new AquaSorp Isotherm Generator instrument makes determination of isotherms quick and automatic. The AquaSorp Isotherm Generator is simple to use and consists of inserting a food sample into the instrument, setting a few parameters for the experiment, and walking away. The AquaSorp Isotherm Generator using the DDI method is the only isotherm instrument that directly measures water activity using Decagon's patented chilled mirror dewpoint technique. Desorption and adsorption are achieved by flowing wet or dry air respectively, and moisture loss and gain are determined by weight changes. The instrument generates the complete absorption and desorption isotherms in approximately 24 hrs with >50 points on each isotherm curve.

AquaSorp Isotherm Generator controls neither the water content nor the water activity, but dries or wets the sample and measures the water activity and water content during the wetting or drying process. Water content is determined by weighing the sample during wetting and drying using a magnetic force balance. Water activity is determined using a standard chilled- mirror dewpoint sensor. Drying is imposed by passing air through desiccant before it enters the sample chamber. Wetting is imposed by saturating the air with water before it enters the chamber. The water chamber is an integral part of the measurement chamber to ensure humidity saturation and minimize temperature fluctuation. The main part of the isotherm generator will consist of a case which houses the power supply, air pump, balance, temperature controlled sample chamber, sensor block, sample, sensor and temperature control electronics, water reservoir, and desiccant supply. Another advantage of the Decagon instrument will be the integrated air pump, which eliminates the need for gas cylinders. This method generates robust isotherms with hundreds of data points much faster than other methods because the sample does not have to equilibrate to a known humidity level.

Utilizing the new AquaSorp Isotherm Generator allows the rapid and detailed creation of isotherms for new product development, ingredients characterization, packaging requirements, and many other moisture research concerns. A few uses for isotherms include:

- Monolayer moisture content determination
- Determine critical water activity or moisture content limits for crispness, hardness, and flow properties
- Maximize moisture contents at safe water activities through formulation adjustment
- Adjust drying process controls to achieve a safe water activity that maximizes moisture content and avoids over drying.
- Determine shelf life and storage stability of a product
- Predict packaging requirements based on sorption properties of a product
- Determine the equilibrium water activity of a mixture of two dry ingredients
- Determine the degree of crystallinity of powders
- Determine the level of amorphous material in a product
- Determine critical water activities for phase transitions
- Determine the relationship between water activity and glass transition temperature
- Determine the relationship between water activity and crystallization temperature
- Determine hysteresis levels for a product
- Determine the moisture sensitivity of a product
- Determine the equilibrium moisture content at a given water activity

Printed in USA

13499 06-30-15