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(54) **CENTRIFUGE FILTER TUBE**

(57) The present invention discloses a centrifuge filtration tube comprising a centrifuge tube (2) and a centrifuge tube (1) housed in the centrifuge tube (2). One or more constant-volume vents (7) and multiple pores (4) are provided on a sidewall of the centrifuge tube (1). The one or more constant-volume vents (7) are located above the pores (4). The pores (4) are covered with a filtering membrane (3). The disclosed centrifuge filtration tube has the advantages of being simple, easy to use, highly efficient, and inexpensive, which can save large amounts of labor and time in analyses of large number of samples.

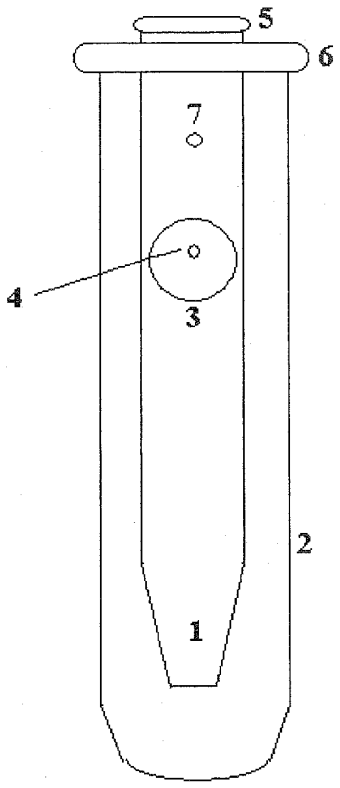

Figure 1

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Description

TECHNICAL FIELD

[0001] The present invention relates to the field of chemical analysis, and in particular, to a centrifuge filtration tube.

BACKGROUND OF THE INVENTION

[0002] For the purpose of various research, it is often necessary to liquefy samples such as soil, meat, water, flora, and fauna, etc., and to separate and remove small solid particles from the treatment liquids before they can be used for testing in large-scale high-precision instruments (such as flow analysis injectors, liquid chromatography mass spectrometry, etc.). Otherwise, these particles will block or wear off the instruments' sample input channels, which can cause instrument failures and shorten their life expectancy. Conventionally, solutions for this problem are filtering or pressurized filtering. But for high volume samples, these methods are inefficient, time-consuming, and laborious.

[0003] Patent application CN202290316U has described a double-layer pipe in which an inner tube is provided with a plurality of openings for blocking polymeric pellets which only allows liquid to flow out under gravity (at rest). The function of the disclosed device is equivalent to a screen, which can only conduct simple solid-liquid separation treatment. The disclosed device can neither produce controlled liquid flow, nor achieve separation of hydrophilic and hydrophobic liquids.

SUMMARY OF THE INVENTION

[0004] The main object of the present invention is to provide a centrifuge filtration tube which makes it more efficient, quick, and convenient for analyses of certain biological or chemical samples.

[0005] The present invention includes the following technical features:

[0006] A centrifuge filtration tube includes a second centrifuge tube (2) and a first centrifuge tube (1) housed in the centrifuge tube (2). The first centrifuge tube (1) includes one or more constant-volume vents (7) and multiple pores (4) on a side wall of the first centrifuge tube (1). The one or more constant-volume vents (7) are located above the pores (4). A filtering membrane (3) covers the pores (4).

[0007] Further, the one or more constant-volume vents (7) can be located in an upper portion of the side wall of the centrifuge tube (1). The pores (4) can be located in a middle portion of the side wall of the centrifuge tube (1).

[0008] Further, the one or more constant-volume vents (7) can be located in a top cover of the centrifuge tube (1). The pores (4) can be located in a middle portion of the side wall of the centrifuge tube (1).

[0009] Further, the filtering membrane can be positioned on an inner wall of the centrifuge tube (2) and covers the pores (4) in the side wall of the first centrifuge tube (1).

[0010] Further, the filtering membrane can be a microporous membrane.

[0011] Further, the filtering membrane can be a polypropylene microporous membrane.

[0012] Further, the filtering membrane can be a polytetrafluoroethylene air filtration membrane.

[0013] Further, the filtering membrane can be a hydrophobic filter.

