



Dynamic Water Vapor Sorption

Multi-Sample Moisture Sorption Analyzer – SPS





The Smart Sorption Solution

The SPS series offers fully automated multi-sample analysis for gravimetric water vapor sorption and combines easy operation with a robust design to deliver reliable, highly sensitive measurements.



Multi-Sample Instrument

Fully automated high throughput test system to measure up to 23 samples simultaneously.



Unique Comparability of Samples

Direct sample comparison under the same climate conditions in one measurement.



Outstanding Precision and Long-Term Stability

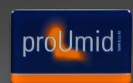
No drift effects and precise closed loop temperature and humidity regulation.



User-Friendly Handling

Easy handling, easy to clean, easy access to measurement chamber.





Dynamic Water Vapor Sorption (DVS)

Moisture

Virtually all materials interact more or less strongly with humidity. Knowledge of moisture-induced changes of the material properties is an important key parameter for decisions regarding processing, packaging, storage and shelf life of a product.

Dynamic Water Vapor Sorption

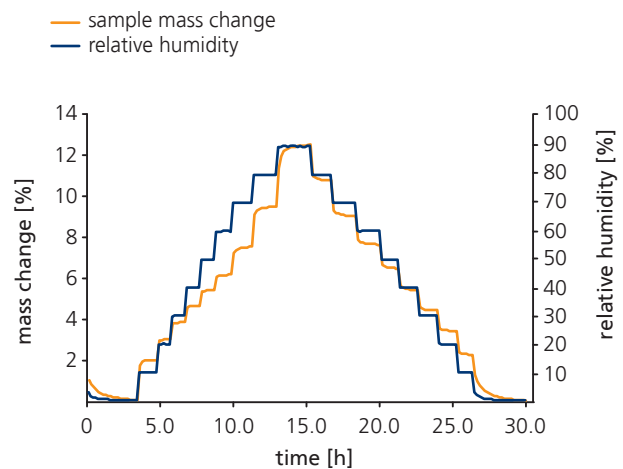
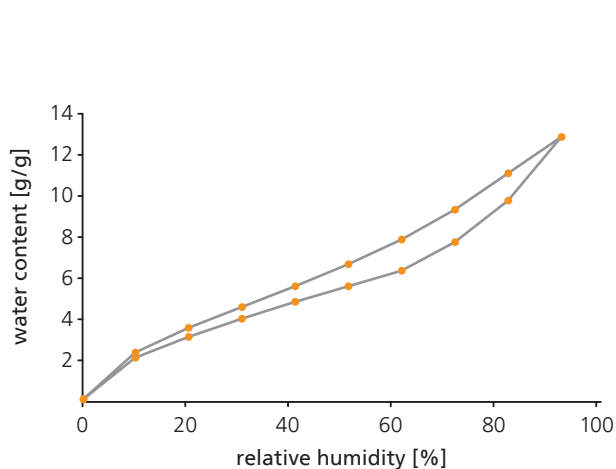
The gravimetric DVS method measures the change in mass over time of a sample kept in an environment of controlled relative humidity and temperature. Change in mass takes place either by water uptake (sorption) from the air or water release (desorption) from the sample.

Sorption Isotherm and Sorption Kinetics

The relationship between the equilibrium water content of a sample and the relative humidity of the ambient air at a particular temperature is known as the water vapor sorption isotherm.

The sorption isotherm enables to draw conclusions on fundamental material properties and provides information on material handling with respect to moisture.

From the sorption kinetics curve of a material, moisture induced structural changes are determined that are often accompanied by changes in the moisture content.



Sorption isotherm (left) and sorption kinetics (right) of microcrystalline cellulose powder.

Application Areas

The instruments of the SPS series differ in precision and load range of their micro- and sub-micro-balances as well as in number and size of the sample positions.

The SPS series covers all areas of application, from pharmaceutical pre-formulation to building materials.

The choice of instrument for an application depends, among other parameters, on the size required for a representative sample, the amount of sample available and the expected total water sorption of the materials.

