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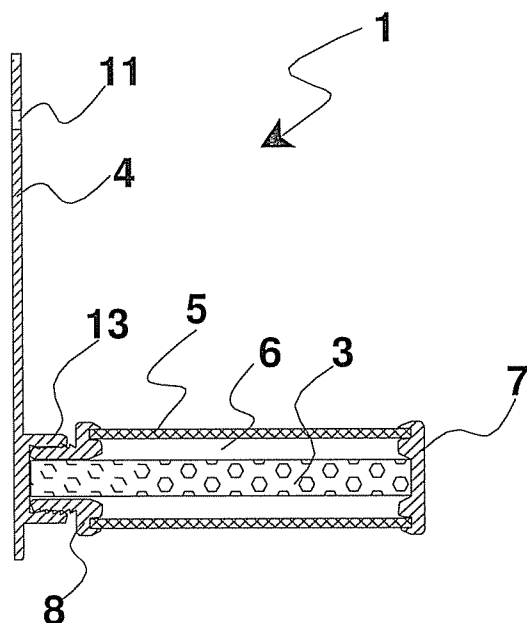
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(54) Title: SAMPLING DEVICE FOR VOLATILE SUBSTANCES



(57) Abstract: A diffusion sampling device for volatile substances dispersed in air, having radial symmetry, provided with a liquid absorbing means which occupies a cylindrical space, coaxial with respect to the diffusion wall, also cylindrical. Diffusion occurs through the wall of a hollow porous polyolefin cylinder, which contains an absorbing cartridge, consisting of a cylinder of the same material, of equal length, but of smaller diameter; the absorbing means is contained in the aforesaid cartridge subsequent to a specific deposition process which allows to fill the pores of the cartridge itself with a suitable liquid mixture, adapted to the sampling of the substances to be determined. The mixture is recovered after sampling for subsequent analysis. The main field of application is that of monitoring the pollution in working and living environments.

Sampling device for volatile substances

DESCRIPTION

Field of the invention

The present invention relates to a sampling device for volatile substances dispersed in air by radial symmetry diffusion, specifically used for monitoring the pollution in working and living environments.

State of the art

Sampling of volatile substances may be currently carried out with low investment and management costs, and entirely without energy consumption, by resorting to diffusion sampling devices or samplers instead of the conventional systems based on the use of suction pumps powered by battery or by the electrical mains.

Diffusion samplers comprise axial symmetry devices and radial symmetry devices. The latter are most advantageous due to their high sampling flow rate. An example of a radial symmetry device is described in EP0714020.

Such diffusion samplers, however, display some disadvantages.

A first disadvantage is represented by the fact that in cases in which use of a liquid absorbing means is provided, as in numerous pollutant sampling methods, the absorbing cartridge containing the liquid does not allow to exploit the diffusion over its entire surface. It is the case, for example, of axial symmetry samplers which contain absorbing liquid deposited on the bottom of a glass tube.

A second disadvantage of the known sampling devices further resides in the fact that simple grids or membranes of low thickness do not maintain the diffusion gradient stable, due to the turbulence of the air in correspondence of the diffusion surface.

The need to make a radial symmetry diffusion sampling device capable of overcoming the aforesaid drawbacks is therefore felt.

Summary of the invention

It is the main object of the present invention to make a sampling device for volatile polluting substances by radial symmetry diffusion which, in addition to allowing high sampling flow rates, allows to exploit the radial symmetry diffusion on the entire surface of a porous cylindrical cartridge provided with a liquid absorbing means immobilised therein.

A further object of the present invention is to make a device capable of

considerably reducing the effect of the air speed on the diffusion sampling flow rate with respect to that of the known devices provided with low thickness grids or membranes.

The present invention thus proposes to obtain the aforementioned objects by

- 5 making a sampling device for volatile polluting substances by radial symmetry diffusion which, in accordance with claim 1, comprises a first tubular diffusion body of said volatile substances from an external environment towards inside said first body, a second body, positionable inside the first body, containing a liquid absorbing means adapted to absorb said volatile substances, characterised in that
10 said second body is formed by porous material having pores containing said liquid absorbing means immobilised therein subsequent to a suitable deposition process.

