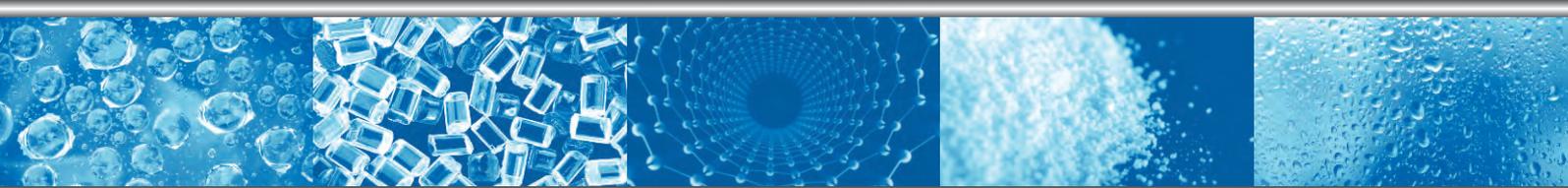
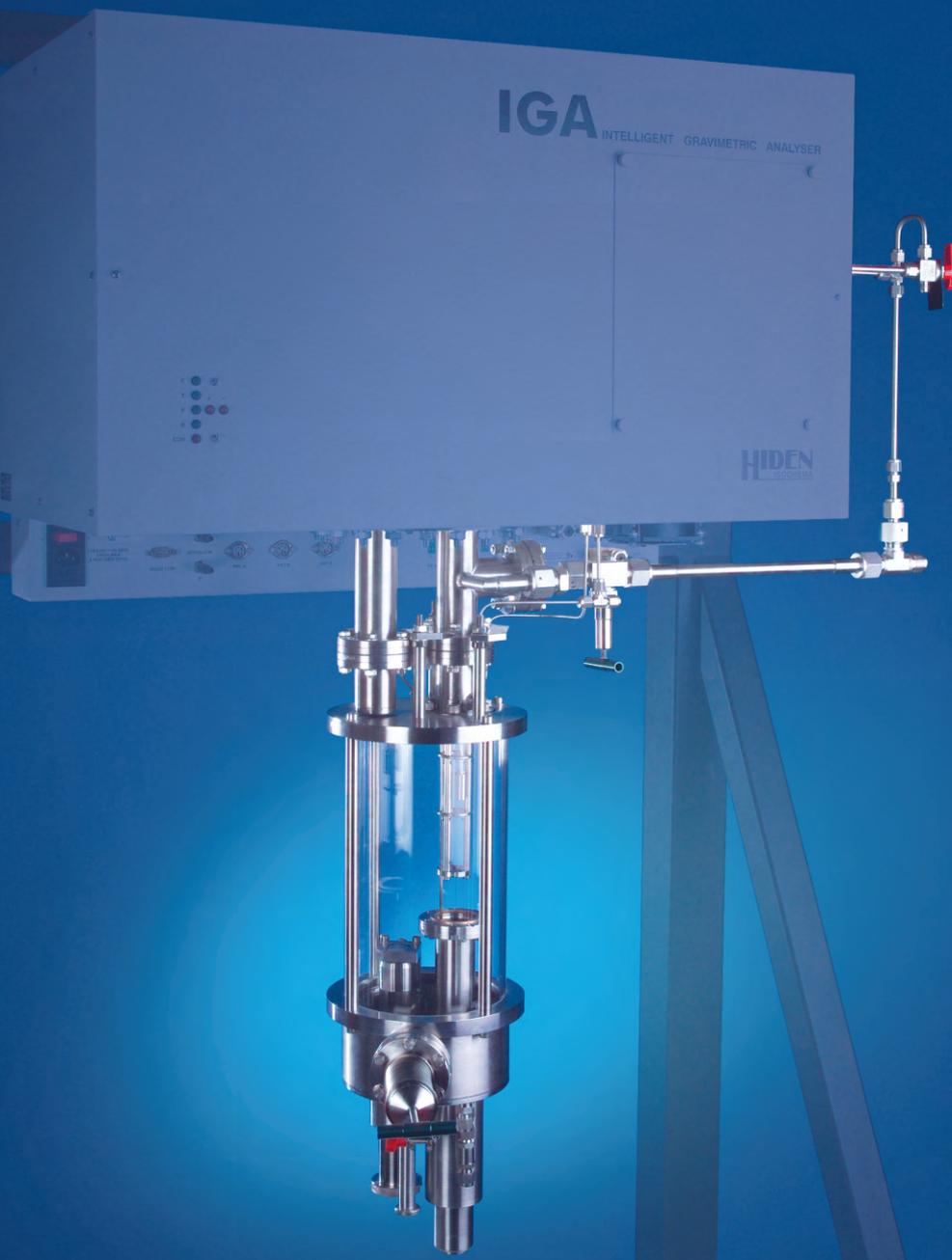