SPS11-10μ	SPSx-1μ High Load	SPSx-1μ Advance	SPS23-100n
			Pharm. Pre-formulation
			Pharm. Applications, (Hydrate Formation, Amorphous Content)
			Material Characterization, Polymers, Electronics
			Food Research, Food Technology, Shelf-Life
			Fine Chemicals, Detergents, Personal Care
			Natural Fibres, Textiles, Wood, Paper
			Building/Construction Materials, Fertilizer
			Permeability, Packaging



SPS Models and Technical Data

SPS model	SPSx-1µ Advance	SPSx-1µ High Load
Number of samples & sample size	Exchangeable samples trays for 11 samples Ø50 mm and 23 samples Ø33 mm	
Temperature range	5 °C to 60 °C (±0.1 K)	
Humidity range*	0 % RH to 98 % RH (±0.5 % RH at 10...30 °C)	
Load range min to max	<10 mg to 22 g	<30 mg to 220 g
Balance resolution	1 µg	1 µg (up to 22 g) 10 µg (up to 220 g)
Repeatability**	±2 µg	±5 µg (up to 22 g) ±20 µg (up to 220 g)
Hardware options	Video camera Raman spectroscopy	Video camera Raman spectroscopy Permeability Kits Large objects sample tray
Software options	21 CFR Part 11 compliant software package Analysis software	

SPS model	SPS23-100n	SPS11-10µ
Number of samples & sample size	23 samples Ø18 mm	11 samples Ø50 mm
Temperature range	5 °C to 40 °C (±0.1 K)	5 °C to 60 °C (±0.1 K)
Humidity range*	0 % RH to 98 % RH (±0.5 % RH at 10...30 °C)	
Load range min to max	<3 mg to 2 g	<50 mg to 220 g
Balance resolution	0.1 µg	10 µg (up to 111 g) 100 µg (up to 220 g)
Repeatability**	±1.5 µg	±20 µg (up to 111 g) ±100 µg (up to 220 g)
Hardware options		Video camera Raman spectroscopy Permeability Kits Large objects sample tray
Software options	21 CFR Part 11 compliant software package Analysis software	

* Maximum humidity is reached at chamber temperature slightly above room temperature.

** Root Mean Square (RMS). The specified values assume that the system is installed in an environment suitable for the operation of micro- or sub-micro-balances.

Balance Stability and Repeatability

Balance Calibration

Fully automated calibration procedure with internal reference weights.

Drift Compensation

Drift effects from the balance are automatically compensated by an internal procedure using an empty reference dish on the sample tray.

Balance Stability

A drift-free measurement enables excellent repeatability of weighing results independent of the duration of a measurement.

High Sample Throughput

Multi-Sample Capability

With up to 23 samples measured simultaneously, the proUmid DVS instruments enable a very high sample throughput compared to a single-sample instrument.

Continuous Weighing

By stepwise rotating and lowering of the sample tray, the sample dishes are placed one after the other on the micro-balance and weighed in predefined time intervals.





Exchangeable Sample Trays

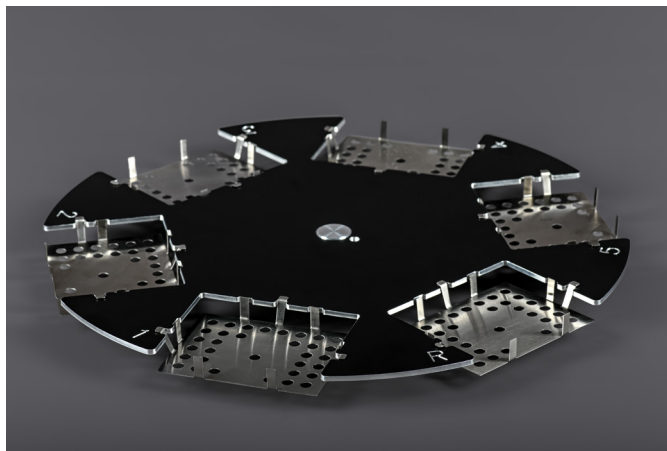
Exchangeable Sample Trays

The sample trays for sample dishes of different sizes can be changed in just a few seconds.

