QUANTACHROME

WAVE™

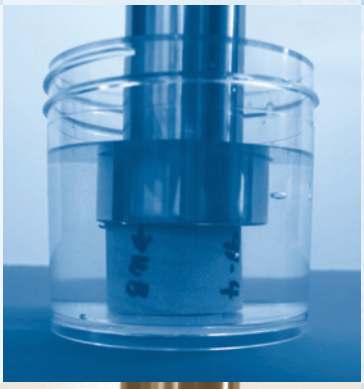
3805 | 2305 | 1905

electroacoustic and conductivity pore analyzers

3805 electroacoustic pore analyzer

2305 porosity and pore zeta potential analyzer

1905 rapid porosity analyzer



WAVE 3805 | 2305 | 1905

PORE SIZE

POROSITY

PORE ZETA POTENTIAL

Quantachrome INSTRUMENTS

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electroacoustic and conductivity pore analyzers

CAPABILITIES

The WAVE series of pore characterization systems consists of three models. The WAVE 3805 can measure all three pore related properties from a single control module using two probes. Pore size analysis and three-in-one capability of the 3805 represents the newest, and probably the most unique, in pore characterization systems.

The WAVE 2305 offers measurement of pore zeta potential and porosity.

The WAVE 1905 is dedicated to the rapid determination of just porosity for those customers who are most interested in that parameter.

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QUANTACHROME

	Mean Pore Size	Percent Porosity	Pore Zeta Potential
WAVE 3805	✓	✓	✓
WAVE 2305	—	✓	✓
WAVE 1905	—	✓	—

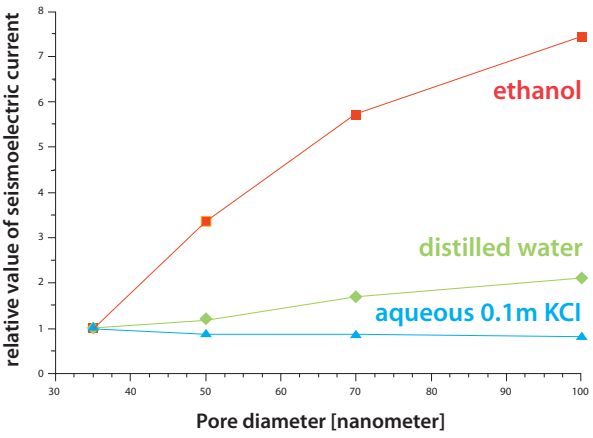
INTRODUCTION

Many applications require rapid evaluation of pore size and porosity. A number of existing techniques are available for pore size measurement but might require many hours, cryogenic coolants and vacuum systems (gas sorption) or mercury and high pressures (mercury intrusion porosimetry), or are restricted to through-pores (porometry).

But now, the technique of electroacoustics is available for the rapid determination of mean pore size[1] in a variety of sample types - without mercury, without vacuum pumps, without pressurized gases, and without the wait.

The fundamental method behind the mean pore size measurement is called the seismoelectric effect. An applied ultrasonic pressure wave causes the so-called electrical "double-layer" at the interface between the surface and a suitable liquid (i.e. low conductivity, for example water, polar or non polar organic) to shear, resulting in an oscillating current. When double layers overlap in pores, the seismo-electric effect depends on pore width.

Overlapping double layers produce a pore size relative response.



"Seismoelectric effect: A non-isochoric streaming current. 1. Experiment." A.S. Dukhin, P.J. Goetz and M. Thommes (2010) *J. Coll. Interface Sci.*, **345**, 547-553.

The same seismoelectric effect is also employed to reveal the zeta potential of the surface inside the pore structure[1]. Propagation of ultrasound through a porous body creates motion of the given liquid, in this case one of high conductivity (to create *isolated* double-layers) inside of the pores relative to the solid matrix. This, in turn, causes relative motion of charges that are located in the diffuse layer and on the pores' surfaces. This is expressed as an oscillating electric current called the *Streaming Vibration Current.*

The measurement of percent porosity uses very high frequency conductivity measurements[2]. And unlike direct current conductivity measurements, the high frequency oscillating current reveals the porosity of all pores - including dead-ended (blind) pores - not just those that form a connected pathway on a macroscopic scale.

