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73 Owner/s:

**UNIVERSITY OF CANTABRIA (100.0%)
Government Pavilion, Avda. de los Castros s/n
39005 Santander (Cantabria) ES**

72 Inventor/s:

**POLANCO MADRAZO, Juan Antonio;
THOMAS GARCÍA, Carlos and
SETIÉN MARQUÍNEZ, Jesús**

54 Title: **Method of measuring the permeability of a material to a gas**

57 Summary:

Method of measuring the permeability of a material to a gas, comprising the stages of:

- preparation of a specimen (12) of a material whose permeability to a gas is to be measured;
- place the specimen (12) on a device (17) configured to keep its side faces sealed;
- connect at least one gas storage medium (11) to the end of the specimen (12) through which the gas enters;
- connect a flow meter (15, 25, 35) to the end of the specimen (12) through which the gas exits;
- connect the output of a mass flow detector (22) within the flow meter (15, 25, 35) to data conversion media (23) connected to a computer;
- select at least three inlet pressure values on a pressure gauge regulator (14);
- for each inlet pressure, make with the flow meter (15, 25, 35) at least one measurement of the flow that crosses the specimen (12), and obtain the permeability coefficient K, substituting the average flow value in the Darcy equation;
- obtain the permeability coefficient of the specimen (12) from the average value of the permeability coefficients K.

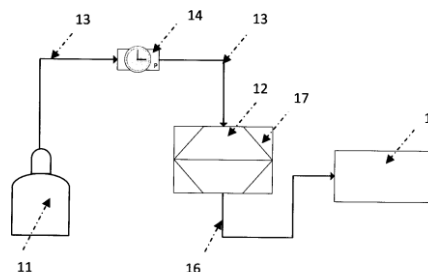


Figura 1

ES 2 406 360 B1

Notice Consultation may be carried out as provided for in art. 37.3.8 LP.

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DESCRIPTION**METHOD OF MEASURING THE PERMEABILITY OF A
MATERIAL TO A GAS****FIELD OF INVENTION**

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The present invention belongs to the field of construction and, more specifically, to methods of controlling the permeability of a material.

BACKGROUND TO THE INVENTION

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There are standards that regulate the measurement of permeability of certain materials against gases. For example, the Spanish regulations regulate the oxygen permeability test method through the *UNE 83966:2008 standards: Durability of concrete. Test methods. Conditioning of concrete specimens for the testing of*

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gas permeability and capillarity and *UNE 83981:2008: Durability of concrete. Test methods. Determination of the oxygen permeability of hardened concrete.*

20

The basis of the test is to apply a constant pressure of gas, on a of the faces of a concrete specimen (or sample) and, after a sufficient time in which the gas has passed through the entire specimen and reached its opposite face, record the gas flow at the outlet, i.e. the volume of gas passing through the specimen per unit of time. To do this, it is necessary that the side faces of the specimen are perfectly sealed, so that no gas escapes through them and

In this way, all the gas that is applied on one of the sides is collected on the opposite side.

The gas flow inlet is controlled by a regulator, and the flow rate at the outlet is measured, according to the referenced standard, by displacing a soap bubble displaced by the outgoing gas inside one of the N pipettes

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graduates who form the essay. To do this, a rubber knob is placed at the bottom of each pipette in the set of N pipettes. By squeezing the knob of the selected pipette by means of a Have, a soap bubble is generated that, pushed by the oxygen, travels through the pipette. It is important to close the Haves of the pipettes that are not there being used.

5

The flow rate that the concrete specimen passes through is the result of dividing the volume that the soap bubble travels, measured as the difference in final and initial values on the graduated scale of the pipette, by the time it takes for the bubble to travel through the pipett.

10 space10.

Each of the N pipettes in the test has a different diameter. The greater the permeability of the concrete specimen, the greater the flow through the concrete specimen, and the greater the velocity of the bubble ascent within the pipette, so a larger pipette diameter is required. Therefore, depending on The pressure and permeability of the concrete material is selected from the set of pipettes, in such a way that during the time that the measurement < the bubble moves upwards within the pipette and always without coming out of its upper end. If the bubble does not move, the oxygen pressure applied is increased.

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A time-measuring device measures the time it takes for the soap bubble to pass through the graduated volume on the surface of the pipette. If the measured time of the bubble passage is less than 30 seconds, the pipette used should be replaced by another with a larger capacity, taking care to close the Haves of the pipettes that are not being used.

At the beginning of each measurement, and to avoid overpressure in the system, the

Have located between the specimen and the pipette assembly is kept open. To perform the test

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Five values of oxygen pressures are selected using the pressure regulator on the nanometer. Pressures between 0.5 bar and

3.5 bar. You can start with 0.1 bar, if the concrete is very permeable, and work up to a maximum of 5 bar, if the concrete is not very permeable.