Variety of Samples

All different kinds of samples such as fine powder, granules or tablets, paper and foils, textiles and fibres and also heavy and bulky samples like wood or construction materials can be analyzed with the proUmid DVS instruments

Suitable Accessories



Large Objects Kit

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*, *SPSx-1 μ Advance*



Sample Tray 11 $\varnothing 50$ mm

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*, *SPSx-1 μ Advance*



Sample Tray 23 $\varnothing 33$ mm

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*, *SPSx-1 μ Advance*



Sample Tray 23 $\varnothing 18$ mm

Compatible with *SPS23-100n*



Permability Kit 5 for Water Vapor Transmission Rate

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*



Permability Kit 11

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*



Inverted Wet Cup Kit

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*



Mesh Cover

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*, *SPSx-1 μ Advance*



Spacer

Compatible with *SPS11-10 μ* , *SPSx-1 μ High Load*, *SPSx-1 μ Advance*



PTFE Inlay

Compatible with *Sample tray 11*



Hardware Accessories

Video Camera

Integrated high-resolution CCD camera for detection of moisture induced changes to the samples such as swelling, hygroscopic expansion, liquefaction, as well as changes in color or texture.



Membrane Dryer

The highly efficient membrane dryer ensures optimal analysis conditions through precise air preparation. As a link between sorption instruments and the compressed air network, it reliably supplies filtered, dried air for up to two devices.



Raman Spectroscopy

Sensor fusion combining water vapor sorption and Raman spectroscopy opens new and exciting perspectives for the analysis of solid materials.



Working with the proUmid DVS Instruments

Sample Preparation

Sample material is applied directly into the dishes on the sample tray. The easily accessible measurement chamber enables a convenient sample preparation.

Comparability of Results

For perfect comparability of different products in a single measurement, all samples are exposed to the same temperature and relative humidity conditions.

Fully Automated Process

Measurement and data acquisition are fully automated. The large glass lid enables the observation of the samples during a measurement. Acquired data can be exported during a running analysis.

Operating Software

Step-by-Step Procedure

- User-friendly and intuitive interface
- Programmable sorption/desorption cycles and unlimited number of cycle repetitions
- Humidity cycles as step profiles, ramps or plateaus
- Templates for standard measurements

Data Security

Optional software to meet the requirements for data security of electronic records in accordance with 21 CFR part 11.



Sample No.	Sample Name	Date	Time	RH Setpoint	RH Read	T Set	T Read	State
1	Water	2022-03-08	10:00	40.0	40.0	25.0	25.0	Standby
2	Water	2022-03-08	11:00	40.0	40.0	25.0	25.0	Standby
3	Water	2022-03-08	12:00	40.0	40.0	25.0	25.0	Standby
4	Water	2022-03-08	13:00	40.0	40.0	25.0	25.0	Standby
5	Water	2022-03-08	14:00	40.0	40.0	25.0	25.0	Standby
6	Water	2022-03-08	15:00	40.0	40.0	25.0	25.0	Standby
7	Water	2022-03-08	16:00	40.0	40.0	25.0	25.0	Standby
8	Water	2022-03-08	17:00	40.0	40.0	25.0	25.0	Standby
9	Water	2022-03-08	18:00	40.0	40.0	25.0	25.0	Standby
10	Water	2022-03-08	19:00	40.0	40.0	25.0	25.0	Standby
11	Water	2022-03-08	20:00	40.0	40.0	25.0	25.0	Standby
12	Water	2022-03-08	21:00	40.0	40.0	25.0	25.0	Standby

