

*If the structure of a substance,  
interaction with other substances,  
or the permeability is the question*

*Hydrocarbon- Geothermal Energy- Raw Material research  
Carbon-dioxid sequestration Water research  
Enviromental Protection Waste Disposal Recultivation  
Material research Construction Industry  
Medicine research Nano-technology Chemical Industry*

***please contact us!***

**GEOCHEM**  
**LABORATÓRIUM**



Dear Prospective Partner,

Our company, called GEOCHEM Ltd. is a small enterprise, having a high-tech equipped petrophysical laboratory, special knowledge and ideas, significant innovation and development potential. Our measurement and development services are demanded in the fields of

geology, like hydrocarbon and raw material exploration, geothermal energy research, carbon-dioxide sequestration, radioactive and hazardous waste disposal.

The accumulated knowledge and our measurement capability, supported by the available instrument park are also useful in the pharmaceutical and construction industry, archeological geology and material research.

***Our main activity is research and development, focusing mainly on special instruments and equipment development and on the complex investigation of very tight and unconsolidated materials.*** These developments are taking place in cooperation with considerable Hungarian research institutes, universities, small and medium enterprises with special knowledge and the companies interested in radioactive waste disposal projects.

The company is a member of the **Cluster of Applied Earth Sciences** and has signed cooperation and R&D agreements with different institutes and companies like: Eötvös Loránd Geophysical Institute of Hungary; University of Szeged, Department of Geology and Paleontology; and Department of Mineralogy, Petrology and Geochemistry; Mecsekérc Co. (the main contractor of radioactive waste disposal projects in Hungary); Hungarian Geological Institute; University of Miskolc, Research Institute of Applied Earth Sciences; Budapest University of Technology and Economics, Department of Physical Chemistry and Materials Science; Geosoft Limited Partnership (CT examinations of rocks); South Transdanubian Regional Innovation Agency; Quantachrome GmbH, Germany. Since these institutes and companies are differently equipped and have wide -spread knowledge background, there is the possibility to execute complex assignments. Common elements in the university agreements are PhD training and the tendering for EU and Hungarian supports.

Our company is the Hungarian dealer and service of Quantachrome GmbH, and our laboratory is the Central-Eastern European reference laboratory of this company in pore characterization.

Our references are mainly connected to domestic radioactive waste disposal projects (like: ***Technology development to investigate clayey barrier behaviours against alkaline.*** 2009. Client: Mecsekérc Co.; ***Rock physical measurement and data interpretation connected to the Safety Assessment of the National Radioactive Waste Repository.*** 2009. Client: Mecsekérc Co.), but many other projects are under progress (like: ***Thin section method development for archeological geology.*** 2010. Partner: University of Szeged, Department of Geology and Paleontology; ***Special Rock Physics and Geophysical Examinations to Compare the Laboratory and Field Measurements.*** 2008-2011. Partners: Eötvös Loránd Geophysical Institute of Hungary; GEOSOFT; University of Szeged, Department of Geology and Paleontology; Geological Institute of Hungary; Karotázs Ltd; SmartCode Ltd; Mecsekérc Co.; ***Three component, wireless seismic data logger development: the production of 10 pieces of prototype.*** 2010-2011. Partner: Eötvös Lóránd Geophysical Institute of Hungary; ***Consultancy services: core samples depot and complex laboratory investment in Kazakhstan.*** 2010-2012. Client. ALT-ENERGO INVEST Ltd).

We hope that your interest is aroused by this short introduction. For more information please find details below. We are looking forward to your potential request for quotation.

Sincerely,



Ferenc Fedor, PhD  
Managing Director

Our motto

*"Do not be so featherbrained.  
Although you are underpaid -  
it is worth to work precisely and fine,  
as a star is going on the sky."*

( Attila József)

**GEOCHEM Laboratory – measurements, capacity, price list**

Hereinafter you can find the list of equipments for sample preparation and the measuring instruments that are available at GEOCHEM Ltd. at the present. Each laboratory is equipped with fan-coil air conditioners that provide constant temperature and a humidity value under 50%. Temperature, humidity and atmospheric pressure are controlled separately in each laboratory room.

Our company has environmental management standard (ISO 14001) and the laboratory is working according to this own internal quality system.