5 To ensure a stable oxygen flow regime, pre-readings of the flow of this flow are made at 5-minute intervals until the difference between successive readings is less than 3%. This stabilization procedure must be repeated for each pressure applied, and is generally achieved in the time between 5 minutes and 30 minutes, depending on the permeability of! Concrete tested. By reaching the

10 Flow stability: The value of the flow that crosses the specimen for each pressure applied is noted. The average value of the flows obtained in each of the pressures for the same specimen is considered in the test.

The gas flow rates to be measured in the oxygen permeability test on concrete specimens are remarkably small, in the order of 0.1 to 0.5 cm³/s; because of this, it is not possible to use conventional flow meters and the soap pump method is usually used. However, this method has a series of limitations and shortcomings, such as:

- The measurement of permeability with the device that applies the soap bubble method is a slow and laborious procedure because for each pressure measurement, it is necessary to find the appropriate pipette for the corresponding flow, being necessary to make a significant number of measurements with different pipettes until the appropriate pipette is found. In addition, once the pipette is located, the

25 Complete flow stabilization is achieved after a time of 5 to 30 minutes, it being understood that this is achieved when the measurements made in 5-minute intervals do not differ by more than 3% from the value of! measured flow. That is, in a test in which the stabilization time is 30 minutes, after locating the most suitable pipette, 6 measurements of the most suitable pipette will have to be made. flow every 5 minutes to confirm the

30 stabilization at the corresponding pressure.

- There is no possibility to electronically record permeability values continuously. Discrete measurements can only be made both in the stabilization process and in the measurements after stabilization.

5 - The device that applies the soap bubble method requires increasing the inlet pressure when the bubble does not move as a result of low flow and low permeability of the concrete. The use of high pressures can lead to modifications in the viscosity of oxygen, thereby altering the permeability values obtained. In addition, the use of high pressures can lead to the rupture of the
10 structure of the concrete cement paste of young concrete, creating new capillaries and voids through which oxygen would pass. This also alters the permeability value obtained.

SUMMARY OF THE INVENTION

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The present invention seeks to solve the above-mentioned drawbacks by means of a method of measuring the permeability of a material to a gas that allows to measure flow rates in the order of hundredths of a cm^3/s , preferably from $0.02 \text{ cm}^3/\text{s}$, and to obtain real-time graphs of the evolution of the flow over time.

Specifically, in a first aspect of the present invention, a method of measuring the permeability of a material to a gas is provided, which includes the steps of:

- preparation of a specimen of a material whose permeability to a gas is to be measured;
- place the specimen in a device configured to keep the side faces of the specimen sealed, ensuring its tightness and allowing gas to enter through
30 one of the ends of said specimen and the exit at the opposite end;

- connect at least one gas storage medium responsible for storing the gas inside, to the end of the specimen through which the gas enters, where at least one storage medium and the specimen is located a pressure gauge regulator configured to measure and regulate the pressure of the gas circulating from it at least one
5 gas storage medium to the end of the specimen through which the gas enters;
- connect a flowmeter to the end of the specimen through which the gas exits, where the flowmeter comprises a mass flow detector configured to convert the
10 amount of gas flow passing through the specimen in a given parameter;
- connect the output of the mass flow detector to data conversion media configured to measure the parameter coming out of the mass flow detector and convert it to a flow value expressed in cm^3/s ;
- connect the means of data conversion to a computer, where this computer allows real-time graphs of the evolution of the flow over time;
- select at least three inlet pressure values on the pressure gauge;
- for each selected inlet pressure, take at least one measurement of the flow through the specimen, expressed in cm^3/s , with the flow meter;
- In the event that in the previous step the number of flow measurements is greater than two, obtain an average flow value for each selected inlet pressure.
- for each selected inlet pressure, obtain the permeability coefficient K , substituting the flow value or the average flow value that the specimen passes through in the Darcy equation;

-Obtain the permeability coefficient of the specimen from the prominence value of the permeability coefficients obtained with Darcy's equation, corresponding to each selected input pressure value.

5 In one possible realization, the parameter obtained with the magnetic flow detector is a continuous electrical voltage. Alternatively, this parameter is an electric current.

In a possible realization, the number of selected input pressure values in the regulator is five.

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In a possible realization, the number of flow measurements made with the quad for each selected inlet pressure is three.

In a possible realization, the regulator-controller is equipped with two different devices: a controller and a regulator, the controller being configured to control the gas pressure that circulates from the to the center of a gas flow to one of the ends of the specimen, and the regulator being configured to regulate this gas pressure.

In a possible realization, the material from which its permeability is to be rendered is hornig6n.

BRIEF DESCRIPTION OF THE FIGURES

In order to help an understanding of the characteristics of the invention, in accordance with a preferential exercise of practical realization of the idea, and to illustrate this description, a set of drawings, the character of which is illustrative and not liRNITATIVE, is made as an integral part of the book. In these drawings:

30 The figure 1 On which the whole of the

invention.

Figure 2 shows a diagram of the interior of a flowmeter included in the system on which the method of the invention is implemented.