Advantageously, the possibility of immobilising a liquid absorbing means in a porous cartridge, arranged inside the sampler, by means of a deposition process
15 within the pores of the absorbing cartridge, allows to exploit radial symmetry diffusion over its entire surface.

The diffusion sampler, object of the present invention, further has the following advantages:

- the diffusion in radial direction over the entire cylindrical surface of the sampler
20 determines, despite its small size, a high value of the ratio between the diffusion surface and the diffusion path length (S/L) and thus a sampling flow rate comparable to that obtainable in sampling by means of suction pumps;
- the thickness of the porous wall considerably reduces the effect of the speed of air on the diffusion sampling flow rate;
- 25 - the possibility of immobilising different absorbing means in the pores of the absorbing cartridge allows to make the sampler adapted to determine various categories of volatile substances.

The sampling is performed in two steps: the volatile substance molecules are diffused from the air of the external contaminated environment into the internal
30 space of the sampling device, being firstly diffused through a tubular porous membrane and subsequently being collected by a porous material absorbing cartridge impregnated with an absorbing liquid.

The dependent claims describe preferred embodiments of the invention.

Brief description of the Figures

Further features and advantages of the invention will be better apparent in view of the detailed description of a preferred, but not exclusive, embodiment, of a sampling device for volatile substances illustrated by way of non-limitative example, with the aid of the accompanying drawings, in which:

Fig. 1 represents a longitudinal section of part of the device according to the invention and side views of its ends;

Fig. 2 represents a side view of a component of the device of the invention;

Fig. 3 represents a side view of a further component of the device of the invention;

Fig. 4 represents a longitudinal section of a complete device fixed to the component of Fig. 3.

Detailed description of a preferred embodiment of the invention

With reference to the Figures, it is represented a sampling device 1, or simply sampler, for volatile substances by radial symmetry diffusion comprising:

- a tubular diffusion body 2, preferably of cylindrical shape, reusable for repeated samplings;
- an absorbing cartridge 3, also preferably of cylindrical shape;
- a supporting plate 4.

Tubular diffusion body 2, shown in Fig. 1, of the volatile substances to be analysed, coming from the external environment, comprises a porous material membrane 5 formed by a tube of porous polymer, preferably polyethylene, closed at the ends by a closed base or bottom 7

and by a through head 8, also these made of polyethylene and fixed, e.g. welded, to the tube.

Absorbing cartridge 3, positionable preferably in concentric and coaxial manner inside tubular body 2, contains an absorbing material adapted to absorb the volatile substances which are diffused through membrane 5.

In the preferred embodiment of the invention, absorbing cartridge 3 is a porous polymer cylinder, hollow or full, as that shown in Fig. 2, which contains the liquid absorbing means within the pores of the polymeric structure, preferably in polyethylene, subsequent to the deposition of a suitable liquid mixture.

Advantageously, indeed, a preventive deposition process of said liquid mixture within the pores or interstices of porous polymer cartridge 3 allows to exploit to the

maximum the collection surface of volatile substances, radially diffused through membrane 5 in space 6 delimited by membrane 5 itself and by cartridge 3.

Cartridge 3 is inserted in tubular diffusion body 2 and maintained in position between a notch or lead-in 10 arranged on the closed base or bottom 7 and the

5 opening of through head 8. The longitudinal extension of cartridge 3 is essentially equal to the extension of tubular diffusion body 2 plus that of through head 8.

Advantageously, the thickness of the porous wall of membrane 5 is such to considerably reduce the effect of air speed on the sampling flow rate by diffusion, thus allowing a better collection of the volatile substances to be analysed. Indeed,

10 by reducing the turbulence in the air in correspondence of the diffusion surface, the diffusion limit layer is made stable thanks to an essentially constant, or however lightly variable, concentration gradient between the outside and the inside of the sampling device.

Preferably, the thickness of the porous wall of membrane 5 is comprised in the
15 range of 1-6 mm.

In the case of a hollow porous cylinder, absorbing cartridge 3 has a thickness from 0,2 to 1 mm.

The dimensions of the pores are advantageously equal to approximately 10-50 μm for membrane 5 and equal to approximately 10-50 μm for cartridge 3.