The mentioned capacity includes the maximum number of measurements that can be performed, based on our present human resources conditions.

**SAMPLE PREPARATION**

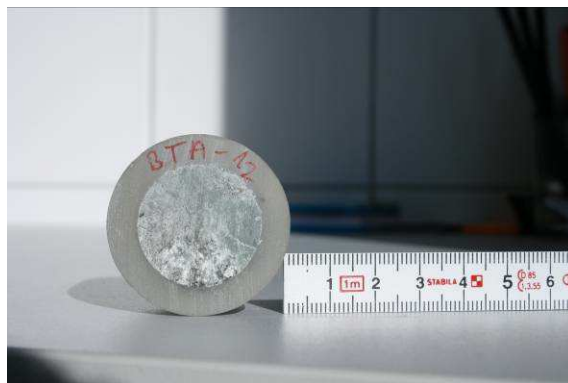
Our company is able to form cylindrical samples of 9 mm, 1" and 1.5" diameter with a maximum length of 3" from solid materials, and to create perfectly parallel endfaces (2.5 mm maximum deviation on 100 cm). Samples are dried in a normal/vacuum drying oven up to 300/200 °C. Samples can be saturated with a liquid of a given content in vacuum drying oven, and burn samples in heat oven at a given (max. 1100 °C) temperature with calculating the heating loss.



We can also manage the embedding of unconsolidated materials into a two-component resin system. In our chemical laboratory samples can be treated by basic alkaline and/or acid solutions. During sample preparation, distilled water, for the measurements ultra clean water is used, produced by a Millipore Direct-Q 3UV water purification system. Water quality is controlled with a inoLab terminal 740 pH and conductivity meter which can measure the resistance, salt content and TDS, as well. The volume of a regular sample can be defined to thousandth of cm<sup>3</sup> accuracy and the weight to tenth of a milligram accuracy (Kern 320 and OHAUS Discovery self-calibrating analytical balances).



In the framework of the cooperation with the laboratory of MECSEKÉRC Ltd., samples from soil, water, wastewater and waste materials can also be shaped, together with the analysis to organic components (ICP-MS, ICP-OES, ion chromatography, titration, etc.).



**Capacity:** Strongly depends on the material characteristics of the sample, it can vary within broad limits.

***Unit prices<sup>1</sup>:***

Preparation of cylindrical samples, drying to dry weight, depending on the number of sample orders and on the quality of material:

**22 - 55 €**

Preparation of powder samples, their drying for pycnometry measuring:

**7 - 14 €**

Saturating solid samples with water or other solution\*:

\*see Notes

**7 - 14 €**

Preparation of samples embedded into resin:

Based on negotiation

In case of measurements performed by our partner company:

Based on quotation agreement

<sup>1</sup> The unit prices in the document are only indicative prices!



## **POROSITY AND DENSITY MEASUREMENTS**

Our company owns an automatic gas pycnometer with five chambers (Quantachrome Pentapyc 5200e) for the accurate measuring of real density and volume of solid materials (e.g.: bodies, powders). The measuring process continues automatically until the toleration value regulated by the meter, or until the maximum number of measurements fixed by the meter. As the result of measuring, the density and volume data are obtained, as well as their statistics (average, deviation). Knowing the exact geometric volume of the sample, specific density and porosity can be calculated. The measurement can be performed in a volume range of 0.1 – 110 cm<sup>3</sup>, in sample cells of four different sizes (4.5, 10, 50, 135 cm<sup>3</sup> cells), at a temperature range of -10 – 100 °C, at +/- 0.02 °C temperature variation, with helium, argon, krypton, nitrogen or other non-corrosive gases. The following table gives information about measurement accuracy and reproducibility:

Sample cells, provided by the manufacturer.

sample cell	accuracy:	reproducibility:
big (~135 cm <sup>3</sup> )	+/- 0.02 %	+/- 0.01 %
medium (~50 cm <sup>3</sup> )	+/- 0.03 %	+/- 0.015 %
small (~10 cm <sup>3</sup> )	+/- 0.1 %	+/- 0.1 %
micro (~4.5 cm <sup>3</sup> )	lower than: +/- 0.01 %	worse than: +/- 0.01 %

According to demand, nano cells can also be used (0.25 cm<sup>3</sup>) that are suitable for measuring the density of extremely small amount of sample. The actual accuracy is determined by error estimation



The measurement of material volume and density is required in all scientific fields, where volume and density has to be defined with high accuracy, thus besides geology, it proves to be useful in the research-development and quality assurance work of various materials sciences, like e.g. in the research of coals, catalysts, cement, ceramics, cosmetics, fume and odour absorbing materials, fertilizers, fibers, filling materials, dry food, ion exchange resins, other powders and in the medical research.