Sample No.	Sample Name	Date	Time	RH Setpoint	RH Read	T Set	T Read	State
1	Water	2022-03-08	10:00	40.0	40.0	25.0	25.0	Standby
2	Water	2022-03-08	11:00	40.0	40.0	25.0	25.0	Standby
3	Water	2022-03-08	12:00	40.0	40.0	25.0	25.0	Standby
4	Water	2022-03-08	13:00	40.0	40.0	25.0	25.0	Standby
5	Water	2022-03-08	14:00	40.0	40.0	25.0	25.0	Standby
6	Water	2022-03-08	15:00	40.0	40.0	25.0	25.0	Standby
7	Water	2022-03-08	16:00	40.0	40.0	25.0	25.0	Standby
8	Water	2022-03-08	17:00	40.0	40.0	25.0	25.0	Standby
9	Water	2022-03-08	18:00	40.0	40.0	25.0	25.0	Standby
10	Water	2022-03-08	19:00	40.0	40.0	25.0	25.0	Standby
11	Water	2022-03-08	20:00	40.0	40.0	25.0	25.0	Standby
12	Water	2022-03-08	21:00	40.0	40.0	25.0	25.0	Standby



Data Export and Data Analysis

Data Export

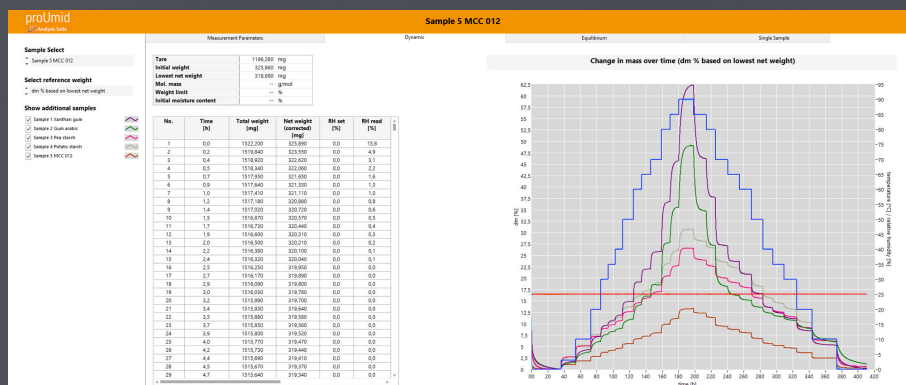
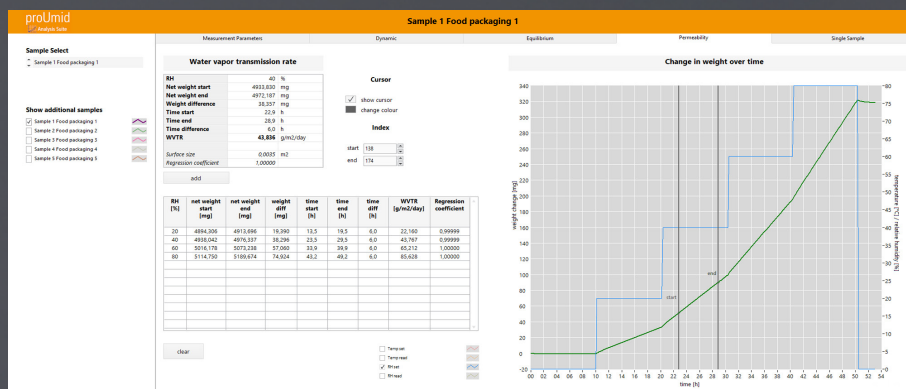
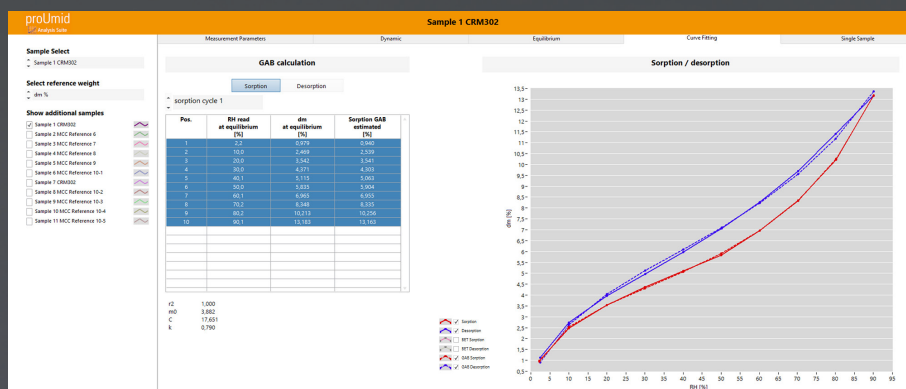
Acquired data is saved in a binary coded data format. Several options are available for data export into an editable format:

