RUBOLAB

RuboSORP

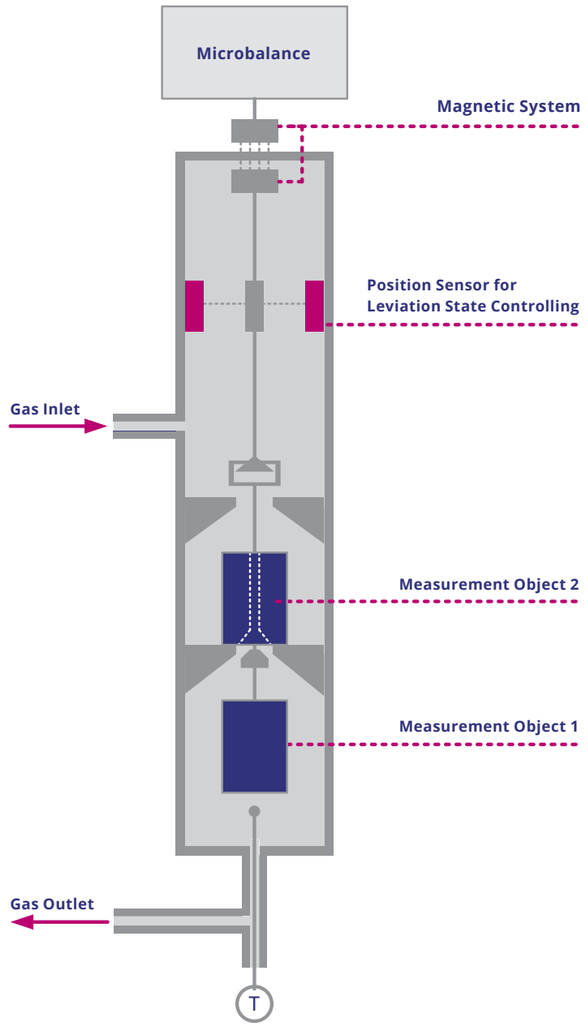
Magnetic Suspension Balance

Measurement Principle

Accurately determining the mass of light-weight samples is very important in many fields of research. In order to accomplish this, high-resolution analytical balances are an integral piece of equipment. Additionally, many technically relevant processes occur under technically demanding conditions such as high pressure, extreme temperatures, and aggressive or toxic atmospheres. Commercially available analytical balances cannot be used under these conditions. Therefore, the technology of the Magnetic Suspension Balance has been developed. RuboSORP's Magnetic Suspension Balance technology offers the unique possibility of high-quality analysis under even the most extreme metrological conditions.

1

Magnetic Suspension Balance technology allows for high resolution mass determination under high pressure and high temperature conditions by utilizing resistant measurement cells. An industrial micro-balance is located outside of the cell. Thanks to contactless magnetic suspension coupling, mass changes within the pressurized measurement cell can be determined.



2

When collecting a measurement, the sample whose mass change is being measured is attached to the permanent magnet. The actual position is then detected and controlled via a high performance PID controller. In order to establish a free levitation position for the permanent magnet and measurement object, voltage is applied to the electromagnet outside of the measurement cell. This allows the sample mass to be measured under contact free extreme conditions. Load decoupling then allows the object weight being measured to be subtracted for taring or calibrating the corresponding measurement signal. When this decoupling occurs, only the permanent magnet remains in levitation position (zero-point position). Taring in zero-point position ensures long term stable and drift-compensated measurements. When measuring point is selected, the measurement object is lifted, and the corresponding weight is detected by the microbalance. The measurement object can be a crucible, containing sample materials (measuring of adsorption isotherms, researching material properties, analyzing catalysis etc.). The measurement object can also be a sinker with calibrated volume. In this case, the Magnetic Suspension Balance can be used for high accurate density measurement of the sinker surrounding fluid. The RuboSORP Magnet Suspension Balances is unique because it can measure the mass of two samples at once with maximum quality and efficiency.