Effective porosity measurement is necessary in those scientific fields, where the central question is: what is the maximum quantity of liquid, gel or gas that can be entered into the volume unit of a solid material? Such fields are geology (e.g. CO<sub>2</sub> sequestration, geological waste disposal, carbon-hydrogen research, coal research, geothermal research, building industry (concrete and cement research), research of fume and odour absorbing materials, medical aids and medical research (e.g. bone texture research, auxiliary materials for medicine).

**Capacity:** in case of the average of 21 measurements: 15 samples/day, in case of the average of 5 measurements: 35-40 samples/day.

**Unit Prices<sup>2</sup>:**

<sup>2</sup> The unit prices in this document are indicative prices!

Density and volume measurement with He, at 25 °C with 5 measurements:

**28 €**

Density and volume measurement with He, at 25 °C with 21 measurements:

**43 €**

in case of other gas types, temperature and accuracy values:

Based on negotiation

## **PORE SIZE DISTRIBUTION MEASUREMENT**

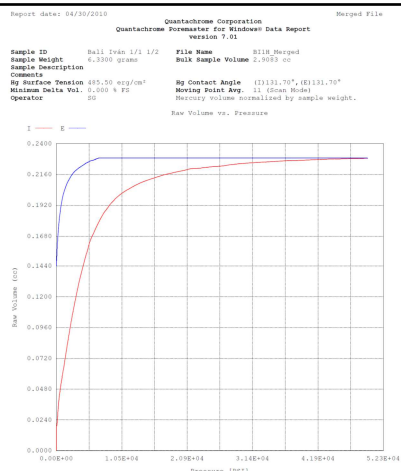


Our company is equipped with a Quantachrome Poremaster-60 GT automatic mercury-porosimeter that is suitable for measuring pore size distribution according to the Washburn-equation on a pore size range of 950  $\mu\text{m}$  - 0.0036  $\mu\text{m}$  (between vacuum and 60.000 psi). Measurement can be performed in the two low pressure and two high pressure stations simultaneously, according to the sample specific parameters given by the operator (scanning speed, contact angle, measurement limits, etc.).

It is possible to measure the extruded, as well as the intruded mercury quantity, so the hysteresis curve for the given sample can be drawn. With this type of measurement several pore related parameters can be defined, e.g. pore throat size distribution, complete pore volume for mezo- and macropores, pore surface and its distribution, pore volume and its distribution together with specific and bulk density.

Through pore space distribution measurements we can calculate various parameters in connection with pores, and the spatial relationship between material and pores, like: tortuosity (refers to the connection of pores with each other and indirectly to effective diffusion), porosity (volume of pores inside the scope of measurement, compared to the total volume), fractal dimension (refers to the roughness of the internal surface of pores), pore size distribution (in case of unconsolidated materials), permeability, compressibility, proportion of pore throat/pore (refers to the shape of pores).

The final report at the end of measurement process summarizes the results and contains the required tables and diagrams. The accuracy of the measurement depends to a great extent on the floating speed, mercury contact angle, temperature and other parameters chosen for the given material. Our company employs a professional who is experienced in measuring and interpreting. A contact angrometer for measuring contact angle in order to improve the reliability of the measurement is also available in our laboratory. Measuring with mercury is of destructive nature, this means that after measurement the sample can not be used again and has to be treated as dangerous hazard and is managed by our company.



Mercury porosimetry is required in such fields, where it has to be defined whether and to which extent the pores of a given material fall into a certain range for research and development or quality assurance purposes. Such fields are geology, the research and quality assurance of catalysts, medical implants, electrodes, ceramics and other heat treated materials, certain types of medicine, membranes, filters (e.g. for car manufacturers, air conditioners).

**Capacity:** depends on the terms of measurement (hysteresis is required, pressure limits), but at least 16 measurements.