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Figure 3 shows a diagram of the front view of the flowmeter included in the system on which the method of the invention is implemented.

Figure 4 shows a gif⁶ of the evolution of the flow that comes out of the specimen in It is measured by the flowmeter for five different inlet pressures.

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DETAILED DESCRIPTION OF THE INVENTION

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In this text, the term "comprises" and its variants should not be understood in an exclusive sense, i.e. these terms are not intended to exclude other technical characteristics, additives, components or steps.

In addition, the terms "approximately", "substantially", "around", "some", etc. should be understood as indicating values close to those that these terms accompany, since due to errors of calculation or measurement, it is impossible to obtain these values with complete accuracy.

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In addition, a specimen is understood to be a sample of a material on which its permeability can be measured.

The characteristics of the method of invention, as well as the advantages derived from them, can be better understood by the following description, made with reference to the drawings listed above.

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The following preferred embodiments are provided for illustration only, and are not

intended to be restrictive of the present invention. In addition, the present invention covers all possible combinations of particular and preferred embodiments herein indicated. For experts in the field, other objects, advantages and characteristics of the invention will be derived partly from the description and partly from the practice of the invention.

5 invention.

The following is a minimum configuration of a system on which the invention method for measuring the gas permeability of a material is implemented, according to the schematic of the material in Figure 1. The Low Material
10 measurement must be permeable. Non-limiting examples of materials whose permeability can be measured by the system described are: concrete, ceramics or natural stones.

The system in Figure 1 comprises at least one gas storage medium 11, **RS** in charge of storing the gas inside. Said at least a gas storage medium 11 must contain the gas at a pressure greater than the pressure necessary to carry out the measurement. In one particular embodiment, this storage medium 11 is a gas bottle.

The gas storage medium 11 is attached to one end of a specimen 12 whose permeability to a gas is to be measured, by means of a transport medium 13 configured so that the gas circulates inside it from the storage medium 11 to the corresponding end of the specimen 12. Preferably, the pressure at which the gas circulates inside the means of transport 13 is regulated and controlled by means of a control meter 14. Alternatively, the manometer-regulator device 14 is implemented by means of two different devices: a manometer and a regulator.

The means of transport 13 can be made of any material capable of withstanding pressures

30 of approximately 10 bars, and with a diameter of no more than approximately 20

Examples of materials are steel, rubber or latex pipes,

rigid or flexible. Preferably, and for safety reasons, the means of transport 13 connected to the storage medium **11** is a rigid steel tube.

5 In a possible realization, in the event that the regulator meter 14 is a single device, it sits between the storage medium **11** and the 12th test tube. In this case, the means of transport 13 may be made up of two different, consecutive elements, joined by the regulator 14. Alternatively, the controller 14 is located in the storage medium itself **11**.

10 In another possible embodiment, if the controller and the regulator are two different devices, they are located between the storage medium **11** and the specimen 12. In this case, the means of transport 13 can be made up of three different, consecutive elements. Alternatively, the pressure gauge and the regulator are located in the storage medium itself **11**. Alternatively, one of the
The devices (Manometer or Regulator) are located on storage medium **11**, and the other device (Regulator or Manometer, respectively) is located between Storage Medium **11** and Specimen 12. In this case, the means of transport 13 can be formed by two different, consecutive elements.

Prior to carrying out the test, specimen 12 is conditioned in such a way that it has a constant moisture content such that the results can be compared.

Specimen 12 is then placed inside a device 17 configured to keep the side faces of specimen 12 sealed, ensuring its tightness and allowing gas to enter through one end of specimen 12 and exit through the opposite end. The materials from which device 17 is made are sealing materials, such as rubber or latex.

30 Therefore, during the use of the system, the gas from the storage medium 11 circulates inside the transport medium 13 with a certain pressure,

selected on the pressure gauge 14 (or on the regulator if two independent devices are used). The gas enters through one end of the specimen 12 and passes through it until it reaches its opposite end.

5 The gas outlet at the opposite end of specimen 12 is measured by a flow meter 15 that is connected to that end of specimen 12 by a means of transport 16. The means of transport 16 can be made of any material such as to guarantee internal pressure and safety. Examples of materials that are not limited to steel, rubber or latex tubes, rigid or flexible.

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The flowmeter 25 comprises a mass flow detector 22 responsible for converting the amount of gas flow that passes through the specimen into direct electrical voltage (or current indistinctly).

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The mechanism by which mass flow is converted into an electric voltage or current depends on the type of detector. A membrane detector quantifies the flow based on the deformation of the membrane. A laser detector is capable of detecting a mass flow from the number of particles that come between a laser emitter and a detector. A temperature detector has an electrical resistance that is cooled by the flow. Preferably the mass flow detector 22 is a membrane or laser mass flow detector.

The mass flow detector 22 must be accurate enough to detect and convert quantities of gas flow in the range of approximately 0.02 cm³/s and 5 cm³/s, at a voltage of ± 5 V. Examples of mass flow detectors with these characteristics are: Honeywell AWM3000 Series, Omron's manifold or Mass flow from SENSORTECHNICS.