**Hiden Isochema IGA Series**

**Gravimetric Gas & Vapor Sorption Analyzers**



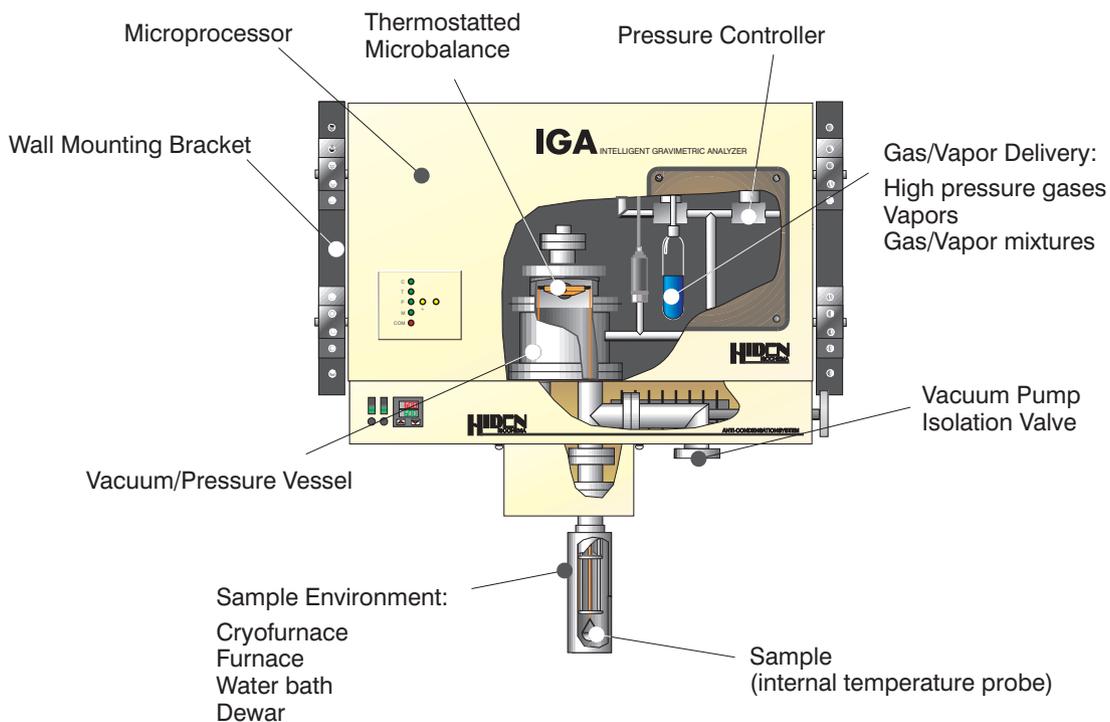
[www.hidenisochema.com](http://www.hidenisochema.com)

# IGA - The Intelligent Gravimetric Analyzer

The **IGA** range from Hiden Isochema provides the ultimate tool for sorption science...

