

Application Note 1501

Background

Dynamic Water Vapour Sorption is the method of choice to determine water uptake and to record sorption isotherms of materials like powders, granules, flakes, tablets or candies. Sorption testers are often used to perform stability testing of new products. These long-term tests may run over several weeks or even months giving valuable results with respect to the influence of temperature and relative humidity on the shelf-life of a product.

Further on, the analysis of how much water vapour permeates through the packaging at particular climatic conditions is of high importance. Sorption of water migrated into the package from the outside atmosphere has a major impact on the shelf-life of a packaged product.

Sample Tray for Large Objects

The SPS and Vsorp sorption testers with their high balance sensitivity along with their large dynamic load range of up to 220g enable the analysis of fine powder samples with a minimum sample amount as well as large objects with high resolution and accuracy.

The Large Objects Tray for large samples (see Figure 1) that is available for the SPS as well as the Vsorp series is designed to hold product packages of dimensions up to 88mm length, 68mm width and 28mm in height.

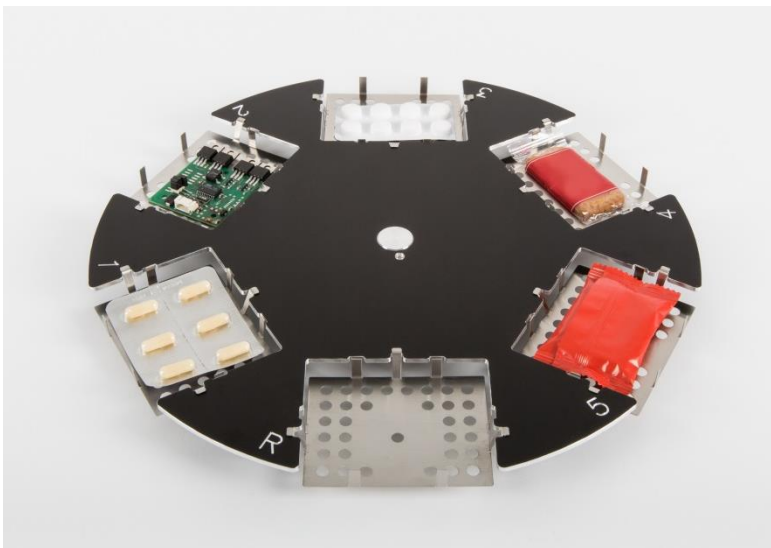


Figure 1 - Large Object tray with 5 sample positions and one reference pan for moisture sorption analysis of product packages.



Application Note 1501

Food Application – Candy Packages

Water uptake of three candy packages using the LO sample tray with a SPSx-1 μ High Load sorption tester was measured. Figure 1 shows the three packages placed on the sample tray. The samples on the positions 1 and 3 were without an additional film packaging whereas sample 2 was enveloped with a transparent plastic film.

The test was done at constant 25°C. The packages were dried at 0% RH first, then humidity was increased rapidly to 90% RH. Weighing was done every 10 minutes.

Discussion

The sorption curves in Figure 2 show that water uptake of the two types of packaging was significantly different. In case of the samples without film packaging, increasing RH from 0% to 90% first caused a rapid uptake of water. In the further course of the test, water vapour migrating through gaps into the inside of the packaging was taken up by the candy at a constant rate resulting in a nearly linear increase of sample weight.

Water vapour sorption by the sample with film packaging took place at a much smaller rate. The plastic around the package, although still permeable for water vapour, provides a much better diffusion barrier than the package itself, slowing down the rate at that water molecules get sorbed by the candy inside the package. Nevertheless a distinct sorption rate could be clearly determined.