### Unit Prices<sup>3</sup>:

Complete analysis (Hg porosity, pore throat size distribution, defining specific and total surface and volume), in case of powders and less compact materials: **145 €**

Complete analysis with hysteresis curve in case of powders and less compact materials: **160 €**

Complete analysis (Hg porosity, pore throat size distribution, defining specific and total surface and volume), in case of tight materials: **175 €**

Complete analysis with hysteresis curve in case of tight materials: **195 €**

<sup>3</sup> The unit prices in this document are only indicative prices!

## **PHYSISORPTION, MICROPOROSITY MEASUREMENT**

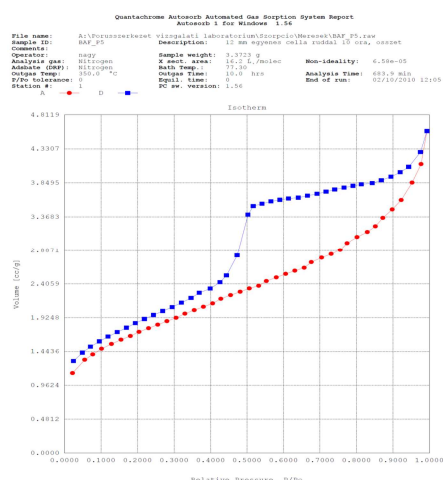
GEOCHEM Ltd is equipped with a Quantachrome Autosorb-1-MPV fully automated vacuum volumetric gas sorption instrument that automatically analyzes specific surface and pore size. The instrument can measure one sample at one time and meanwhile it is possible to prepare two further samples with heating in vacuum. Available adsorbents: nitrogen, CO<sub>2</sub> (needs previous discussion or other non-corrosive organic materials). The usage of other materials than water has to be discussed in advance.

Depending on the nature of the samples, following possibilities for interpretation are provided:

- Isotherms: adsorption/desorption, optional number of data points, at  $p/p_0$  pressure values defined by the instrument or by the operator;
- BET specific surface: single point, multi point, gradient, intersection, „C” constant, correlation factor, table and/or diagram format;
- Langmuir specific surface: multi point, gradient, intersection, correlation factor, table and/or diagram format;
- BJH pore size distribution: volume, surface, adsorption, desorption, cumulative, derivative (linear and logarithmic), interpolated, table and/diagram format;
- Dollimore-Heal pore size distribution: mesopore volume, surface, adsorption, desorption, cumulative, derivative (linear and logarithmic), table and/or diagram format;
- Dubinin-Radushkevich micropore: gradient, intersection, average pore size, micropore volume, average adsorption energy, table and/or diagram format;
- Total pore volume: optional by  $p/p_0$ ;
- Average pore size: radius, diameter;
- Statistic thickness (t-plot): de Boer, Halsey or Carbon Black model;
- t-method: micropore surface, mesopore surface, micropore volume, correlation factor, table and/or diagram format;
- Micropore pore size distribution: MP, HK, SF, DA, D(ensity) F(unctional) T(heory), table and/or diagram format;
- NLDFT-methods: (non-local density function models): for micro- and mesopores carbons, silica, zeolites in case of cylindrical and slot pore models.
- GCMC method (Grand Canonical Monte Carlo simulation): investigation of micro- and mesopore carbons with CO<sub>2</sub> and N<sub>2</sub>, slot pore models.
- Fractal size: Neimark – Kiselev (NK), Frenkel – Halsey – Hill (FHH).







Physisorption and microporosity measurements are needed when the task is to define the structure of the material and the material itself – which the pore surface of the material is able to adsorb.

The system can be used for the comprehensive characterization of material samples. For example: catalysts, coals, active coals, ceramics, filling materials, plastic materials, rock samples, etc. The samples can be powders, granulates, extrudates, debris, crystals, etc. – and the maximum size is 9 mm\* 25 mm of a cylindrical shape (core plugs).

**Capacity:** depends on the type of measurement, in case of complete microporosity measurement 1 sample/2 days, adsorption-desorption isotherm 1-2 samples/day, BET measurement 5 samples/day.

