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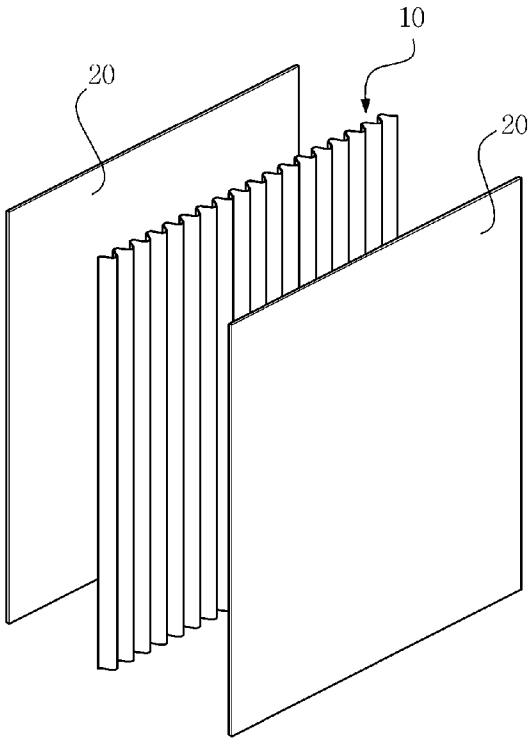
[Continued on next page]

(54) Title: MEMBRANE MODULE FOR TREATING WATER

[Fig. 3]



(57) Abstract: The present invention relates to a membrane module for treating water. The present invention provides a membrane module, which includes a support; and a membrane laminated on the support, wherein the support is deflected when one end of the support is fixed. The support is made of a plastic corrugated cardboard with a thickness of 0.2 to 1.0 mm or a fiber sheet coated with a resin. According to the present invention, the support for supporting a membrane has flexibility, so that during a washing (or aeration) process, the membrane is freely moved to thereby be easily washed (that is, impurities can be easily removed) with the increased washing efficiency. In addition, the membrane module is light in weight and small in thickness. Also, due to the reduced thickness, the membrane module occupies a reduced area in a water treatment plant, thereby decreasing a building site of the water treatment plant.

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Description

MEMBRANE MODULE FOR TREATING WATER

Technical Field

[1] The present invention relates to a membrane module for treating water, and more particularly, to a membrane module for treating water, which has a flexible support thereby being easily washed, having an excellent washing efficiency, and also reducing a site of a water treatment plant due to its reduced thickness.

[2]

Background Art

[3] A large water treatment plant is used for purifying dirty water, wasted water and leachate, which are generated at home, industrial spots and agricultural and stockbreeding spots. Physical, chemical, and biological treatment method are used for treating water, and recently, a high-tech treatment method in the combined form of the above treatment methods is frequently used. Generally, a water treatment plant is provided with a membrane filter for solid-liquid separation, and a plurality of membrane modules for substantially separating solid and liquid from each other are arranged in the membrane filter. In addition, a module having a hollow fiber membrane and a flat sheet membrane is used as the membrane module.

[4] Figs. 1 and 2 show a conventional flat sheet membrane module for water treatment, wherein Fig. 1 is an exploded perspective view and Fig. 2 is an assembled perspective view.

[5] Referring to Figs. 1 and 2, a conventional membrane module 1 for water treatment generally includes a support plate 2, spacers 3 laminated on both surfaces of the support plate 2, and membranes 4 laminated on outer surfaces of the spacers 3. Also, frames 9 are coupled to edges of the membrane module 1 to fix the aforementioned components, and a discharge hole 8, which is connected to a pump, is formed in the frame 9 positioned in an upper portion. At this time, the spacer 3 has a plurality of pores p formed in a thickness direction thereof. In addition, the support plate 2 has a plurality of pores p formed in a thickness direction thereof and channels 2a formed in its perpendicular direction (namely, in a longitudinal direction thereof).

[6] A plurality of membrane modules 1 regularly arranged are soaked in a reservoir containing polluted water to separate solid and liquid from each other. Specifically, due to suction force of a pump, solids included in the polluted water over a certain size do not pass through the membrane 4, but liquid and solids below the certain size pass

through the membrane 4 and then along the channels 2a of the support plate 2 via the spacer 3 and are finally discharged to the outside through the discharge hole 8.

[7] However, the membrane module 1 shown in Figs. 1 and 2 has a problem in that a manufacturing process thereof is difficult since a penetration process should be conducted to form the pores p and the channels 2a formed in the support plate 2. As an improvement therein, Korean Patent No. 0459038 discloses a flat sheet membrane module in which a plurality of protrusions are formed on a support plate 2 in order to form channels 2a by spaces defined by the protrusions.

[8] However, the conventional membrane module 1 including that disclosed in the above document has the following problems.