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Data conversion media 23 measures direct electrical voltage (or current indistinctly) that comes out of the mass flow detector 22 and converts it into a flow value expressed in cm³/s. To do this, it is necessary to carry out a prior calibration of the

the

Data conversion means 23, comparing at least five flow values measured by the soap bubble method with the voltage measured by the data conversion means 23, thus obtaining a calibration equation. This equation is valid for the measurement of the permeability of any material that

5 require inlet pressure ranges between the minimum and maximum calibration values.

The 23 data conversion media is connected through a digital output interface, to a computer. Thanks to this connection, it is possible to obtain in real time

10 graphs of the evolution of the flow over time and observe when the system stabilizes without the need to carry out measurements to check it. In addition, the data conversion media 23 can comprise a display 21 showing the gas flow rate in cm^3/s that passes through the specimen.

In a possible realization, the means of data conversion 23 are external and are not included in the flow meter 25. Preferably, the flowmeter 25 has an output interface 24, preferably an analog output type BNC, which allows the mass flow detector 22 output of flowmeter 25 to be connected to the data conversion media 23 extremes. In another possible realization, the means of data conversion 23 are included in the flow meter 25. In another possible realization, data conversion means 23 are implemented both inside the flowmeter 25 and outside it.

An example of the front of the flowmeter 35 is shown in Figure 3, showing the on-off switch 31 connected to the main voltage input, the display of the data conversion media 32 contained in the flowmeter 35, the input of the flowmeter 33 and the output interface 34 that provides an analog electrical output of $\pm 5\text{V}$ corresponding to the flow measured by the flowmeter 35.

30

To carry out the measurement of the permeability of a specimen 12 to a gas, it is necessary to measure the permeability of a specimen 12 to a gas.

Select at least three input pressure values on the controller meter 14 (or on the controller if two independent devices are used). Preferably the number of selected input pressure values is five.

5 For each of the selected inlet pressure values, at least one measurement of the flow through specimen 12, expressed in cm, is made with the flow meter 15, 25, 35³/s. Preferably, the number of flow measurements that are carried out for each selected inlet pressure is three. Then, and in the event that this number of flow measurements is different from one, a
 10 average flow value.

The measured flow value for each selected input value (or the average value in the case of a different number of flow measurements than one) is substituted into Darcy's equation, thus obtaining the permeability coefficient K:

$$K = \frac{2P_i R L I}{A(P_1 - P_2)}$$

Where

20 K = Permeability coefficient [m²]
 IJ = Viscosity of the gas used [N*S/m²] L
 = Length of the specimen [m]
 R = Gas flow rate at the outlet of the specimen [m³/s]
 A = Area of the cross-section of the specimen [m²] P₁
 = Absolute pressure at the exit of the specimen [N/m²]
 25 P₂ = Absolute pressure at the entrance of the specimen
 [N/m²]

Finally, the permeability coefficient of specimen 12 is obtained from the average value of the permeability coefficients obtained with Darcy's equation,
 30 corresponding to each selected input pressure value.

The method of the invention solves the drawbacks detected in the current state of the art, since it allows the measurement of the flow in real time. In this way, it is possible to obtain the stabilization curve of the system, specifying the moment at which the data can be recorded without the need to make measurements

5 spaced in time to confirm stabilization. This reduces the time of test and the number of measurements needed to stabilize the system, optimizing the Duration of the trial. Flow values are obtained more quickly than with the method described in the prior art.

10 The method allows the evolution of the permeability of a material to a gas to be measured, over wide intervals of time, allowing continuous flow measurements to be taken in real time. In this way, it is possible to obtain the stabilization curve of the system, specifying the moment in which the data can be recorded without the need to make measurements spaced in time to confirm stabilization. This reduces the test time and the number of measurements required to stabilize the system, optimizing the duration of the test. Flow values are obtained more quickly than with the systems described in the state of the art.

In addition, the greater sensitivity of the flow meter 15, 25, 35 included in the system on which the method is implemented, allows the measurement of flows of the order of hundredths of cm^3/s , preferably from 0.02 cm^3/s , avoiding having to use pressures as high as those necessary to obtain measurable flows in the device that applies the soap pump method.

Example

Below is a concrete example of the realization of the invention and the results obtained.

30 The gas storage medium used is a gas bottle, which contains the gas to a pressure greater than the minimum necessary in the course of the tests, which shall be

It regulates and is controlled thanks to a pressure gauge-regulator. This gas cylinder is connected to the upper end of a specimen whose permeability to a gas is to be measured, by means of a rigid steel tube that connects the gas cylinder with the pressure gauge-regulator and by means of a flexible gas rubber tube that connects the gas cylinder.