**Unit Prices<sup>4</sup>:**

BET measurements: with nitrogen (1 or 5 point BET) - first measurement:

**90 €**

Further measurements (same type and characteristics):

55 €

BET measurement with another gas (5 point BET):

**Based on negotiation**

Adsorption isotherm in p/p= 0-0.995 range, BET surface, analysis of total volume (N2):

**180 €**

Further measurements (same type and characteristics):

125 €

Adsorption-desorption isotherm in  $p/p_0 = 0-0.995$  range, BET surface, analysis of total volume according to the parameters/functions applicable for the given type (in case of mesopore systems with nitrogen):

**250 €**

Further measurements (same type and characteristics):

195 €

Adsorption isotherm in  $p/p_0 = 0-0.995$  range BET surface, analysis of total volume (with another non-corrosive gas, except Kr):

**Based on negotiation**

Adsorption-desorption isotherm in  $p/p_0=0-0.995$  range, BET surface, analysis of total volume acc. to the parameters/functions applicable for the given type (in case of mesopore system with another gas, except Kr):

### Based on negotiation

Complete analysis in the micropore range with Kr:

### Based on negotiation

Vapor sorption analysis – first measurement:

**215 €**

Further measurements (same type and characteristics):

160 €

<sup>4</sup> The unit prices in this document are only indicative prices!

### **Notes:**

Parallel measurements count as one type, the above mentioned prices include one measurement.

Samples of the same type and characteristics: the same or similar chemical composition, probably similar BET specific surface that means the possibility of the same sample preparation process (measurement, temperature, etc.), samples coming regularly from a certain user, etc.

Required sample amount: previous discussion is necessary, all surfaces in the measurement should be 10-20 m<sup>2</sup>. Consequently: from samples with small specific surface (< 5 m<sup>2</sup>/g), we need substantially more, but from samples with big specific surface (> 10 m<sup>2</sup>/g), we need much less. So the required sample amount is 2-20 g, if no parallel measurements are ordered.

In case of vapor sorption, the given price refers to water vapour sorption. When other adsorbent is to use, the liquid (at least 30 ml) has to be provided by the customer (at least analytical purity).

Possibility for sample preparation: ambient pressure - 10<sup>-5</sup> Torr, room temperature - 350 °C.

Please specify the maximum temperature value that still does not change the sample features (e.g. melting, decay, alteration of crystalline structure, etc.). Certain sensitive organic materials can not be put under vacuum, so we are not able to undertake their analysis.

After the measurement, the customer has to take all the used and unused samples; in case of non-hazardous material he can declare that our laboratory should destroy the sample.

The above described measurement processes (pycnometry, physisorption, mercury porosimetry) cover the complete pore structure analysis. This section of our lab functions as the Hungarian reference laboratory of Quantachrome GmbH.

### **Notes to the pore structure analyses:**

Our company does not perform the preparation and analysis of radioactive (except rocks with natural radioactivity), toxic, carcinogenic, teratogenic and mutagenic samples, because at the present time we are not prepared for such measurements.

The sender of the sample has to make a written declaration that his sample does not belong to the mentioned categories.

The sender of the sample has to ensure that the amount of the given sample is representative regarding quantity. In case of filling the sample with other special liquids (permeametry), we charge the costs of chemicals needed for the solution.

If possible, we demand the characteristic features of the material, e.g. CAS number, MSDS sheet, type of the rock or ground material, etc.

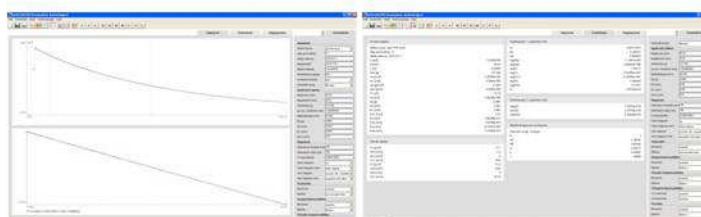
Over 100 measurements we provide 10 % discount.