[9] The membrane module 1 should be washed (or, back-washed) at a certain point of time. However, the conventional membrane module 1 is not easily washed and shows a poor washing efficiency since the support plate 2 and the frames 9 are made of hard plastic material (or, metal material). In addition, in a manufacturing process of the membrane module, a process of forming the passages for fluid flow, i.e., the channels 2a and the pores p, in the support plate 2 and the spacers 3 should be conducted. In addition, the conventional membrane module 1 is heavy and thick. That is, all the components except for the membranes 4 are made of hard plastic, and the components such as the support plate 2, the spacers 3 and the frames 9 should be essentially included, so that the membrane module is heavy and thick. In addition, since the membrane module has many components, its manufacturing process is complicated, and its thickness results in a great volume, thereby requiring a large site for a water treatment plate.

[10]

Disclosure of Invention

Technical Problem

[11] The present invention is conceived to solve the aforementioned problems in the prior art. An object of the present invention is to provide a membrane module for treating water capable of being easily washed, having an excellent washing efficiency, being easily manufactured, and also reducing a site of a water treatment plant due to its reduced thickness.

[12]

Technical Solution

[13] According to an aspect of the present invention for achieving the objects, there is

provided a membrane module, which includes a support; and a membrane laminated on the support, wherein the support is deflected when one end of the support is fixed.

[14] At this time, the support preferably has a deflection more than 1/2 of a length between fixed and free ends thereof.

[15] The support may include a plastic corrugated cardboard with a thickness of 0.2 to 1.0 mm according to a first aspect of the present invention. At this time, the plastic corrugated cardboard has valleys and ridges and a thickness of 0.2 to 1.0 mm.

[16] In addition, the support may include a foam or soft material with a thickness of 1.5 to 6.0 mm according to a second aspect of the present invention.

[17] Also, the support may include a fiber sheet coated with a resin according to a third aspect of the present invention. Here, the fiber sheet may be selected from a woven fabric and a non-woven fabric, and a woven fabric is preferred.

[18] In addition, the support is formed with a channel through which liquid having passed through the membrane flows.

[19]

Advantageous Effects

[20] According to the present invention, a support for supporting a membrane has flexibility. Thus, during a washing (or aeration) process, the membrane is freely moved to thereby be easily washed (that is, impurities can be easily removed) with the increased washing efficiency. In addition, the membrane module is light in weight and small in thickness. Also, due to the reduced thickness, the membrane module occupies a reduced area in a water treatment plant, thereby decreasing a building site of the water treatment plant.

[21]

Brief Description of the Drawings

[22] Fig. 1 is an exploded perspective view of a conventional flat sheet membrane module for water treatment.

[23] Fig. 2 is an assembled perspective view of Fig. 1.

[24] Fig. 3 is an exploded perspective view of a membrane module according to a preferred embodiment of the present invention.

[25] Fig. 4 shows a support of the membrane module of Fig. 3.

[26] Figs. 5 and 6 are exploded perspective views of membrane modules according to other embodiments of the present invention.

[27] Fig. 7 is an assembled perspective view of Fig. 6.

[28] Fig. 8 is a sectional view taken along line A-A of Fig. 7.

[29]

Best Mode for Carrying Out the Invention

[30] Hereinafter, the present invention will be described in more detail with reference to the accompanying drawings. The accompanying drawings show exemplary embodiments of the present invention, which is provided for the purpose of describing the present invention in more detail, but the scope of the present invention is not limited thereto.

[31] Fig. 3 is an exploded perspective view of a membrane module according to a preferred embodiment of the present invention, and Fig. 4 shows a support of the membrane module of Fig. 3

[32] First, referring to Figs. 3 and 4, the membrane module of the present invention includes a support 10, and membranes 20 laminated on both surfaces of the support 10. The membrane 20 is a general one, which is a thin membrane with fine pores.

[33] The support 10, which is to support the membranes 20, has flexibility according to the present invention. In the present invention, the term flexibility is defined as a property by which one free end (or, a free end) droops when the other end of the support 10 is fixed. Specifically, referring to Fig. 4, the flexibility in the present invention means that when one of both ends (a fixed end designated by a point P1 in Fig. 4) in any one direction selected from x and y directions is gripped by a hand, the other free end (a free end designated by a point P2 in Fig. 4) is deflected in a z direction. In addition, the x and y directions mean length and width directions, respectively, when the support 10 is positioned in parallel with the ground as shown in Fig. 4. Also, the z direction means a thickness direction of the support 10.

[34] At this time, the deflection of the support 10 is preferably at least 1/2 of the length between the fixed and free ends. For example, in case of dimensions of 30 cm (x direction) X 30 cm (y direction), the free end is preferably deflected over 15.0 cm. Specifically, in a case where the support 10 is cut into dimensions of 30 cm (x direction) X 30 cm (y direction), when one of both ends in any one direction selected from x and y directions is fixed, the other free end (free end designated by the point P2 in Fig. 4) is preferably deflected over 15.0 cm. More specifically, in the support 10 having the dimensions of 30 cm (x direction) X 30 cm (y direction), a straight distance h dropping in z direction in Fig. 4, i.e., a deflection, is preferably 15.0 to 30.0 cm.