5 Pressure gauge-regulator with said upper part of the specimen.

The specimen is cylindrical made of 20% recycled concrete, measuring 96 mm in height and 150 mm in diameter, and is located inside a rubber side covering device, configured to keep the side faces sealed

10 of the specimen, in such a way that the constant pressure of gas that is applied at its upper end passes through the entire specimen and reaches its opposite end.

Therefore, during the use of the system, the gas from the gas cylinder circulates inside the rigid steel tube at a pressure of 5 bar. Once this gas reaches the pressure gauge, it passes through the flexible gas rubber tube, at the pressure selected in the pressure gauge, until it reaches the upper end of the specimen. The gas enters through this upper end and passes through the entire specimen until it reaches its lower end.

e0 The gas outlet at the opposite end of the specimen is measured by a flow meter connected to the lower end of the specimen by a latex tube.

The flowmeter comprises an on-off switch, which must be connected to the main voltage input, a membrane mass flow detector responsible for converting the amount of gas flow that passes through the specimen into direct electrical voltage (or current indistinctly) and a BNC output that allows the output of the mass flow detector of the flowmeter to be connected to external data conversion media that measures the voltage or current. The electrical flow detector that comes out of the mass flow detector and converts it into a flow value expressed in cm^3/s . The means of
30 conversion are in turn connected to a computer, and thanks to this connection it is possible to obtain real-time graphs of the evolution of the flow over time.

Figure 4 shows a graph obtained with the flowmeter included in the system on which the method of the invention is implemented, which represents the stabilization curve of the concrete specimen described above for five different pressure values. The ordinate axis represents the flow rate in cm^3/s and the axis
5 of abscissas represents time in seconds.

Each of the five peaks observed in the figure correspond to the five pressure values selected in the regulator-meter, these inlet pressures being 1 bar, 1.1 bar, 1.2 bar, 1.3 bar and 1.4 bar respectively.

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The first ascent corresponds to the system connection (start of the test) with an input pressure of 1 bar. The graph then descends gently until it reaches the stabilization zone. As can be seen, this stabilization process lasts approximately 300 seconds (5 minutes).

Next, a new rise in the flow corresponding to the disconnection and connection of the pressure gauge can be observed, with the aim of modifying the inlet pressure in the system. In this case, the input pressure is increased to 1.1 bar, which is why this second peak is higher than the first. The stabilization curve is very similar to that of the first peak and its duration is also approximately 300 seconds. As expected, the stabilization asymptote and, therefore, the flow at the exit, is higher in the second case.

The third, fourth and fifth ascent correspond to the disconnection and connection of the pressure gauge-reducer, with the aim of increasing the input pressure of the system to 1.2 bars, 1.3 bars and 1.4 bars respectively, which is why each peak is greater than the previous one. The stabilization curve is very similar in all cases, lasting approximately 300 seconds. Each stabilization asymptote, and therefore the flow at the outlet, is greater the greater the power at the inlet.

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For each inlet pressure, three measurements of the flow are made once it has stabilized and its average is made. This average flow value as a function of pressure is shown in Table 1.

Press O2 [kg/cm ²]	Flow rate [m ³ /s]
1.00	1.25E-06
1.10	1.43E-06
1.20	1.61E-06
1.30	1.79E-06
1.40	1.98E-06

5

Table 1. Average value of flow through the specimen as a function of the inlet pressure.

The mean flow value is substituted in Darcy's equation, thus obtaining the permeability coefficient K shown in Table 2:

Press O2 [kg/cm ²]	Flow rate [m ³ /s]	Coef. Permeability [m ²]
1.00	1.25E-06	9.14E-16
1.10	1.43E-06	9.20E-16
1.20	1.61E-06	9.20E-16
1.30	1.79E-06	9.16E-16
1.40	1.98E-06	9.13E-16

Table 2. Average value of flow through the specimen and permeability coefficient as a function of inlet pressure.

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Finally, the permeability coefficient of the specimen is the average value of the permeability coefficients obtained with each pressure, being in this case 9.17E-16 m.²

DEMANDS

1. Method of measuring the permeability of a material to a gas, characterized by the fact that it includes the stages of:

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- preparation of a specimen (12) of a material whose permeability to a gas is to be measured;

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- place the specimen (12) on a device (17) that is configured to keep the side faces of the specimen (12) ensuring its tightness and allowing gas to enter through one end of the specimen (12) and exit through the opposite end;

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- connect at least one gas storage medium (11) responsible for storing the gas inside it, to the end of the specimen (12) through which the gas enters, where between said at least one storage medium (11) and the specimen (12) there is a pressure gauge regulator (14) configured to measure and regulate the pressure of the gas circulating from at least one gas storage medium (11) to the end of the test tube (12) through which the gas enters;

- connect a flowmeter (15, 25, 35) to the end of the specimen (12) through which the gas exits, where the flowmeter (15, 25, 35) comprises a mass flow detector (22) configured to convert the amount of gas flow passing through the specimen (12) into a given parameter;

- connect the output of the mass flow detector (22) to data conversion media (23) configured to measure the parameter coming out of the mass flow detector (22) and convert it into a flow value expressed in cm^3/s ;

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- connect the data conversion media (23) to a computer, where the computer allows to obtain real-time graphs of flow evolution with the time;

- select at least three input pressure values on the controller (14);

5 - For each selected inlet pressure, perform with the flow meter (15, 25, 35) at the
minus a measure of the flow through the specimen (12), expressed in cm³/s;

-In the event that in the previous step the number of flow measurements is greater than two, obtain an average flow value for each selected inlet pressure.