[0014] The centrifuge filtration tube of the present invention includes a microporous membrane coated on the inner tube having pores. Since the microporous membrane has a large surface tension, a liquid inside the microporous membrane does not flow out when only gravity is present (still state); this state is equivalent to a closed valve. When the centrifuge filtration tube is put to high-speed rotation in a centrifuge, the centrifugal force overcomes the liquid surface tension, which allows the liquid to flow out of the microporous membrane; this state is equivalent to an open valve. The pores in the membrane function as a valve under the control of centrifuge forces, which can be closed or opened by centrifugal rotations; its role is completely different from the screen using in conventional technologies. In practice, the present invention only requires for a low-speed centrifugal rotation (2000-4000 rpm) for a short period (3-5 min), which is particularly suitable for scientific research workers handling a large number of samples, and can save a lot of manpower and time.

[0015] The present invention can be implemented by the following technologies: a plastic centrifuge filtration tube comprising a centrifuge tube 1 having one or a plurality of pores in the middle of its side wall. The pores in the side wall are sealed with a layer of membrane. The side wall of the centrifuge filtration tube 1 includes a constant-volume vent 7 for balancing the internal and external air pressures during centrifugation. The centrifuge tube 1 is placed in another 50 mL commercial centrifuge tube 2. When the test is started, a sample liquid suspension is placed in the centrifuge tube 2, and the centrifuge tube 1 with filtration pores on its side wall is placed in the centrifuge tube 2. The centrifuge is started. At this time, the portion of the liquid having the liquid level higher than the pores is moved into the centrifuge tube 1 by centrifuge forces, to achieve the goal of rapid clearing of the sample suspension.

[0016] Compared with conventional technologies, the present invention includes the following advantageous effects: it only requires for a low-speed centrifugal rotation (2000 - 4000 rpm) for a short period (3-5 min), which is particularly suitable for scientific research workers handling a large number of samples, and can save a lot of manpower and time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017]

Figure 1 is a schematic diagram of the disclosed centrifuge filtration tube;

Figure 2 is a partial cross-sectional view of the centrifuge filtration tube;
wherein 1 - small centrifuge tube, 2 - large centrifuge tube, 3 - filtering membrane; 4 - pore, 5 - a top cover of the small centrifuge tube 1,6 - a top cover of the large centrifuge tube, 7 - constant-volume vent, 11 - a side wall of the small centrifuge tube, 21 - a side wall of the large centrifuge tube, and 31 - a cross section of the filtering membrane.

DETAILED DESCRIPTION OF IMPLEMENTIONS

[0018] The present invention is now described in further detail with reference to the accompanying drawings,
[0019] Figure 1 is a schematic diagram for a centrifuge filtration tube, including: a small centrifuge tube 1; a large centrifuge tube 2, a filtering membrane 3 attached to the side wall of the small centrifuge tube 1; one or more pores 4 on the small centrifuge tube 1, a top cover 5 of the small centrifuge tube 1, a top cover 6 of the large centrifuge tube 2, and a constant-volume vent 7 on the upper portion of the small centrifuge tube 1 (the constant-volume vent 7 may be provided on the top cover 5 of the small centrifuge tube 1). A large hole is opened in the top of the large centrifuge tube 2 through which the small centrifuge tube 1 is placed into the large centrifuge tube 2. The constant-volume vent 7 is opened in the upper portion of the small centrifuge tube 1 for exhausting air and maintaining constant volume.
[0020] Figure 2 is a cross-sectional view of the centrifuge filtration tube. The small centrifuge tube 1 includes a side wall 11. The large centrifuge tube 2 includes a side wall 21. The filtering membrane 3 has a cross section 31.
[0021] Example 1: place the liquid to be cleared in a commercially available centrifuge tube 2, place the centrifuge tube 1 therein, and start the centrifuge. Wait until the liquid flows into the centrifuge tube 1 through the pores in the side wall of the centrifuge tube 1. Depending on different pore sizes of the pores, the filtering membrane can block macromolecules or large particles away outside of the centrifuge tube 1. A relatively pure solution can thus be obtained in the centrifuge tube 1.
[0022] Example 2: The filtering members affixed to the sidewall of the centrifuge tube 1 can be formed by different types of films such as polypropylene microporous membrane, a polytetrafluoroethylene air filtration membrane, or a hydrophobic membrane, etc.

Claims

1. A centrifuge filtration tube (1), comprising:

a first centrifuge tube (1) comprising a side wall that includes one or more constant-volume vents (7) and multiple pores (4), wherein the constant-volume vents (7) are located above the pores (4);
a filtering membrane (3) that covers the pores (4); and
a second centrifuge tube (2) in which the first centrifuge tube (1) is housed.

2. The centrifuge filtration tube of claim 1, wherein the one or more constant-volume vents (7) are located in an upper portion of the side wall of the centrifuge tube (1), wherein the pores (4) are located in a middle portion of the side wall of the centrifuge tube (1).