The RuboSORP Magnetic Suspension Balance is available in the following versions:

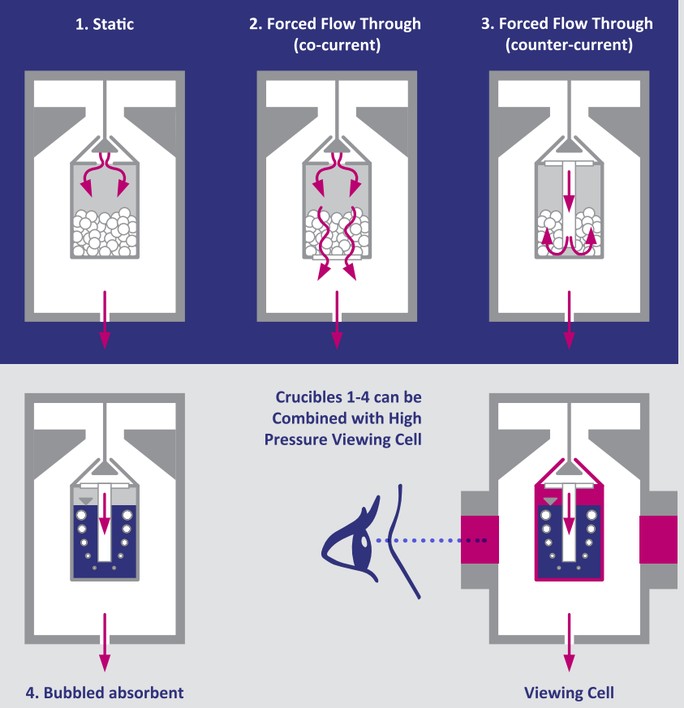
Version Type	Max Pressure bar	Temperature °C	Resolution µg	Max Load g	Fluids
RuboSORP-150	150	-10 – 400	10	20	• Inertgas • Aggressive, Toxic Gases • Supercritical Fluids • Flammable, Explodable Gases • Gas Mixtures • Vapor
RuboSORP-150-HR	150	-10 – 400	1	10	
RuboSORP-350	350	-10 – 200	10	20	
RuboSORP-350-HR	350	-10 – 200	1	10	
RuboSORP-700	700	-10 – 150	10	20	
RuboSORP-700-HR	700	-10 – 150	1	10	

Highlights

Extreme Conditions The unique measurement principle and high-quality instrumental design ensures measurements within a pressure range of up to 700 bar and a maximum temperature of 400 °C. Additionally, the measurement cell and all its components in contact with fluids are resistant to aggressive and toxic atmospheres.

Simultaneous measurements of two samples When sample containing crucibles are used for both measurement objects, the Magnetic Suspension Balance simultaneously measure two different sample materials (dual sample version). When one sample crucible and one sinker are used, a combined measurement of material properties and fluid density can be determined.

Viewing Cells The Magnetic Suspension Balance measurement cell is also available in a viewing cell version which can be used up to a pressure of 400 bar. This allows for the visual observation of fluids and materials inside the measurement cell. This observation provides valuable additional information on topics such as swelling behaviors and VLE measurements (Vapor Liquid Equilibrium).



Integrated Calculation of Measurement Uncertainty The software which will be used for controlling the RuboSORP Magnetic Suspension Balance contains an integrated calculation of measurement uncertainty according to the GUM guidelines (Guide to the expression of uncertainties in measurement). This allows a more holistic view of the data, the best level of scientific work.

Realistic material measurement via forced flows through sample containers The Magnetic Suspension Balance can be equipped with a forced flow through the sample crucible which improves interaction between the sample and the surrounding fluid atmosphere. Please note, this device needs a corresponding gas dosing unit, ideally a dynamic measurement atmosphere (e.g. GDU DYNAMIC series).

Most advanced Magnetic Suspension Balance technology on the market Our Magnetic Suspension Balance is equipped with unique features, leading to best measurement accuracy as well as a high level of ease of operation. These features includes a self-optimizing Magnetic Suspension Balance controller as well es the using of a failsafe ethernet interface.