[1] Protected by U.S. Patents: U.S. Patent No: 8,281,662 B2 "Method for determining porosity, pore size and zeta potential of porous bodies"

[2] Patent Pending: A1 20110012627 "Method for determining porosity with high frequency conductivity measurement"

electroacoustic and conductivity pore analyzers

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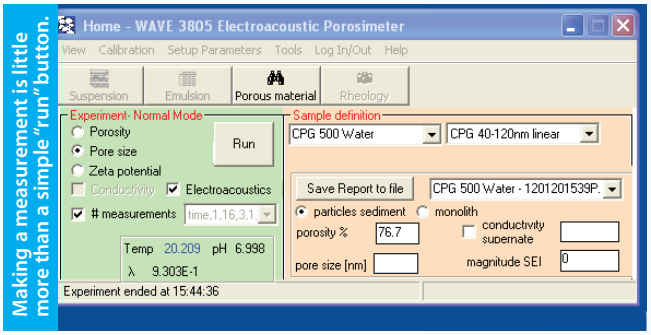
MEASUREMENTS

All measurement modes are performed in a similar fashion, that is, the sample is fully wetted with a suitable fluid (water, organic solvent or electrolyte depending on the exact measurement to be done and pore size range of the sample) and then contacted by the appropriate probe (the probes can be used in any orientation to facilitate ease of use). The electronics and measuring circuits do the rest. Results are displayed on screen in a minute or two and saved to the database.



APPLICATIONS

There is no fundamental limitation as to the type of material that can be analyzed using the WAVE analyzers so long as the sample is stable with respect to the fluid used to wet the pores, and for pore size that they are within the range of the technique.

Typical applications include green and fired ceramics, core samples, chromatography silicas and resins, tablets, battery components, friction products, frits, cement and other construction materials, to name but a few.

QUANTACHROME

SPECIFICATIONS

MEAN PORE SIZE	3805
Measuring principle	Electroacoustics (seismoelectric effect)
Mean pore size (min)	~10nm
Mean pore size (max)	>5 µm (5000nm)
Repeatability	<1%

POROSITY	3805	2305	1905
Measuring principle	Conductivity (very high frequency)		
Porosity (resolution)	0.5%		
Porosity (accuracy)	<10%		
Repeatability	<1% absolute		
Conductivity	0.001-10 S/m, ± 1%		

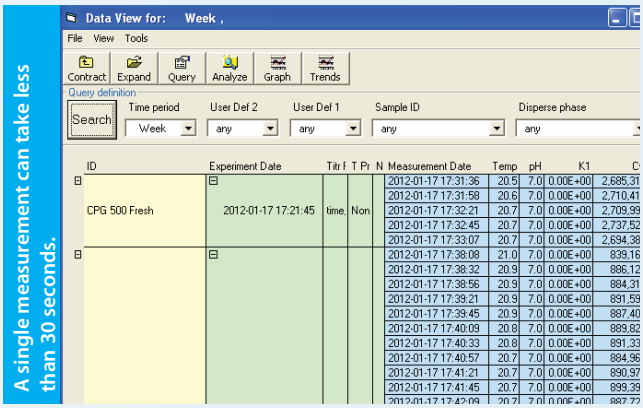
PORE ZETA POTENTIAL	3805	2305
Measuring principle (zeta potential)	non-isochoric streaming current (seismoelectric effect)	
Zeta potential (min)	±0.1 mV	
Zeta potential (max)	no restriction, + or -	
Zeta potential (resolution)	±(0.1 + 0.5%)	

PHYSICAL	3805	2305	1905
Height	21cm (8.5 in)		12.5cm (4.5 in)
Width	33cm (13 in)		21cm (8.5 in)
Depth	41.5cm (16.5 in)		26cm (10.5 in)
Weight	20kg (44 lbs)		4kg (9 lbs)

ELECTRICAL	Universal input
Voltage	100-240 VAC
Frequency	50/60 Hz

SOFTWARE

The WAVE analyzers are supplied with Windows®-based software for control, data acquisition and report generation, and which runs on the control module so a separate PC is not required. The WAVE software features an easy-to-use interface, prompted calibration procedures, a defined-materials database and real-time data capture. Data are stored in database format and can be output in popular .csv format.



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Contact your local representative or call 1-800-989-2476 (in USA/Canada) to request pricing information.

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