20 The assembly of the sampler of the invention is completed by fixing head 8 of tubular diffusion body 2, containing absorbing cartridge 3, to supporting plate 4, preferably made of polycarbonate or polyethylene, in the manner shown for example in Fig. 4. In this case, the through head 8 is provided with an external threading 12 for fixing the sampler to the corresponding threaded seat 13 provided
25 on supporting plate 4. In an alternative embodiment, fixing between sampler of the invention and plate may simply be of fitting-in type with plate 4 acting as cap.

Supporting plate 4 is preferably, but not necessarily, triangular in the shape, as shown in Fig. 3. Such plate 4, provided with one or more housings for clips 11, preferably three in number, allows to apply the sampler to people's clothes or to fix
30 it to a suitable support provided in the various environments.

The absorbing material is retrieved after sampling in order to analyse the substances to be determined by means of suitable chemical reactants.

The "equivalent pumping" capacity of the sampler of the invention is

approximately 80-100 cm³/min of air, its total weight is equal to approximately 15-20 g, and its analytic sensitivity limit is in the order of 0,1 µg/m³ for a seven-day exposure.

The sampler, except for the supporting plate, is made of high-thickness
5 polyethylene so as to confer great strength and chemical inertia.

CLAIMS

1. A sampling device for volatile polluting substances by radial symmetry diffusion, comprising:

- a first tubular diffusion body (2) of said volatile substances from an external
5 environment towards inside said first body,

- a second body (3), positionable inside the first body (2), containing a liquid
absorbing means adapted to absorb said volatile substances,
characterised in that said second body (3) is formed by porous material having
pores containing said liquid absorbing means immobilised therein subsequent to a
10 suitable deposition process.

2. A device according to claim 1, wherein the second body (3) is a full cylinder
formed by porous polymer.

3. A device according to claim 1, wherein the second body (3) is a hollow cylinder
formed by porous polymer.

15 4. A device according to claim 2 or 3, wherein said porous polymer is preferably
polyethylene.

5. A device according to any of the preceding claims, wherein the first tubular
body (2) is a porous membrane (5) arranged coaxially and externally to the
second body (3).

20 6. A device according to claim 5, wherein said membrane (5) is formed by a
polymer, preferably polyethylene.

7. A device according to claim 5 or 6, wherein the thickness of the membrane (5)
is comprised in the range of 1-6 mm.

8. A device according to any of the preceding claims, wherein the dimension of the
25 pores is equal to approximately 10-50 μm for the first tubular body (2) and equal to
approximately 10-50 μm for the second body (3).

9. A device according claim 5, wherein the membrane (5) is closed at the ends by
a closed bottom (7) and by a through head (8).

10. A device according to any of the preceding claims, wherein the second body
30 (3) is adapted to be inserted in the first tubular body (2) and maintained in position
between a lead-in (10) provided on the closed bottom (7) and the opening of the
through head (8).

11. A device according to any of the preceding claims, wherein there is provided a

supporting plate (4) adapted for a fixing of the device provided with one or more housings for clips (11) so as to apply the sampler to people's clothes or to a suitable support provided in the various environments.