- Import into an Excel® template with fully configurable graphical and tabulated data
- LIMS compatible data format
- Advanced data analysis

Analysis Software

Optional software package for data import and advanced data analysis:

- Tabular and graphical display of data
- Configurable and editable diagrams
- Advanced multi-sample data handling
- Curve fitting functionality (BET, GAB)
- Amorphous content calculation
- Calculation of the water vapor transmission rate
- Calibration tool
- Report generator



Application Examples

DVS is an established standard method in many industries such as pharma, food and feed, fertilizer and agrochemicals, fine chemicals, detergents, cosmetics, building materials, textiles, electronics and archeology.

Dynamic Vapor Sorption is applied to Study:

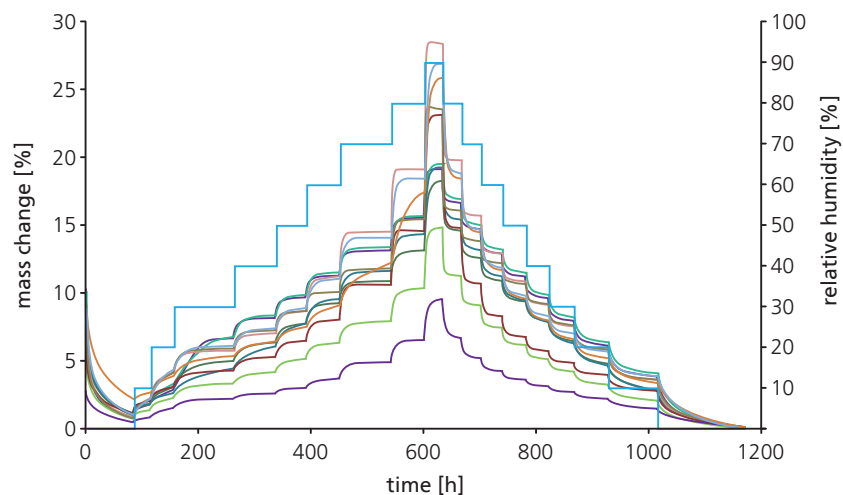
- Kinetics of moisture sorption/desorption
- Equilibrium water content at different relative humidity levels (sorption isotherm)

Special Applications are among Others:

- Structural changes (hydrate formation, crystallization)
- Amorphous content determination
- Shelf life and stability studies
- Deliquescence
- Thermodynamic parameters such as heat of sorption
- Permeability and diffusion studies
- Swelling and hygroscopic expansion
- Quality assurance: determination of minimal differences between batches of a product