[35] According to the present invention, since the support 10 has flexibility as mentioned above, the support 10 may freely move together with the membranes 20 during a

washing process (or, an aeration process), thereby easily removing impurities and enhancing the washing efficiency.

[36] The support 10 may include any material or structure if it has the flexibility defined in the present invention, and preferably has the following material and structure.

[37] In a first aspect of the present invention, the support 10 is made of a plastic corrugated cardboard with a thickness of 0.2 to 1.0 mm. Specifically, as shown in Figs. 3 and 4, the support 10 is made of hard plastic plate with a thickness T0 of 0.2 to 1 mm and configured to have valleys 10a and ridges 10b. At this time, if the plastic plate has a thickness T0 less than 0.2 mm, the plastic plate is too flexible to provide a sufficient supporting ability (shape holding ability), and also its strength becomes too weak to be used as the support 10. If the plastic plate has a thickness T0 exceeding 1.0 mm, it is difficult to obtain the flexibility desired in the present invention, and also, the plastic plate is undesirably heavy.

[38] In addition, the valleys 10a and ridges 10b formed in the plastic plate provide supporting ability (shape holding ability) and also provide passages through which liquid having passed through the membrane 20 may easily flow. Specifically, the valleys 10a define channels 15 through which the fluid having passed through the membrane 20 may flow. At this time, the plastic corrugated cardboard preferably has an entire thickness Tt of 1.5 to 6.0 mm, including the valleys 10a and the ridges 10b. If the entire thickness Tt including the valleys 10a and the ridges 10b is less than 1.5 mm, the supporting ability (shape holding ability) is deteriorated due to the small size of the valleys 10a and the ridges 10b. If the entire thickness Tt exceeds 6.0 mm, the membrane module occupies a large volume in a water treatment plant due to the large thickness.

[39] The support 10, i.e., the plastic corrugated cardboard, is made of natural resin or synthetic resin, which may be for example selected from polyvinyl chloride, polyethylene, polypropylene, polyester, polyamide, polyurethane, acryl-based resin, epoxy-based resin, and melamine-based resin. In addition, the plastic corrugated cardboard may be made of such a synthetic resin as a base component by further adding a plasticizer such as DOP (dioctyl phthalate) or DBP (dibutyl phthalate) according to the kind of synthetic resin for the flexibility. In addition, the valleys 10a and the ridges 10b in the plastic corrugated cardboard may be formed during an extrusion process or by a thermal pressing process. Specifically, a plastic cardboard may be manufactured in such a manner that a plastic plate with a thickness T0 of 0.2 to 1.0 mm is first manufactured and then the valleys 10a and the ridges 10b are formed in

the plastic plate by putting the plastic plate into a mold with valleys and ridges and then thermally pressing it.

[40] According to the present invention, the support 10, i.e., the plastic corrugated cardboard, ensures the flexibility defined above, thereby ensuring easy washing and improving washing efficiency. In addition, the plastic corrugated cardboard is in line contact with the membranes 20, thereby enhancing membrane washing efficiency. Specifically, the ridges 10b of the plastic corrugated cardboard are in contact with the membrane 20, thereby minimizing a contact area with the membrane and accordingly enhancing membrane washing efficiency. In addition, the support 10 can be light and have a reduced thickness.

[41] In a second aspect of the present invention, the support 10 is made of foam or soft material with a thickness of 1.5 to 6.0 mm. At this time, the foam is obtained by adding a foaming agent into synthetic resin or rubber and then foaming it. The synthetic resin may include polyvinyl chloride, polyethylene, polypropylene, polyester, polyamide, polyurethane, acryl-based resin, epoxy-based resin, melamine-based resin, and the like. The rubber may include ethylene propylene diene monomer (EPDM) rubber, styrene-butadiene rubber (SBR), nitril rubber (NR), isobutylene-isoprene rubber (IIR), nitril-butadiene rubber, and the like. In addition, the soft material may be selected from silicon, rubber, and the like.

[42] The foam (or soft material) has a thickness of 1.5 to 6.0 mm. If the thickness is less than 1.5 mm, the supporting ability (shape holding ability) is deteriorated, so that it may be not used as the support 10. If the thickness exceeds 6.0 mm, it is difficult to provide the flexibility desired in the present invention, and also, the great thickness makes the membrane module occupy a great volume in the water treatment plant, which is undesirable. In addition, the foam (or soft material) has channels 15 through which liquid having passed through the membrane 20 may flow. These channels 15 may be formed in various shapes. Specifically, the channels 15 may be defined by grooves formed in the foam (or soft material). Also, the channels 15 may be defined by a plurality of protrusions formed on the surface of the foam (or soft material). At this time, spaces existing between the protrusions define the channels 15.

[43] Figs. 5 and 6 are exploded perspective views of membrane modules according to other embodiments of the present invention, Fig. 7 is an assembled perspective view of Fig. 6, and Fig. 8 is a sectional view taken along line A-A of Fig. 7.