10 - for each selected inlet pressure, obtain the permeability coefficient K , substituting the flow value or the average flow value that the specimen passes through (12) in Darcy's equation;

11.5 -Obtain the permeability coefficient of the specimen (12) from the average value of the permeability coefficients obtained with the Darcy equation, corresponding to each selected input pressure value.

2. The method of any of the above claims, where the parameter obtained with the mass flow detector (22) is a continuous electrical voltage.

3. The method of claim 1, where the parameter obtained with the mass flow detector (22) is an electric current.

4. The method of any of the above claims, where the number of input pressure values selected on the regulator (14) is five.

5. The method of any of the above claims, where the number of flow measurements made with the flow meter (15, 25, 35) for each selected inlet pressure is three.

30 6. The method of any of the above claims, where the manometer

The regulator (14) is implemented by means of two different devices: a pressure gauge and a regulator, the pressure gauge being configured to measure the pressure of gas circulating from at least one gas storage medium (11) to one of the ends of the specimen (12), and the regulator being configured to regulate this pressure gas pressure.

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7. The method of any of the above claims, where the material to be measured for permeability is concrete.

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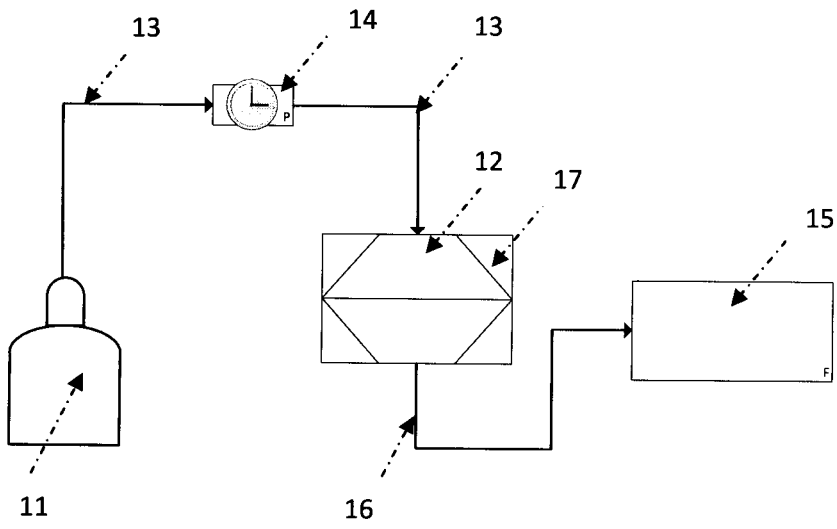