## PERMEABILITY MEASUREMENT

Our company owns a self-developed RS-PPD-1 universal permeameter. This instrument is suitable for performing both steady-state (acc. to the Darcy principle) and unsteady-state (pressure pulse decay – PPD) axial flow permeability measurements either by water or gas, at max. 320 bar pore pressure and at max 350 bar confining pressure and at max. 150 °C temperature on 1" or 1.5" diameter and max 3" length core plugs. The pressure difference between the two sides is 0.01 - 30 bar, at present. The pore and confining pressure are handled by programmable high accuracy synchronized hydraulic pumps. Acid and alkaline solutions and petroleum can also be used for saturation and measurement. The volume of input and output sides are variable by 0.01 cm<sup>3</sup> accuracy. PPD permeability measurement is performed between micro- to pikodarcy range, steady-state permeability measurement is performed between 0.01 darcy – microdarcy range. Pressure falloff test can be programmed as an option. The instrument is mainly used for investigating very tight rocks based on the Jones' theory (1997). The input and output side can be equipped with 0.5 - 230 micron filter. The permeameter is equipped by high pressure saturation cells for sample saturation and flooding cell for non-water permeability (brine, petroleum, etc) measurements.

After the sample saturation, the permeability measurement of very tight rocks - with uncertainty estimation – can be performed quite quickly with the PPD method with low core internal stress (1 bar pressure difference). The measurement is repeatable.

In case of PPD gas permeability, the developed software provides porosity, viscosity (Lee-Gonzales-Eakin, Sutherland, or measurement result), compressibility (calculation or measurement result for volume, mass or pore structure) and formation factor (Brill-Beggs, Beattie-Bridgeman) data according to real circumstances. The result file provides permeability and average viscosity and compressibility with uncertainty by two methods: for the entire measurements or for points.



In case of PPD water permeability, viscosity (Method 1., Meehan), compressibility (calculation or measurement result for volume, mass or pore structure) and porosity can also be provided by the two calculation methods. During the calculation process, the gas-water ratio and the salt content can be taken into account.

In both cases, the smoothing of the data by average or median arbitrary point is possible. Report generating function is available in pdf form. Graphics for the entire interval or chosen range can be performed: pressure difference vs. time; pore pressure and confining pressure vs. time; pore pressure change, momentary pore pressure change, calculated permeability for given point vs. time; temperature vs. time; etc. The threshold value for the slope of the curve for permeability data can also be provided. Measurement unit conversion and other report generating properties are configurable either in Hungarian or English.

**Technical data**

Max. confining pressure:	350 bar (5076 psi) (10 000 psi is optional)
Max. pore pressure:	320 bar (4641 psi)
Pressure difference range	0.01-30 bar (0.15-435 psi)
Measurement temperature range	room to 150 °C (302 F)
Thermostate temperature range	30-250 °C
Theoretical minimum and maximum difference between upstream and downstream volume	0.02 cm <sup>3</sup> – 50 cm <sup>3</sup> (higher difference is optional)
Minimum upstream volume	30 cm <sup>3</sup> (less is optional)
Accuracy of pressure transducers	0.01 bar (0.15 psi)
Flow speed (mass flow meter)	0.01-10 nl/min
Core diameter	1 and 1.5" (other is optional)
Core length	up to 3"
Two high accuracy pump	pressure, volume and mantle control, programmable hysteresis and speed
Saturation cell	3 (more is optional)
Flooding cell for non-water permeability measurements	200 cm <sup>3</sup> (higher volume is optional)

Permeability measurements are needed when the task is to define how fast a liquid or gas is getting through a porous solid body. Such measurements are undertaken in various fields of geology (CO<sub>2</sub> sequestration, geological waste disposal, hydrocarbon exploration, coal research, geothermal researches), in materials research, for ex.: space research, building industry, in the wood industry (treatment of wood with chemicals), in medical research and in food industry.

**Capacity:** depends on the features of the sample, but at least 3 measurements a day.

#### **Unit Prices (only permeability measurements):**

Steady-state axial gas permeability measurement at room temperature: **140 €**

Unsteady-state axial gas permeability in case of less compact materials: **125 €**

Unsteady-state axial water permeability measurement based on pressure pulse decay method in case of less compact materials: **140 €**

Unsteady-state axial gas permeability in case of tight materials: **140 €**

Unsteady-state axial water permeability in case of tight materials: **300 €**

Unsteady-state axial gas or water permeability under reservoir conditions (at high pressure and temperature, see technological notes):

**Based on negotiation**

#### **Notes:**

At the present time we can perform permeability measurements only on standard cylindrical samples. Sample preparation, drying of the sample, porosity measurement and in case of water permeability the saturation of the sample with liquid, are necessary parts of the permeability measurement process. The costs of these can be calculated according to the unit prices listed in the sample preparation section!