The **IGA** system uses the gravimetric technique to accurately measure the magnitude and dynamics of gas and vapor sorption on materials. The **IGA** design integrates precise computer-control and measurement of weight change, pressure, temperature, gas flow and composition. The system can automatically and reproducibly measure sorption isotherms/isobars as well as investigating thermal desorption in diverse operating conditions. The unique **IGA** method exploits the relaxation behaviour of the interaction process after pressure/gas composition/temperature changes to simultaneously evaluate kinetic parameters and the asymptotic uptake.

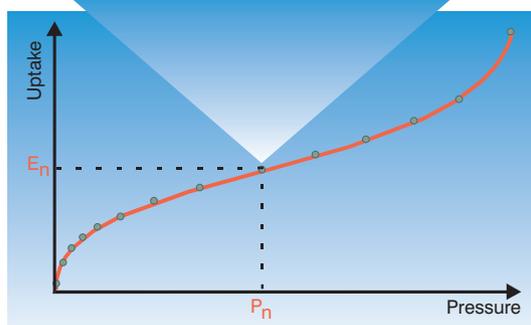
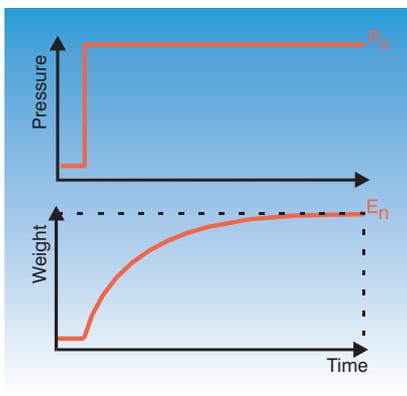
An uncompromising attitude to system design coupled with our experience in solving problems in sorption science in some of the most prestigious laboratories around the world makes Hiden Isochema the obvious and only choice for a sorption analyzer.



All **IGA** models incorporate the following features:

- Ultra-sensitive microbalance mounted in thermostatted heatsink to provide high resolution and precise long-term stability.
- Pressure vessel incorporating all-metal seals designed to UHV standards to allow measurements from high vacuum to high pressure.
- Basic models can be upgraded to extend their range of applications, as your research program develops.
- State-of-the-art pressure control system capable of accurately controlling the pressure of gases and vapors across eight decades of pressure measurement.
- Versatile temperature controller for ramp and set-point operations in the temperature range from cryogenic to 1000°C. Internal temperature probe to measure sample temperature.
- Full automation and extensive software package for experiment design, system control, data acquisition/archival, analysis and export.
- Unique and innovative approach for the determination of the sorption kinetics and equilibrium isotherms - The **IGA** method.
- Complete range of accessories including vacuum pumping stations, furnaces, humidifiers, water baths etc. to enable a broad range of experiments to be performed.

# The IGA Method



- Pressure/gas composition is changed and then held constant during sorption at the set point  $P_n$ .
- Weight data is acquired and analyzed in real-time to determine kinetic parameters and predict the exact point of equilibrium uptake  $E_n$ .
- Equilibrium points are collected and plotted as an isotherm. The **IGA** method provides a consistent reproducible analysis method point-to-point on the isotherm whilst making the optimum use of laboratory time.



## IGA-001 Gas Sorption Analyzer

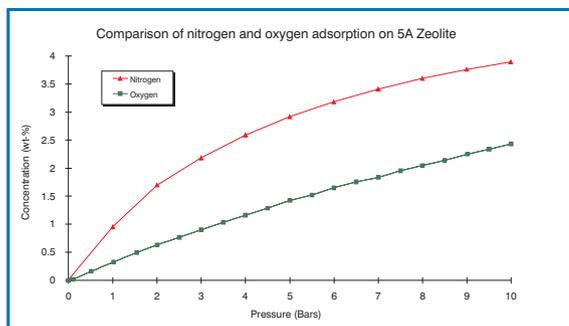
The **IGA-001** is specifically designed as a versatile gravimetric analysis system. The system can be configured to study general gas sorption processes from vacuum to high pressure as well as being used as a high pressure thermobalance with mass spectrometer interface.