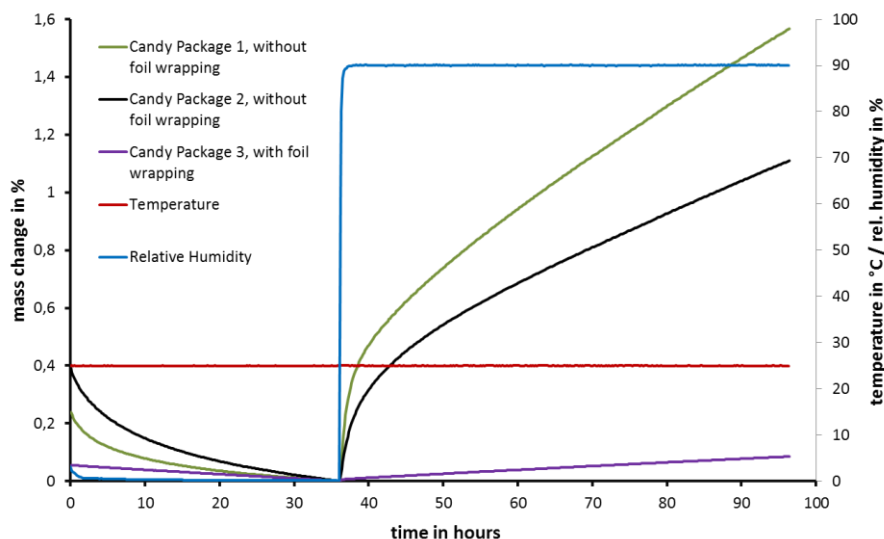


Figure 2 - Sorption kinetics curves of different types of candy packages when increasing RH from 0% to 90%, measured at constant 25°C.

The smaller scale in Figure 3 enables a closer look on the sorption behaviour of the sample with an additional film packaging. The abrupt jump in sample weight immediately after increasing RH to 90% indicates adsorption of water molecules to the surface of the film. Following surface coverage, water molecules diffuse through the film at a constant rate and get adsorbed by the candy inside the package as well as by the package itself.

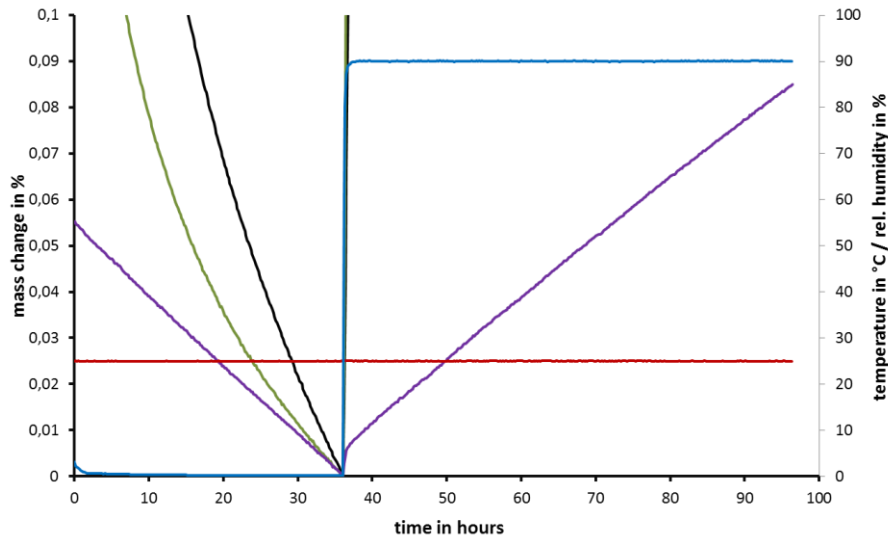


Figure 3 - Sorption kinetics curve of a candy package enveloped with plastic film when increasing RH from 0% to 90%.

Permeability rate

The permeability rate was determined from the slope of the linear part of the sorption curve. With the surface area of the packaging not known, the unit is [g/day]. If the surface area of a film packaging is known, the standard unit [g/day*m²] for permeability tests according to the EN ISO 7783-1 is used.

Package 1 (green line): 0.056 g/day Film Package (purple line): 0.006 g/day
Package 2 (black line): 0.042 g/day

Conclusions

- The SPS and Vsorp sorption systems are well suited to analyse water vapour sorption of large samples such as product packages.
- Determination of the water vapour permeability rate (g/day) of product packages is feasible even at sealed packages.
- The sample tray for large objects adds another dimension of the analysis capabilities of the SPS and Vsorp multi-sample sorption testers, enabling the analysis of the sample material itself as well as the final product in its packaging.
- The applicability of the sorption tester is thereby extended from research and product development to the process of package design, increasing the instrument value to the end-user.