## Acoustic velocity measurement

Our company is equipped with an AVS-700 acoustic velocity system that is suitable for weighing each elastic moduli of the core sample in both dry and saturated cases, at max. 700 bar pore pressure and at max. 700 bar confining pressure on 1" or 1.5" diameter and max. 3" length core plugs. The system consists of a fully equipped pressure vessel, an Olympus 5072PR impulser with 35 MHz ultrasonic bandwidth and max. -350 V spike pulse, and a 2-channel Tektronix TDS2012B digital oscilloscope with 100 MHz bandwidth. At the present, such transducers are connected to the impulser that are able to produce compression and sharing waves with 150 kHz central frequency. This makes it possible to observe the velocity of the waves in the core, in case of optional pore and confining pressure. We are able to determine the velocity of the elastic waves by an algorithm based on STA/LTA (Short Time Average/Long Time Average) proportion and Akaike information criterion. From the measured speed all elastic moduli, such as the Poisson-ratio, the Young-, the bulk-, the shear- and the P-wave-modulus, the compressibility, the acoustic impedance and the Lamé-constant are calculable, together with their relative errors.



### *Unit prices*

<b>Dry samples in a given pressure</b>	
less compact materials ( $k > 1$ mD)	<b>105 €</b>
tight samples ( $k < 1$ mD)	<b>90 €</b>
<b>dry samples in pressure steps</b>	
less compact materials ( $k > 1$ mD)	<b>160 €</b>
tight samples ( $k < 1$ mD)	<b>125 €</b>
<b>Saturated sample in a given pressure</b>	
less compact materials ( $k > 1$ mD)	<b>140 €</b>
tight samples ( $k < 1$ mD)	<b>210 €</b>
<b>Saturated sample in pressure steps</b>	
less compact materials ( $k > 1$ mD)	<b>195 €</b>
tight samples ( $k < 1$ mD)	<b>300 €</b>

k – permeability, mD - milliDarcy

### *Remarks:*

The sample will not be damaged by the process, and it is repeatable. The recommended value of the minimum effective pressure for a given sample depends on its porosity. In general, in case of dry core it is 100 bar, in case of saturated core it is 50 bar.

**Capacity:** depends on the number of pressure values, average is 45 minutes per point.



## Measurement of electrical properties

Our company is equipped with an EPS-700 electrical properties measuring system that is suitable for weighing the resistivity of the sample in both partial and fully saturated cases, at max. 700 bar confining pressure on 1.5" diameter and max. 3" length core plugs. The system includes a hydrostatical, max. 4 electrodes coreholder, a hand pump for the confining pressure, a pore pressure control for core desaturation and an LCR-817 precision lcr meter with continuously adjustable frequency from 12 Hz to 10 kHz and 0.05% measuring accuracy.



In case of optional confining pressure, the following possibilities for measuring are provided:

- determination of the resistivity, the resistivity index, the formation factor, the tortuosity, the cementation and the saturation exponent in different cases of the saturation of a core;
- the observation of a given nonwetting phase saturation in a sample – measuring of the capillary pressure curve;
- obtaining graphically a mean saturation exponent through various saturation phases;
- if there is a suite of such measurements from core plugs from a particular formation, a mean cementation exponent can be also obtained.

### *Unit prices*

<b>Saturated samples in a given confining pressure</b>	
less compact materials ( $k > 1$ mD) 1 measurement	<b>90 €</b>
less compact materials ( $k > 1$ mD) capillary pressure curve + saturation exponent	<b>140 €</b>
tight samples ( $k < 1$ mD) 1 measurement	<b>175 €</b>
tight samples ( $k < 1$ mD) capillary pressure curve + saturation exponent	<b>350 €</b>

### *Remarks:*

Before the measurement the core plug is saturated with a conductive liquid, thus the sample might be damaged during the process. The recommended value of the minimum confining pressure is 20 bar.

**Capacity:** in fully saturated cases the measuring of one data series takes about 8 hours, the measuring time of the capillary pressure curve depends on the porosity, it may take a few hours to several weeks.