[44] First, referring to Figs. 5 and 6, the support 10 is configured by coating a fiber sheet 12 with resin according to a third aspect of the present invention. The fiber sheet 12

may be selected from a woven fabric made by weaving fibers (grey yarns) and a non-woven fabric made by opening fibers in a web shape using a carding machine, and the woven fabric is preferred. The fibers used for the fiber sheet 12 may include synthetic fibers and natural fibers, and for example, may includes one or two selected from synthetic fibers such as polyester, polyamide, polyacryl, polyurethane, polyvinyl chloride, polyvinylidene chloride, polyethylene, polypropylene, rayon and nylon, and natural fibers such as cotton, wool, linen, and silk. More preferably, the fiber sheet 12 may usefully include a woven fabric in which nylon woven fabric or polyurethane/ polyester grey yarns with a low strain are mixed and woven.

[45] In a case where the support 10 includes the fiber sheet 12 according to the third aspect of the present invention, the fiber sheet 12 has pores in itself so that liquid may pass through them. Thus, it is possible to exclude a process of forming channels 2a (see Fig. 1) or pores p (see Fig. 1) of the prior art, and so the support can be easily manufactured with low cost. In addition, the fiber sheet 12 has the flexibility defined in the above, so that it may be freely moved during a back washing process of the membrane module, and thus, the membrane module can be easily washed. Further, many air bubbles are generated (i.e., eddies occurs by air), thereby enhancing washing efficiency and moreover reducing weight and thickness.

[46] In addition, if the support 10 includes only the fiber sheet 12, the support 10 is too flexible to maintain its supporting ability (shape holding ability). Accordingly, the fiber sheet 12 is coated with a resin for ensuring supporting ability (shape holding ability). Due to the resin coating, the fiber sheet 12 may have shape and rigidity so that it can be used as the support 10. A method for coating the fiber sheet 12 with a resin is not particularly limited, but include various an injection coating method, a dipping coating method and a brush coating method.

[47] The resin applied to the fiber sheet 12 may include natural resin or synthetic resin, and be used while being diluted by a solvent. The diluting solvent may be selected from water and hydrocarbon-based organic solvents depending on the kind of resin. As the diluting solvent, water is preferably used in consideration of environmental problems and work conditions such as coating work and smell. At this time, the resin preferably includes a hydrophile resin (or a composition in which an additive is added to a hydrophile resin). The resin used in the coating may preferably include one selected from the group consisting of acryl-based resin, epoxy-based resin, melamine-based resin, polyvinyl alcohol and polyethylene oxide, a mixture of at least two of them, or a polymer thereof. In addition, the resin may usefully include EM-101-50

(available from Kukdo Chemical Co. Ltd. of Gasan-dong, Kumcheon-gu, Seoul, Korea) that is a commercialized product.

[48] The support 10 according to the aforementioned third aspect, i.e., the fiber sheet 12 coated with the resin, has pores in itself so that liquid may pass through them, whereby there is no need for separately forming the channels 15 for allowing the liquid having passed through the membrane 20 to flow. However, it is also preferred that the channels 15 be formed so that the liquid having passed through the membrane 20 may flow smoothly. At this time, the channels 15 may be formed by bending the fiber sheet during a curing process after the fiber sheet is coated with a resin, or prepared in a manufacturing process of the fiber sheet 12. More specifically, the channels 15 may be formed by a concavo-convex structure of a mold in such a manner that the fiber sheet 12 coated with the resin is put into the mold having the concavo-convex structure formed on its inner surface and then pressed and cured. At this time, the inner surface of the mold is preferably coated with a releasing agent so that the support 10, i.e., the fiber sheet 12 coated with the resin, can be easily separated from the mold. In addition, the channels 15 are preferably formed while the fiber sheet 12 is woven, i.e., while fabric is woven.

[49] In addition, as shown in Fig. 5, the support 10, i.e., the fiber sheet 12 coated with the resin, is preferably bent to have rounds R in a wave shape. If the support 10 is bent to have the rounds R, the channels 15 in the shape of valleys are formed and at the same time the fiber sheet 12 is in line contact with the membrane 20 to enhance membrane washing efficiency. In addition, the channel 15 may have a "ㄷ"shape as shown in Fig. 6.

[50] The support 10 and the membranes 20, described above, are laminated, and then their edges are fixed with each other. More specifically, referring to Figs. 7 and 8, the edges of the support 10 and the membranes 20 may be fixed through adhesive 30 or a frame 40. Preferably, the four edges (upper, lower, left and right edges) are fixed through the adhesive 30, and then the frame 40 is further coupled to the upper one among the four edges (upper, lower, left and right edges). At this time, the frame 40 coupled to the upper edge has a discharge hole 50 connected to a pump.

[51] In addition, referring to Fig. 5, at least one hole 18 may be bored at least in the lower one among the four edges (upper, lower, left and right edges) of the support 10. Fig. 6 shows as an example that two holes 18 are borer at both sides of the lower edge. In addition, a hole 28 may also be bored in the membrane 20 at a position corresponding to the hole 18. A plurality of membrane modules can be connected with each other

using fasteners such as rivets and pins through the holes 18 and 28. Also, the support 10 may have a plurality of channel holes bored in a thickness direction (the z direction in Fig. 4).