Figura 1

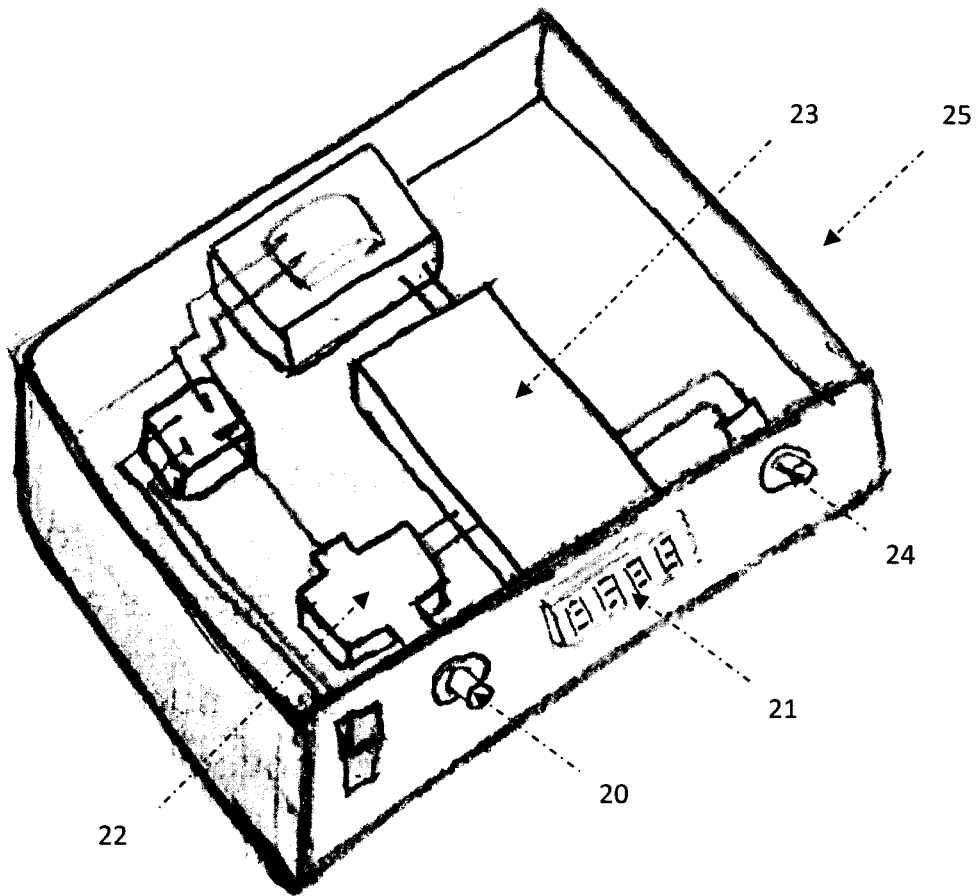


Figura 2

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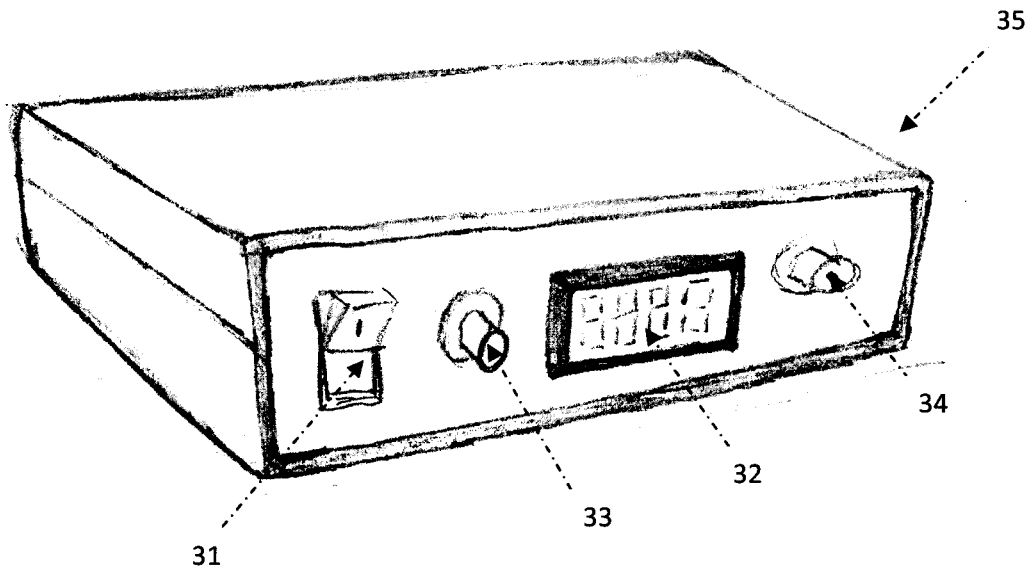