### Typical Application

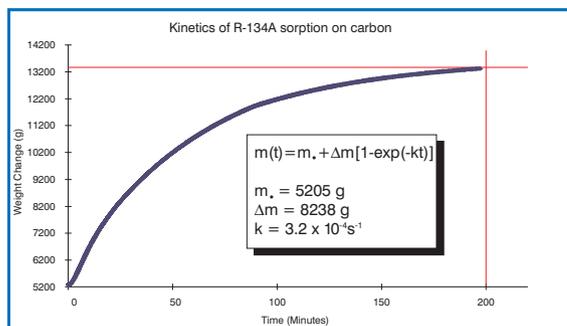
- Gas sorption
- Sorption kinetic analysis
- Outgassing behaviour
- TG studies
- In-situ surface area analysis
- In-situ pore size analysis

### Materials

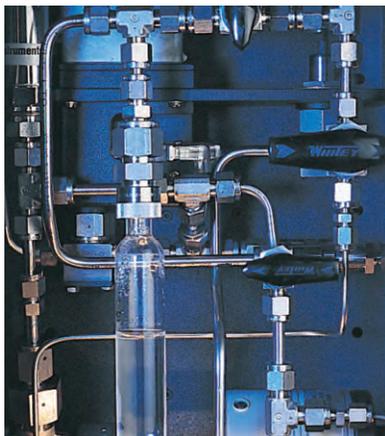
- Zeolites
- Carbons
- Metal/intermetallic hydrides
- High  $T_C$  materials/ceramics
- Polymers
- Metal-Organic Frameworks



The **IGA-001** system can be used to determine the gas sorption properties of porous materials such as zeolites. The data shows a comparison between the oxygen and nitrogen sorption on a 5A zeolite up to an equilibrium pressure of 10 bars.



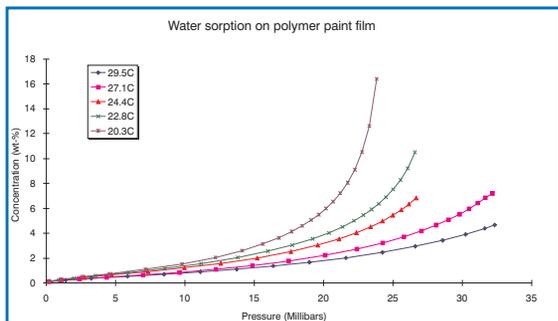
The kinetic response shown above (the **IGA** method) is used to determine equilibration. Such data can prove useful in understanding the non-equilibrium sorption behaviour of materials in order to determine diffusion and transport parameters of adsorbates in materials. The example above shows a kinetic response for the sorption of a freon on activated carbon.



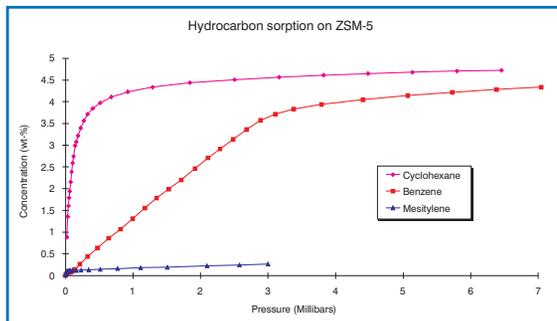
## IGA-002 Gas & Vapor Sorption Analyzer

The **IGA-002** system is specifically designed to study general vapor sorption processes from vacuum. This model includes all the features of the **IGA-001** model but additionally incorporates anti-condensation protection rated to 50°C. An additional low range pressure sensor is included. The system can be fitted with a UHV pump isolation valve to achieve the best possible vacuum at the sample position and a vapor delivery system is incorporated with the pressure controller. The **IGA-002** can be used to study water and hydrocarbon vapor sorption on porous materials such as pharmaceuticals, carbons, catalysts, zeolites, clays and polymers.