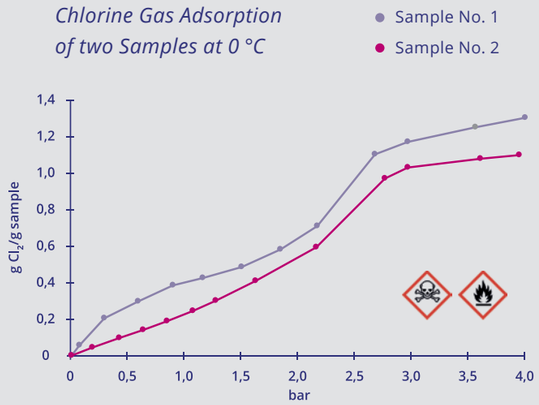
Applications

Sorption Isotherm Measurement

Generally, the term sorption describes the attachment of particles in a fluid phase, such as liquids or gases, onto the surface of a solid or a liquid. This kind of process is of particular importance for numerous technical processes. In pressure swing adsorption processes, these effects are used for air separation, nitrogen generation, and the treatment of biogenic gases. These processes are mainly characterized by their adsorption isotherms. Therefore, the sorbent gas uptake is applied under isothermal conditions via changing adsorptive pressures. The Magnetic Suspension Balance is currently the most accurate measuring instrument for recording these isotherms over a wide range of pressures and temperatures.

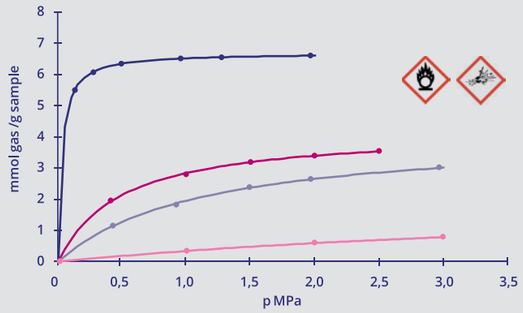
The figure on the right shows the experimental results of an adsorption measurement using extremely toxic chlorine gas. This was collected simultaneously on two materials within a pressure range of up to 3.5 bar at 10 °C. This was achieved by equipping the Magnetic Suspension Balance with two sample crucibles to measure both samples at the same time (dual sample measurement)

Chlorine Gas Adsorption of two Samples at 0 °C



With the increasing usage of biogas as an energy source, the corresponding purification treatment of its gas components has become increasingly more important. The figure on the right shows the pure gas isotherms of CO_2, CH_4, N_2 and H_2 as measured on zeolite, which is an industrially used sorbent for biogas purification. In combination with an appropriate dosing unit, the Mangetic Suspension Balance could also be used to measure the corresponding gas mixture sorption.

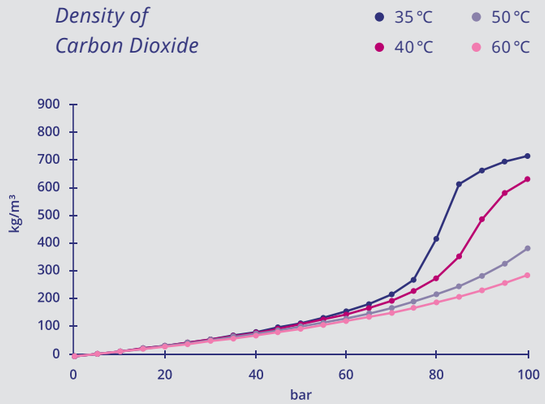
Adsorption Isotherm of Biogas Related Gas Types on Zeolite



Fluid Density Measurement

Sinkers with a known volume can be used instead of sample containers for high accurate determination of fluid phase density, even in supercritical atmospheres. The figure on the right shows density data for CO_2 measured in both sub-critical and super-critical states. By using sinker and sample crucible as measurement objects a combined measurement of adsorption and fluid density can be obtained.

Density of Carbon Dioxide



Gas Dosing Units

Rubolab's RuboSORP Magnetic Suspension Balance and other analytical equipment can be combined with our different gas dosing and pressure controlling units to create a fully automated measurement instrument. Rubolab's gas dosing units can be divided into two general groups: the GDU DYNAMIC and GDU STATIC series. GDU DYNAMIC series units can be used to generate dynamic atmospheres in connected instruments. These systems contain several types of thermal mass flow controllers to generate pure gas flows and defined gas mixture compositions. Depending on the existing fluid flows, the system pressure will be controlled using a front pressure controlling valve. In contrast, systems from the GDU STATIC series generate statically pressurized measurement atmospheres using pulse-width controlled dosing valves.