## Coreval-700

Our company is equipped with a Coreval-700 fully automated permeameter and porosimeter that is suitable for measuring the porosity and permeability of the samples by gas (helium/nitrogen) at max. 700 bar confining pressure on 1" or 1.5" diameter and max. 3" length core plugs. The instrument is provided with a data acquisition and calculation computer station.



Permeability measurements are based on the unsteady state pressure drop (pressure falloff) method. This data is used to determine the equivalent liquid permeability, slip and turbulence factors. Equivalent air permeability at a user specified pressure is also computed. Porosity and pore volume measurements are made using the Boyle's and Charles' law technique. Besides the compressibility, the fracture volume and the real pore volume can also be computed.

Minimum five pressure point are recommended for the measuring.

### **Results**

Klinkenberg permeability  
Air permeability  
Slip factor (b)  
Turbulence factor ( $\alpha$ )  
Inertial resistivity ( $\beta$ )  
Real pore volume  
Porosity  
Grain volume  
Grain density  
Compressibility  
Fracture volume

### **Specifications**

Permeability range: 1 $\mu$ D – 10 D  
Porosity range: 0.1 – 60%  
Max. pore pressure: 250 psi  
Length: 0.5 – 3 inch  
Diameter: 1 inch, 1.5 inch or 30 mm  
Confining pressure: 400 – 10 000 psi  
Temperature accuracy: +/- 0.1 °C  
Helium: 400 psi  
Nitrogen: 500 psi  
Air: 100 psi (dry)

**Capacity:** depending on the core sample and the parameters of the weighing about 2 measurements per day.

### **Unit prices**

<b>5 measured point</b>	
less compact materials (k > 1 mD)	<b>125 €</b>
tight samples (k <1 mD)	<b>160 €</b>
<b>extra points (x/point)</b>	
less compact materials (k > 1 mD)	<b>20 €</b>
tight samples (k <1 mD)	<b>40 €</b>

## **Particle size distribution measurement**

The particle size distribution of powders and granulates can be determined with the CILAS 1180 LD type laser granulometer. This up-to-date, complex particle size analytical instrument is suitable for the investigation of powders, ground materials, granulates, etc. in an interval between 0.040 – 2500 µm. The dispersion of the sample is possible with water and water mixed with wetting fluid, with condensed air devoid of oil and water, and sample feeding can be made with free fall adapter between 500 – 2500 µm. The assessment of received results contains among others particle diameter for the 10, 50 and 90% of the distribution curve, mean diameter and the sizes and percents definable by the user, and several other parameters. The instrument can measure using the Fraunhofer or the Mie pattern (according to the Mie pattern, one has to know the fracture index of the particle, referring to air).



Sample preparation (if needed) is done according to the possibilities and prices above. For wet dispersion, about 10 g sample is enough, in case of dry dispersion for the first setting of parameters with unknown sample 200 – 500 g. For further measurements usually 100 g is necessary, but it can vary, according to agreement.

Our company does not perform the preparation and analysis of radioactive (except rocks with natural radioactivity), toxic, carcinogenic, teratogenic and mutagenic samples, because at the present time we are not prepared for such measurements. The sender of the sample has to make a written declaration that his sample does not belong to the mentioned categories.

The sender of the sample has to ensure that the amount of the given sample is representative regarding quantity.

Wet (with water) dispersion can be applied in the case of materials whose particle structure does not go through physical (dissolution) or chemical (reaction) changes. The investigation is destructive in the sense that we can not return the sample after measurement. After the measurement, the customer has to take all the used and unused samples; in case of non-hazardous material he can declare that our laboratory should destroy the sample.

### ***Unit prices***

Measurement of 1 sample with wet or dry	<b>60 €</b>
Measurement of 2-10 samples of similar type	<b>30 €</b>
Measurement of more than 11 samples	<b>25 €</b>
Measurement under 10 micron (10 micron-40nm)	<b>Based on negotiation</b>

Resulting from the principle of the measurement, one „measurement” consists in fact of a lot of individual measurements. A separately started measurement (parallel) counts as a distinct one, but of the same type. According to this, 3 measurements of an unknown sample cost for ex.: 60 + 2 x 30 = 120 €

The sender of the sample has to determine the name of the sample for identification. The measurement results are handed over via e-mail, in pdf format, in the form of printed report, professional assessment, recommendation, etc., based on the individual quotation, as agreed beforehand.

### How to find us



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