- The **IGA-002** vapor delivery and pressure control system. A broad range of liquids can be used in the reservoir to generate the vapor adsorbate.



The **IGA-002** system can be used to determine the water sorption properties of porous materials such as polymers and zeolites. The data shows isothermal uptake curves measured at closely separated temperatures between 20°C and 30°C on a polymer paint film.



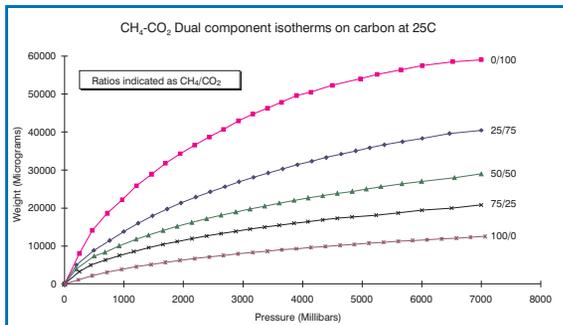
The **IGA-002** system can be used to measure hydrocarbon vapor sorption on porous materials. Such data can be used to determine sample properties such as pore size from adsorbate molecular dimensions.



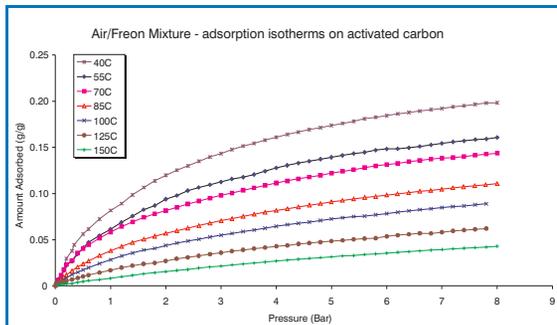
## IGA-003 Dynamic Mixed Gas Sorption Analyzer

The **IGA-003** system is designed to study mixed gas and/or vapor sorption processes from vacuum to high pressure. The system incorporates a multiple inlet mass flow control system. An internal gas delivery system injects the gas stream below the sample and extracts above enabling a defined gas composition to be established at the sample position. Flow and pressure control are independent allowing different gas compositions to be generated at different pressures. A balance purge can be provided in this system to allow the use of corrosive gases/vapors at the sample position while protecting the integrity of the weighing system. An optional humidifier or vapor generator allows delivery of defined vapor compositions to the sample reactor. The **IGA-003** system can be used to study mixed gas/vapor sorption on materials such as carbons, zeolites, polymers and catalysts.

- The **IGA-003** gas injection/exhaust system. Up to four gas streams can be mixed prior to injection into the sample reactor.



The **IGA-003** system can be used to determine mixed gas sorption isotherms. The data above shows the binary isotherm for carbon dioxide and methane measured on carbon. Each isotherm was obtained at a constant gas composition. It is similarly possible to measure a composition scan at constant pressure.



The data shows adsorption isotherms for a freon/air mixture of 4% on an activated carbon. Such information is required when designing filtration systems.



## IGA-100 Integrated Gas & Vapor Sorption Analyzer

The **IGA-100** is designed for gravimetric mixed gas sorption, as well as single component vapor sorption analysis, and powerfully combines the features of the **IGA-001**, **IGA-002** and **IGA-003**. The multiple inlet mass flow controller system allows mixed gas experiments with full pressure and composition control. Anti-condensation protection to 50 °C is also included to allow operation with water and an extensive range of hydrocarbon vapors. As for the IGA-003, an optional vapor generator extends dynamic functionality to include gas and vapor mixtures.