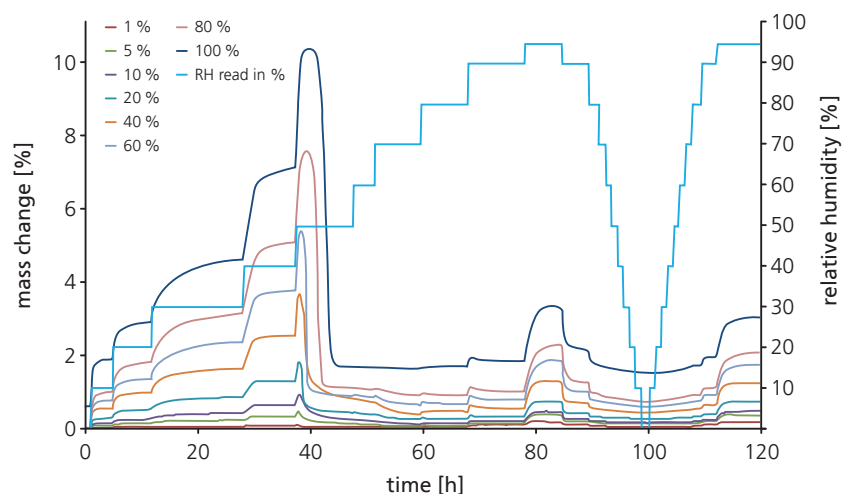
Analysis of Multi-Samples



Multi-Sample Analysis

Longterm study with food materials at 25 °C.

long grain rice	caraway seed
risotto rice	pumpkin seed
spelt	couscous instant
barley	brown lentils
psyllium	red lentils
chia seeds	RH read in %

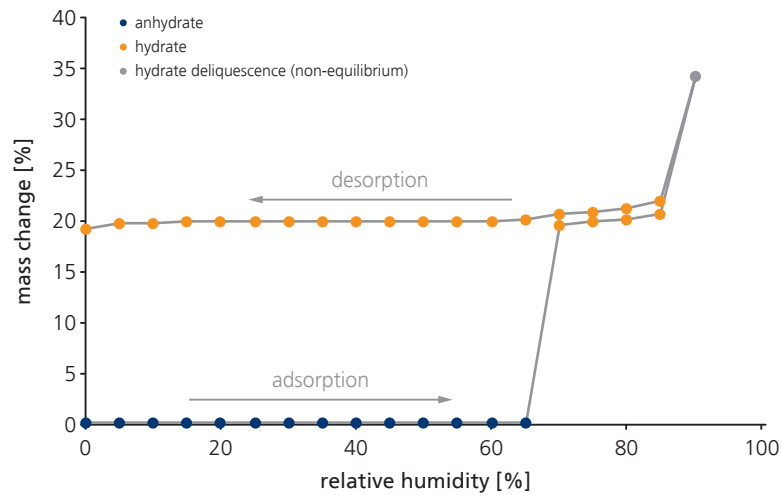


Determination of Aamorphous Content

Sorption kinetics of lactose mixtures with different levels of amorphous lactose (crystallization peak at 50 % RH). The data enables to create a calibration curve for amorphous content determination of lactose mixtures.*

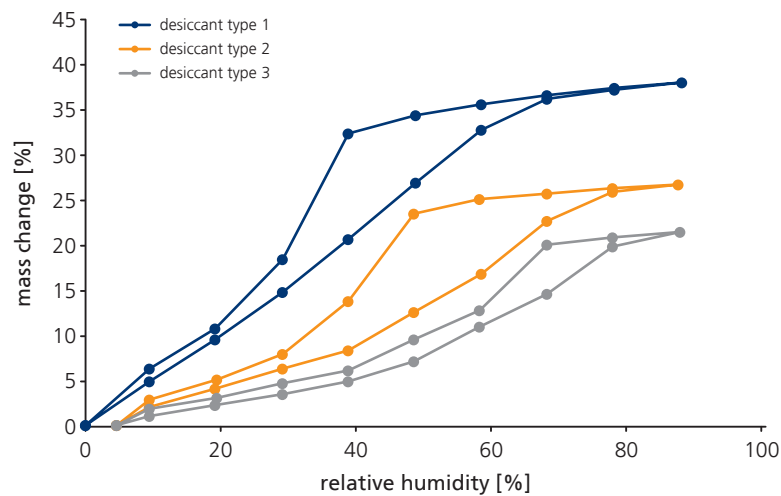
* Data kindly provided by the University of Innsbruck, Institute for Pharmacy.