Figura 3

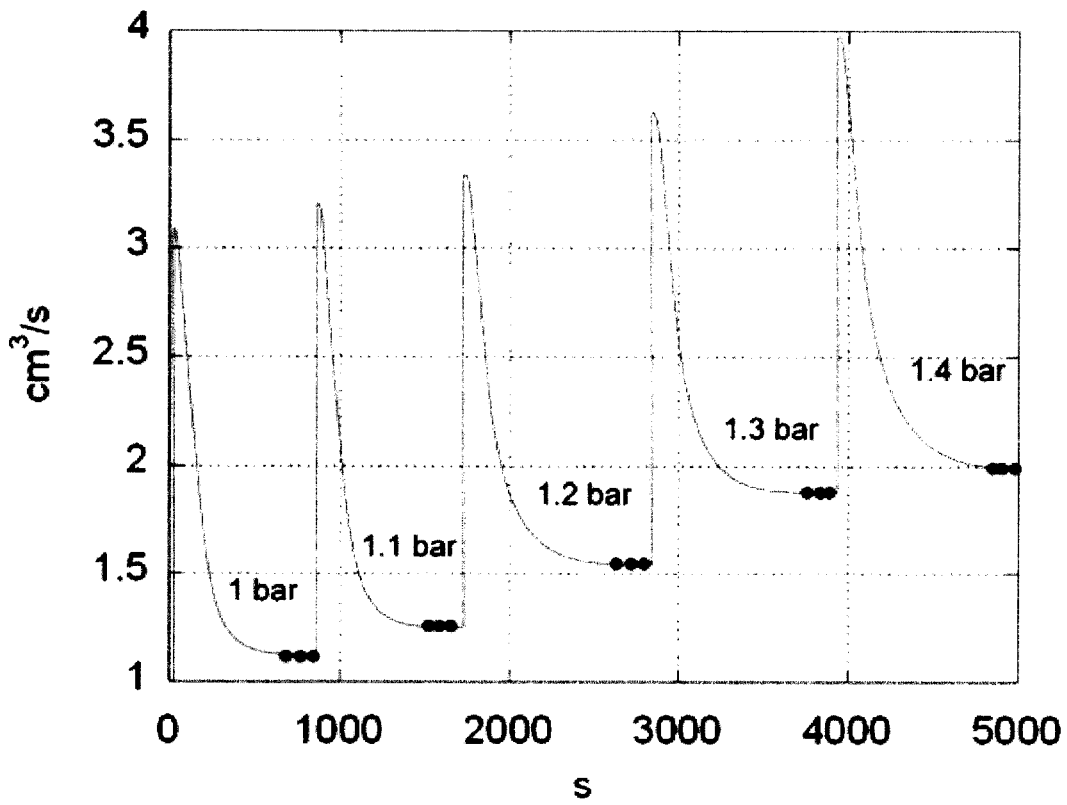


Figura 4



- ②① Application number: 201300198
- ②② Date of submission of application: 19.02.2013 Priority
- ③② date:

REPORT ON THE STATE OF THE ART

⑤① Int. Cl. : **G01N15/08** (2006.01)

RELEVANT DOCUMENTS

Category	⑤⑥ Documents cited	Affected claims
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A	US 4979390 A (SCHUPACK et al.) 25.12.1990, Figures 1,3.	1,4,6
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Category of documents cited

X: of particular relevance
And: of particular relevance combined with others of the same category
A: reflects the state of the art

Or: referred to unwritten disclosure
P: published between the priority date and the filing date
E: previous document, but published after the date of submission of the application

This report has been prepared

☐ for all claims

■ for claims no:

Date of preparation of the report 23.05.2013	Examiner F. J. Olalde Sánchez	Page 1/4
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Minimum documentation sought (classification system followed by classification symbols) G01N15/08

Electronic databases queried during the search (name of the database and, if possible, search terms used)

EPODOC

Date of Written Opinion: 23.05.2013

Statement

Novelty (Art. 6.1 LP 11/1986)	Claims 1-7 Demands	YES NO
Inventive step (Art. 8.1 LP11/1986)	Demands Claims 1-7	YES NO

The application is considered to meet the requirement of industrial application. This requirement was assessed during the formal and technical examination phase of the application (Article 31.2 of Law 11/1986).

Basis of the Opinion.-

This opinion has been made on the basis of the patent application as published.

1. Documents considered.-

The following is a list of the documents pertaining to the state of the art taken into consideration for the realization of this opinion.

Document	Publication or Identification Number	Publication Date
D01	CN 1815174 A (UNIV TONGJI)	09.08.2006
D02	"Mass flow sensor for gases: AWM3000 Series".	June 2006
D03	US 4979390 A (SCHUPACK et al.)	25.12.1990

2. Reasoned declaration in accordance with Articles 29.6 and 29.7 of the Implementing Regulations of Law 11/1986 of 20 March 1986 on Patents on novelty and inventive step; Quotes and explanations in support of this statement

In accordance with Article 29.6 of the Implementing Regulations of Law 11/86 on Patents, it is considered, preliminarily and without obligation, that the objects defined by claims 1-7 do not apparently meet the requirement of inventive step within the meaning of Article 8.1 LP, in relation to the prior art established by Article 6.2 of said Law. Specifically,

Document D01 disclosed a method for measuring the permeability of a material (concrete) to a gas in which a specimen (3) of that material is placed in a device (1,2) configured to keep the lateral faces of the specimen sealed (4); a gas storage medium (7) is connected to one end of the specimen; the end of the specimen through which the gas exits is connected to a flow meter (8) whose output parameter is converted to a flow value expressed in L³/T (volume/time); three pressure values are selected and between three and five flow measurements are made for each pressure; the average permeability values are obtained using the Darcy equation of the application.

The differences between the claimed method and the one disclosed in D01 lie in the use of a computer to carry out the calculations and in the use of a pressure gauge-regulator for the control/measurement of the inlet pressures, extremes not explicitly disclosed in D01. Both differences can be considered implicit in D01 and in any case, they are evident and commonly used in the technique (D03), lacking inventive step.

DEPENDENT CLAIMS

The additional characteristics of claims 5 (three flow measurements for each pressure) and 7 (concrete specimen) are explicitly disclosed in D01, so they appear to also lack inventive step.

D01 discloses a method with tests at three different pressures while the object of protection of claim 4 establishes five pressure values, resulting in an arbitrary choice devoid of inventive step compared to the three values used in D01.

D01 did not disclose the use of a combination of separate pressure gauge and regulator (as opposed to the pressure gauge-regulator in claim 1). The same considerations regarding lack of inventive step are now applicable.

D01 did not disclose the fact that the output parameter of the mass flow detector of the flowmeter used was a direct voltage (claim 2) or an electric current (claim 4), both being non-inventive choices compared to D01, knowing the equipment available in the technique (D02).