[52]

Industrial Applicability

[53] The membrane module of the present invention as described above is installed to a soaking-type filter of a water treatment plant, wherein a plurality of the membrane modules with a general flat sheet shape are arranged and installed regularly. In addition, the membrane module of the present invention has flexibility and thus can be installed in a cartridge form.

[54] As described above, according to the present invention, the support 10 for supporting the membranes 20 has flexibility, so that during a washing (or aeration) process, the membrane is freely moved to thereby be easily washed (that is, impurities can be easily removed) with the increased washing efficiency. In addition, as compared with the conventional membrane module having the support plate 2 (see Fig. 1) and the spacers 3 (see Fig. 1), the support 10 is light since it is composed of plastic, foam (soft material) or the fiber sheet 12. In addition, the membrane module of the present invention has a small number of components, and particularly, since the fiber sheet 12 has pores in itself, it need not be subjected to a separate channel forming process and does not need a spacer 3. Accordingly, the membrane module of the present invention has a reduced thickness, which allows the membrane module to occupy a small volume in a water treatment plant, and as a result, a building site for the water treatment plant is decreased.

[55]

[56]

Claims

[1] A membrane module for treating water, comprising:
a support; and
a membrane laminated on the support,
wherein the support is deflected when one end of the support is fixed.

[2] The membrane module as claimed in claim 1, wherein the support has a deflection more than 1/2 of a length between fixed and free ends thereof.

[3] The membrane module as claimed in claim 1, wherein the support includes a plastic corrugated cardboard with a thickness of 0.2 to 1.0 mm.

[4] The membrane module as claimed in claim 1, wherein the support includes a foam or soft material with a thickness of 1.5 to 6.0 mm.

[5] The membrane module as claimed in claim 1, wherein the support includes a fiber sheet coated with a resin.

[6] The membrane module as claimed in claim 5, wherein the fiber sheet is a woven or non-woven fabric.

[7] The membrane module as claimed in claim 5, wherein the resin applied to the fiber sheet includes any one selected from the group consisting of acryl-based resin, epoxy-based resin, melamine-based resin, polyvinyl alcohol and polyethylene oxide, or a mixture of at least two of them.

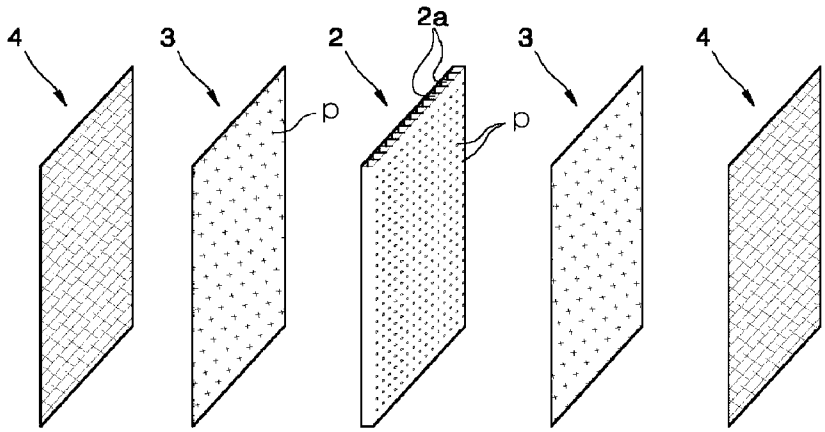
[8] The membrane module as claimed in any one of claims 1 to 7, wherein the support is formed with a channel through which liquid having passed through the membrane flows.

[9] The membrane module as claimed in any one of claims 1 to 7, wherein edges of the support and the membrane are fixed with each other by means of an adhesive or frame.

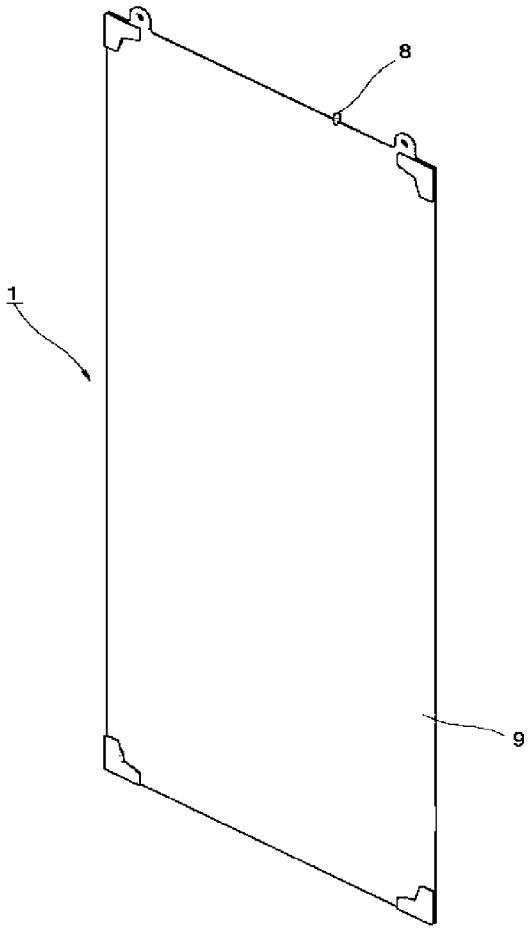
[10] The membrane module as claimed in any one of claims 1 to 7, wherein edges of the support and the membrane are fixed with each other by means of an adhesive, and a frame is coupled to the upper edge thereof.