Application Examples



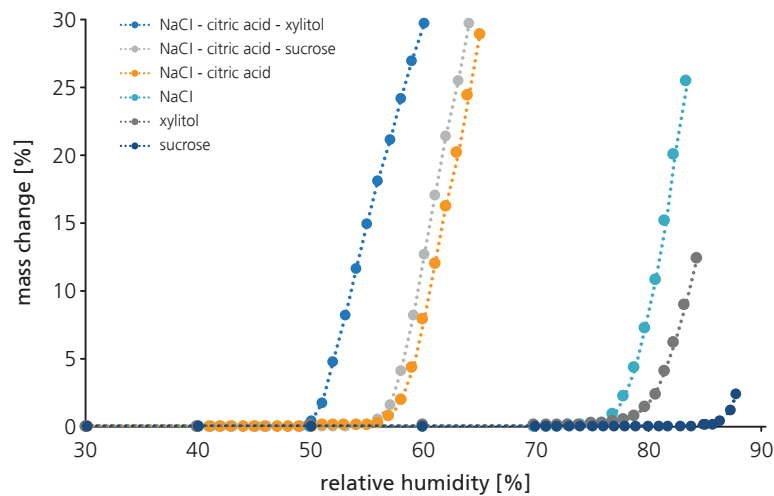
Hydrate Formation

Sorption isotherm of L-lysine HCl at 25 °C. Complete adsorption desorption cycle with transition from anhydrate to hydrate crystals.



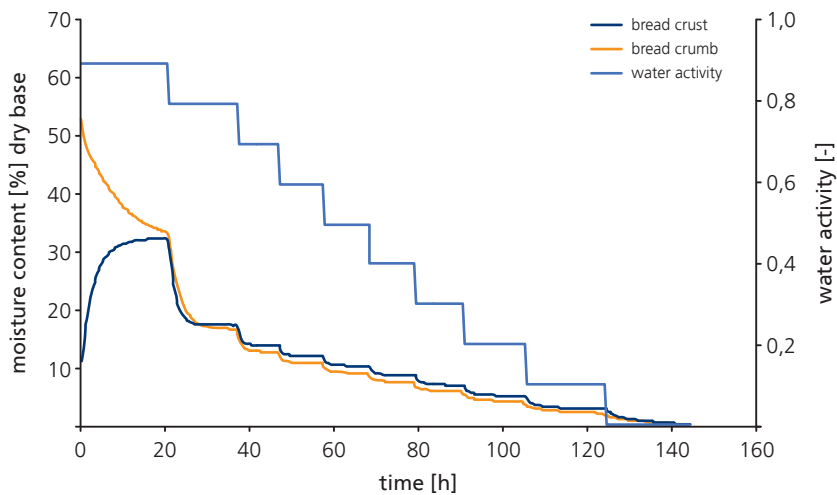
Porosity and Hysteresis

Sorption isotherms of three types of desiccant at 25 °C.



Deliquescence

Deliquescence of water-soluble food ingredients and the effect of deliquescence lowering in mixtures.



Shelf life of Food Products

The desorption kinetics of fresh bread crust and fresh bread crumb.*

* Data kindly provided by the Institute of Food, Nutrition and Health, ETH Zürich.

The SPS in a Nutshell



High Sample Throughput

Analyzing up to 23 samples simultaneously saves valuable measurement time compared to a single sample instrument and enables the results to be directly compared.



Large Dynamic Weighing Range

Different balance resolutions from 0.1 µg for samples of a few mg up to 10 µg for heavy samples enable the analysis of both, tiny samples as well as large samples with lowest water uptake.



Balance Stability

The automatic drift compensation enables excellent repeatability of weighing results independent of the duration of a measurement.



Versatility

Optional sensors like Raman spectroscopy or video camera and complementary methods for permeability testing extend the application range of the SPS.



Sustainability

The SPS instruments are designed for a long life cycle. The first device sold in 1999 is still in daily operation and runs with the latest software version.



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