## Integrated Dynamic System Options



### Breakthrough Reactors

The Automated Breakthrough Reactor (**ABR**) for dynamic IGA systems allows the analysis of gas and vapor separation and purification processes from breakthrough curves. The **ABR** design features a minimized dead volume for rapid response times and an integral temperature regulation system for high performance thermal control. Other key features include:

- 2cm<sup>3</sup> nominal bed volume, with maximized length-to-width ratio
- Operation throughout the range 0 – 500 °C and 0 – 20 bar
- Fully integrated control and datalogging from the **IGASwin** software



### Quadrupole Mass Spectrometers

Hidden's range of quadrupole mass spectrometers can be interfaced to all dynamic **IGA** systems. The combination of gas analysis and gravimetric sorption measurement provides an invaluable tool for materials characterization. These hyphenated systems can also be used to study thermal decomposition and desorption processes.

- Broad atomic mass unit (amu) range with triple mass filter options
- Heated capillary transfer with high and atmospheric pressure sampling options
- Bypass pumping arrangements
- Mobile cart for standalone operation
- Fully integrated, automated control from the **IGASwin** software



### Other Accessories

The **IGA** series is available with a wide range of accessories to suit individual application requirements. Systems are fully upgradable and bespoke solutions can also be provided. Options include:

- Additional low pressure measurement and control ranges
- Humidity generator module for delivery of humid gas with feedback control
- Recirculating water bath and environment jacket for optimum near-ambient thermostating, with integrated degas heater option
- Range of furnaces from set-point control to high temperature TG linear ramp applications, including a unique programmable cryofurnace for operation at user-specified cryogenic temperatures
- Enhanced temperature rating (800 °C) at pressure for high temperature and pressure studies
- BET (liquid nitrogen) jacket including automatic refill option
- Unique sample loader to allow air- or moisture - sensitive samples to be transferred to the **IGA** in a controlled, inert atmosphere
- Actuated sample environment arm to replace standard lab stands

## Technical Specifications

<b>Weight</b>	Balance capacity:	1 g (standard), or 5 g (optional)
	Weighing range:	0 – 200 mg (standard)
	Resolution:	0.1 $\mu\text{g}$ (0.2 $\mu\text{g}$ with optional 5 gram balance)
	Stability:	$\pm 1 \mu\text{g}$ long term ( $\pm 0.1 \mu\text{g}$ short term)
<b>Pressure</b>	Design pressure:	10 bar (standard), or 20 bar (optional)
	Typical accuracy:	$\pm 0.05 \%$ of range
	Transducer ranges:	1, 10, 20 bar
	(up to 3 per system)	2, 10, 100 mbar
	Base Vacuum:	$< 10^{-6}$ mbar
	Typical regulation accuracy:	$\pm 0.02 \%$ of range
<b>Temperature</b>	Measurement range:	77 – 1273 K
	Temperature sensors:	Platinum Resistance Thermometer (Pt100) or Type-K Thermocouple
	Measurement accuracy:	$\pm 0.1$ K (Pt100) or $\pm 1$ K (Type-K)
	Typical regulation accuracy:	
	Water bath:	$\pm 0.05$ K
	Furnace options:	$\pm 0.1 - 1$ K
	Balance temperature regulation accuracy:	$\pm 0.1$ K
	Linear ramp option:	0.05 – 20 K/min (depending upon system accessories)
<b>Mass Spectrometer</b>	Coupling method:	Heated Quartz Inert Capillary (2 m)
	Atomic mass range:	1 – 200 amu standard (1-300 amu optional)
	Detection limit:	0.1 to 1 ppm, subject to spectral interference Better than 20 ppb (Triple Mass Filter option)
	Detector:	Dual Faraday/Electron Multiplier

It is Hiden Isochema's policy to continually improve product performance and therefore specifications are subject to change.

# Hiden Isochema

## Advancing Sorption Analysis

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