[11] The membrane module as claimed in any one of claims 1 to 7, wherein the support is formed with a hole into which a fastener is inserted.

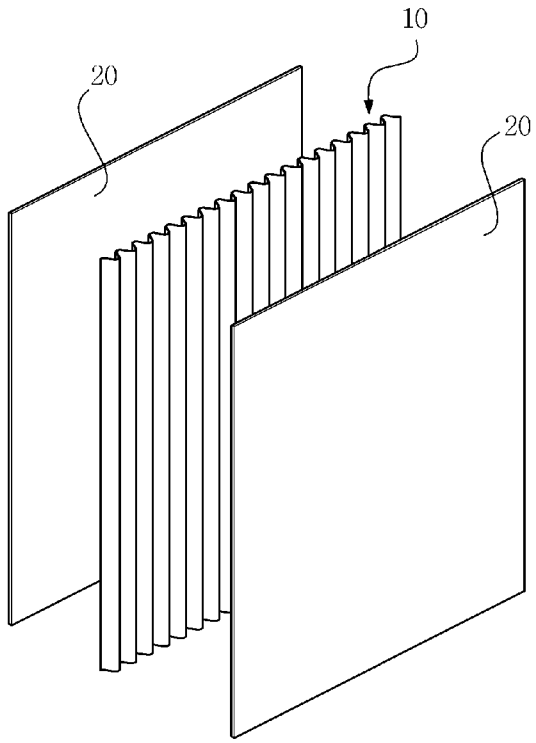
[Fig. 1]



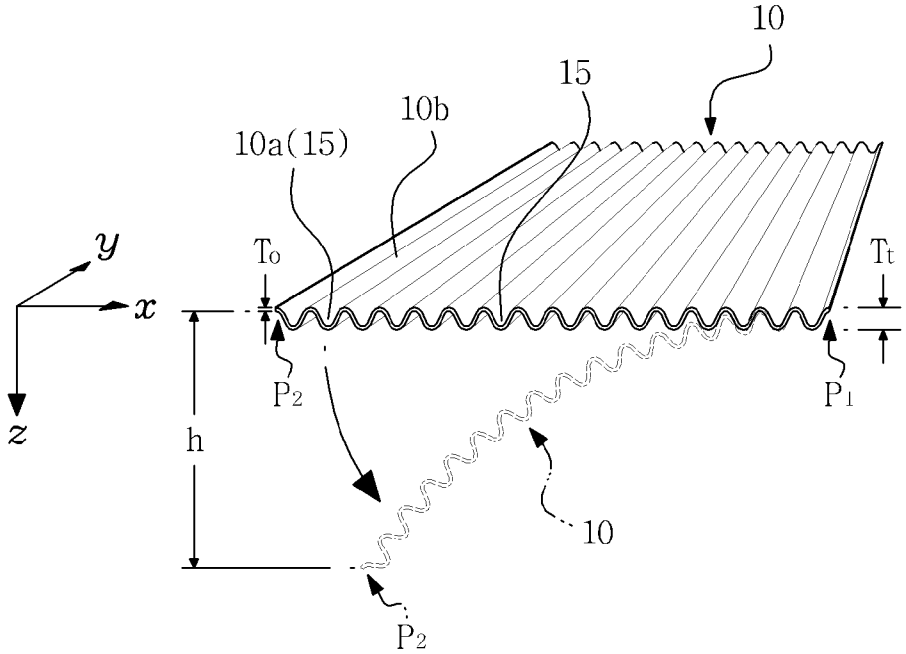
[Fig. 2]