Version Name	Atmosphere Type	Max Pressure bar	Temperature (Manifold) °C	Gas Mixtures	Super-critical Fluids	Vapor Dosing
GDU-STATIC-150	Static	150	Room temp			
GDU-STATIC-350	Static	350	Room temp			
GDU-STATIC-350-SC	Static	350	200		•	
GDU-STATIC-700	Static	700	Room temp			
GDU-STATIC-700-SC	Static	700	200		•	
GDU-DYNAMIC-7	Dynamic	7	Room temp	•		
GDU-DYNAMIC-7-V	Dynamic	7	200	•		•
GDU-DYNAMIC-150	Dynamic	150	Room temp	•		
GDU-DYNAMIC-150-V	Dynamic	150	200	•		•
GDU-DYNAMIC-350	Dynamic	350	Room temp	•		
GDU-DYNAMIC-350-V	Dynamic	350	200	•		•
GDU-STATIC-MIX	Static	100	200	•		

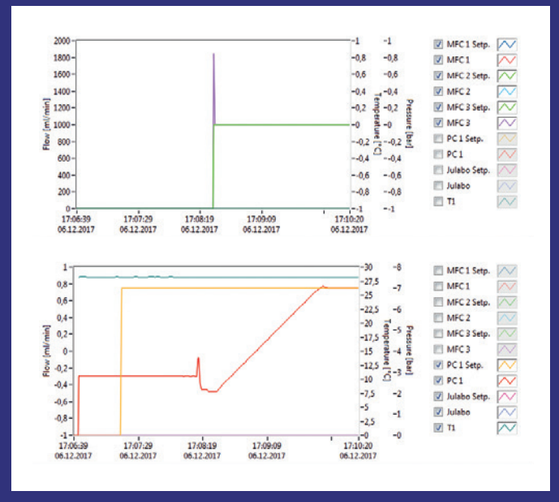
Both Series can be Modified

The gas dosing units from both series can be modified to provide a tailor-made instrument which meets each customer's specific needs. These modifications include the integration of HPLC pumps to combine gas and vapor dosing. Additionally, the systems can also handle fluids in supercritical state by including piping which includes an anti-condensing heating device.

All Rubolab dosing devices will be built using stainless steel pressure resistant tubing. We only use high quality components to ensure the best sealing and long lifetime of our instruments. Standardized 19-inch racks with variables heights provide the best possible flexibility in system design to meet our customers' needs.

Rubolab GDU Software

The gas dosing units will be delivered together with our Rubolab GDU Software to control the complete system. By using a user-friendly interface all setpoints for mass flows, pressures or temperatures can be selected by the user. The corresponding process values are shown in an online diagram and can be saved and exported in a data file. All measured values are checked continuously with the maximum allowed system parameter. If values exceed the defined limits, such as for pressure and temperature, the software will automatically switch to a safety state to ensure the greatest possible workplace safety.



Rubolab GDU Software User Interface

Applications

Automatization of laboratory equipment

Our Gas Dosing systems are the perfect device to achieve a high level of automatization for laboratory equipment. Our clients combine existing or new instruments with our dosing systems to minimize working time and to maximize instrument accuracy. Thanks to our programmable dosing sequences, fully automated dosing steps can be performed overnight or over long periods of time without any need for user interaction.

Catalysis Research

Heterogeneous catalysis is of major interest for several technical processes. For this reason a consistent flow control of corresponding gases is important to ensure the best possible interaction between the catalysts and the reactants. Our customized gas dosing units can be used for the simulation of many possible catalytic reactions.

Foaming of Polymers

Physical foaming is a very important process in polymer production. During production, CO_2 and N_2 are often used as blowing agents. Therefore, stable and accurate controlling of corresponding gas flows is very important. Both of these factors can be ensured by using our dynamically working gas dosing units from the GDU DYNAMIC series.

Calibration Gas Mixture Generation

Our gas dosing units are ISO 6145 compliant and can be used to generate gas mixture compositions. These mixtures exhibit calibration quality gases, which are needed for the calibration of external analytic such as gas chromatographs. Our gas dosing units can be a meaningful alternative to conventional calibration gases obtained from an external supplier.

Contacts

For further information about our products please contact our head office or the corresponding local distributor.

Please find more detailed information about our sales network on www.rubolab.de/distributors

Rubolab GmbH, Neckarstr. 27, 40219 Düsseldorf, Germany
Dr. Jens Rother

info@rubolab.de | +49 (0) 211 52874549 | www.rubolab.de