3. The centrifuge filtration tube of claim 1, wherein the centrifuge tube (1) include a top cover, wherein the one or more constant-volume vents (7) are located in the top cover of the centrifuge tube (1), wherein the pores (4) are located in a middle portion of the side wall of the centrifuge tube (1).

4. The centrifuge filtration tube of claim 1, wherein the filtering membrane is positioned on an inner wall of the centrifuge tube (2) and covers the pores (4) in the side wall of the first centrifuge tube (1).

5. The centrifuge filtration tube of claim 1, wherein the filtering membrane is a microporous membrane.

6. The centrifuge filtration tube of claim 5, wherein the filtering membrane is a polypropylene microporous membrane.

7. The centrifuge filtration tube of claim 5, wherein the filtering membrane is a polytetrafluoroethylene air filtration membrane.

8. The centrifuge filtration tube of claim 5, wherein the filtering membrane is a hydrophobic filter.

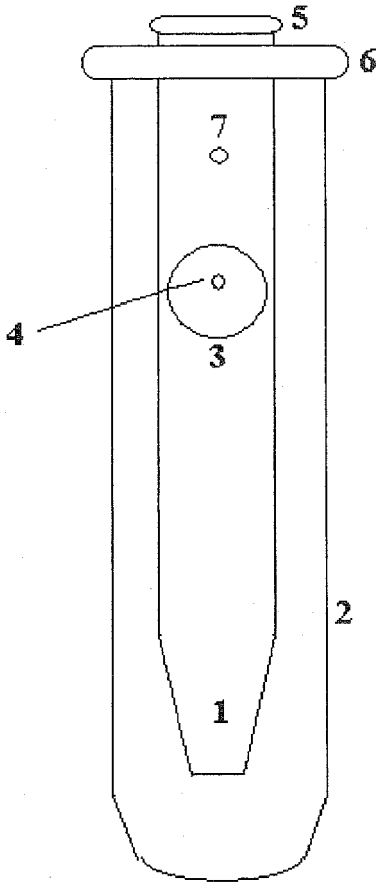

Figure 1

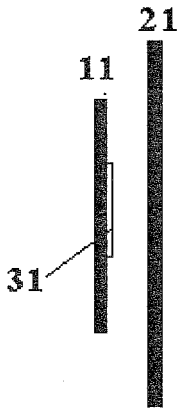

Figure 2

INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/084924

A. CLASSIFICATION OF SUBJECT MATTER

B04B 7/16 (2006.01) i

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)

B04B; 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 practicable, search terms used)

CNPAT, SIPOABS, DWPI, CNKI: centrifugal, filter+, tube?, duct?, pipe?, membrane?, film?

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
PX	CN 204182492 U (LIU, Yuemeng) 04 March 2015 (04.03.2015) see claims 1-8	1-8
X	CN 103364522 A (SHEN, Jiate) 23 October 2013 (23.10.2013) see description, paragraphs [0029]-[0036], and figure 1	1, 4-8
X	CN 202290316 U (TIANJIN HEOWNS BIOCHEMICAL TECHNOLOGY CO., LTD.) 04 July 2012 (04.07.2012) see description, paragraphs [0022], [0023], and figures 1 and 2	1, 4-8
A	CN 201586570 U (LANZHOU UNIVERSITY) 22 September 2010 (22.09.2010) see the whole document	1-8

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

* Special categories of cited documents:

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"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

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 October 2015	03 November 2015
Name and mailing address of the ISA State Intellectual Property Office of the P. R. China No. 6, Xitucheng Road, Jimenqiao Haidian District, Beijing 100088, China Facsimile No. (86-10) 62019451	Authorized officer YANG, Guiquan Telephone No. (86-10) 62085242

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/CN2015/084924

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2013147515 A1 (APINTECH INC.) 03 October 2013 (03.10.2013) see the whole document	1-8
A	CN 202683355 U (SHANGHAI UNIVERSITY OF SCIENCE & TECHNOLOGY) 23 January 2013 (23.01.2013) see the whole document	1-8

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/CN2015/084924

Patent Documents referred in the Report	Publication Date	Patent Family	Publication Date
CN 204182492 U	04 March 2015	None	
CN 103364522 A	23 October 2013	None	
CN 202290316 U	04 July 2012	None	
CN 201586570 U	22 September 2010	None	
WO 2013147515 A1	03 October 2013	KR 20130111153 A	10 October 2013
CN 202683355 U	23 January 2013	None	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- CN 202290316 U **[0003]**