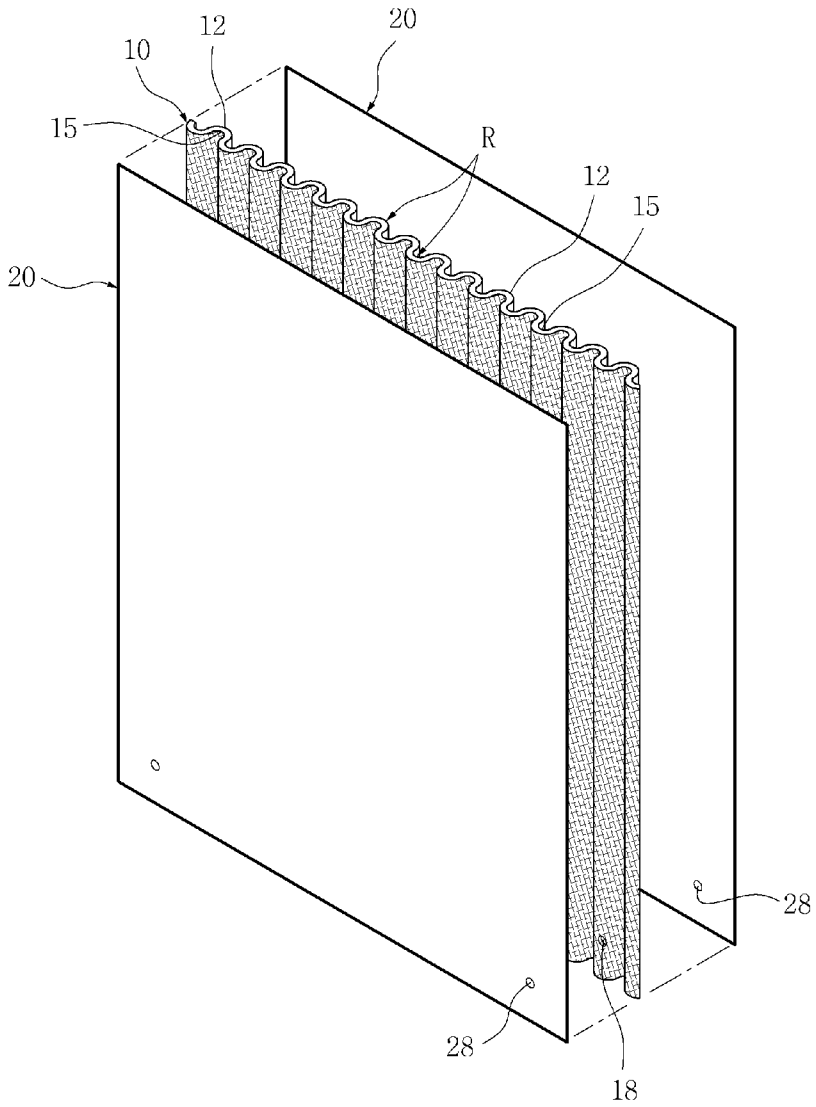
[Fig. 3]



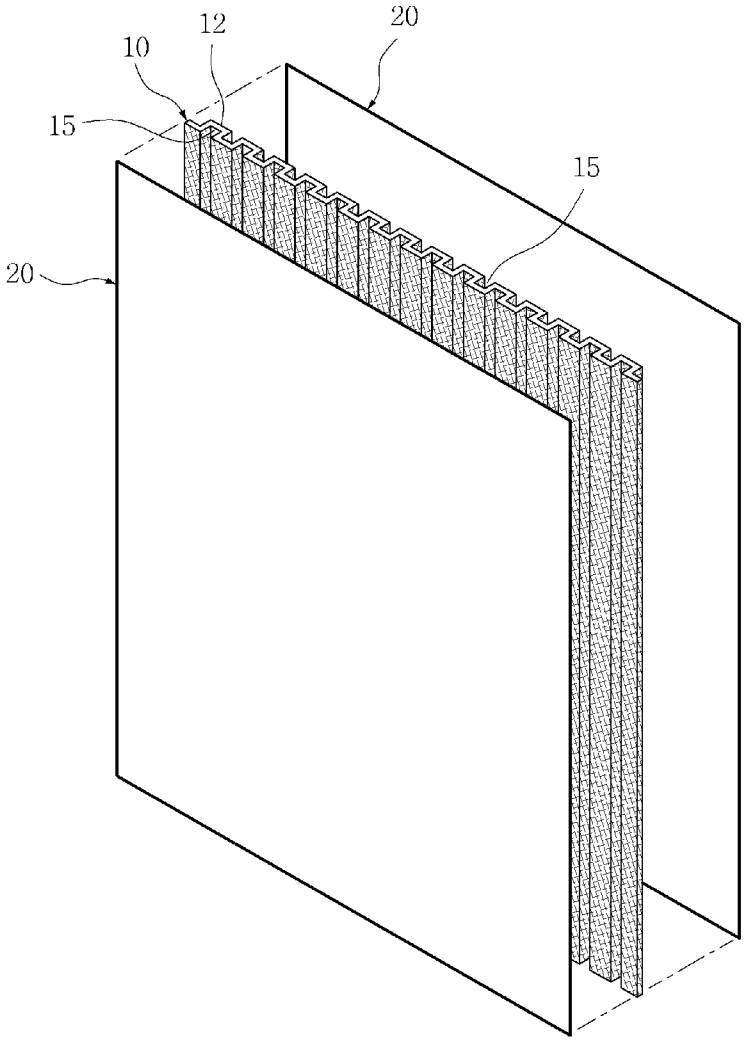
[Fig. 4]