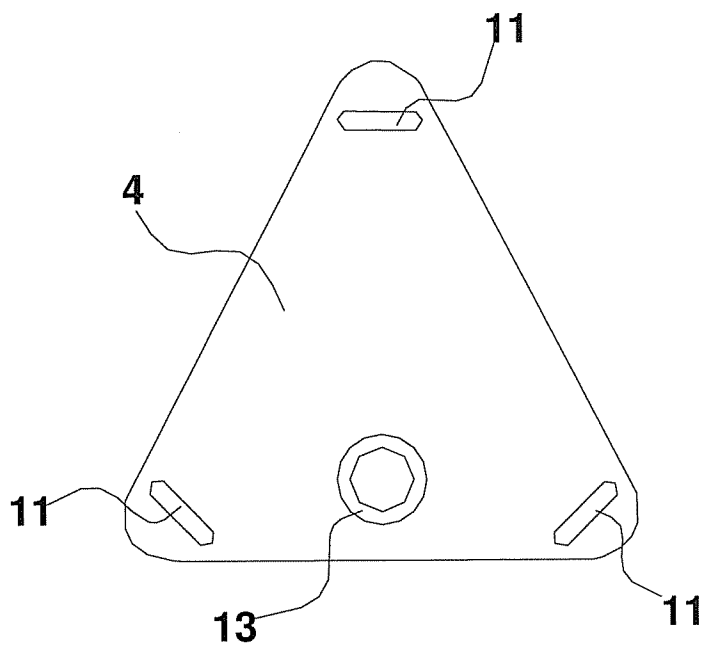
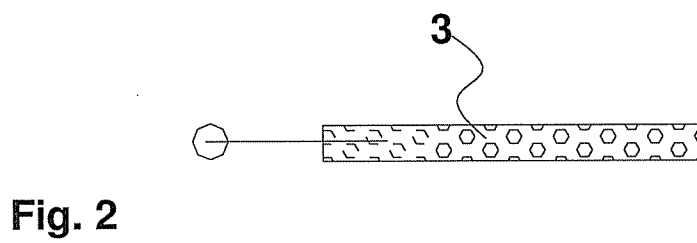
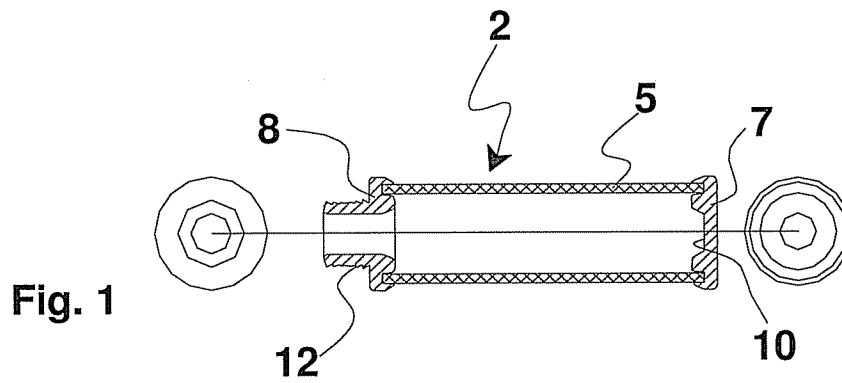


Fig. 3

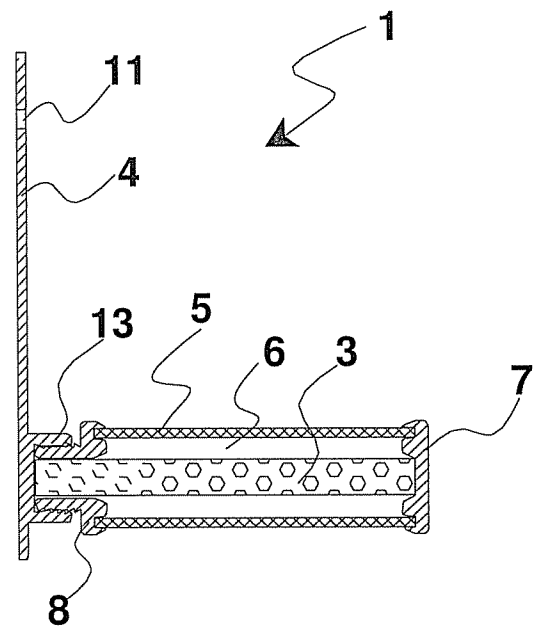


Fig. 4

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/053842

A. CLASSIFICATION OF SUBJECT MATTER
INV. G01N1/22

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

G01N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, WPI Data, INSPEC, COMPENDEX, BIOSIS, EMBASE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 714 020 A2 (FONDAZIONE SALVATORE MAUGERI [IT] FONDAZIONE SALVATORE MAUGERI) 29 May 1996 (1996-05-29) the whole document -----	1-11
A	US 4 973 434 A (SIRKAR K K [US] ET AL) 27 November 1990 (1990-11-27) the whole document -----	1-11
A	US 2003/215958 A1 (KIN PONG BOON [SG] ET AL) 20 November 2003 (2003-11-20) figure 1 -----	1-11
A	DE 39 08 046 C1 (DRAEGERWERK AG, 2400 LUEBECK, DE) 23 August 1990 (1990-08-23) figure 2 -----	1-11

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

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X document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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