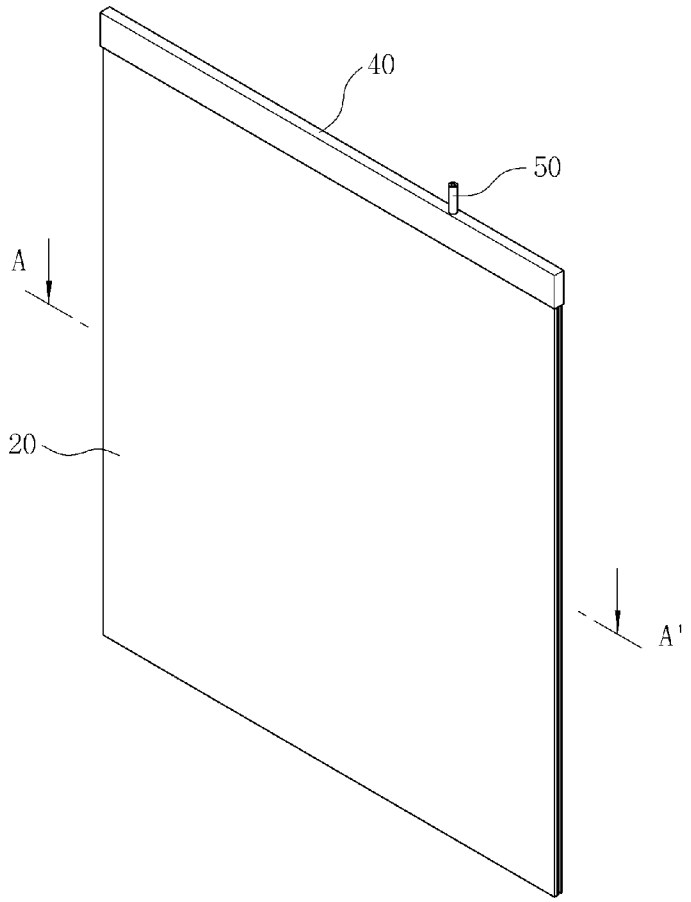
[Fig. 5]



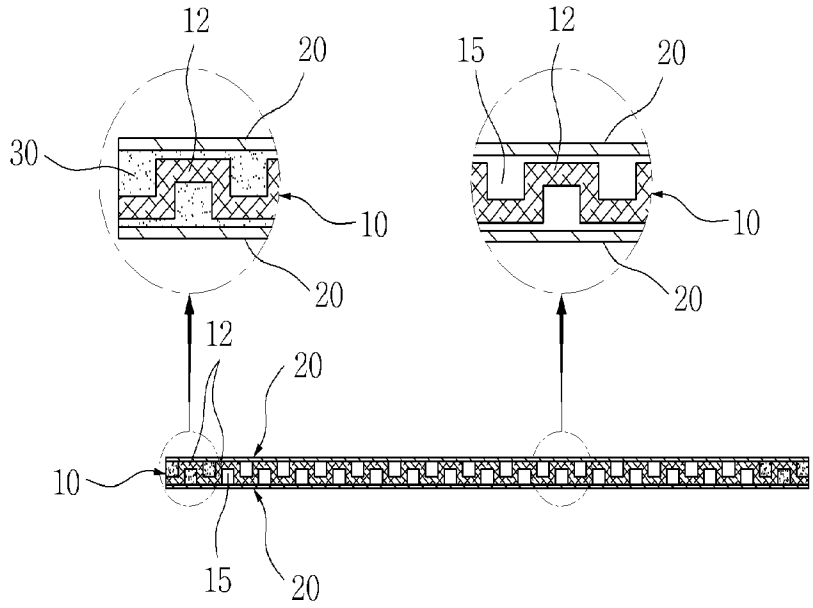
[Fig. 6]



[Fig. 7]



[Fig. 8]



INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/002041

A. CLASSIFICATION OF SUBJECT MATTER

B01D 71/00(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)

IPC 8: B01D 71/00

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

Utility models and applications for Utility Models since 1975
Japanese Utility Models and application for Utility Models since 1975

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

eKIPASS(KIPO net), Delphion; 'membrane, laminate*, support, module, water'

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	JP 9-141071 A(TORAY IND INC) 03 June 1997 See claims, [0021] and [0022]	1,5-8 9-11 2-4
Y A	JP 11-169683 A(KURITA IND INC) 29 June 1999 See abstract and figure 1	9-11 1-8
A	US 2003/0098274 A1(Lee, K.H., et al.) 29 May 2003 See abstract and claims	1-11
A	KR 10-1997-0059224 A(KOREA INSTITUTE OF SCIENCE AND TECHNOLOGY) 12 August 1997 See abstract	1-11

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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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
27 AUGUST 2008 (27.08.2008)	**27 AUGUST 2008 (27.08.2008)**
Name and mailing address of the ISA/KR Korean Intellectual Property Office Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea Facsimile No. 82-42-472-7140	Authorized officer PARK, JEONG UNG Telephone No. 82-42-481-8131

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/KR2008/002041

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 09-141071	03.06.1997	JP 3467940 B2 JP 9141071 A2	17.11.2003 03.06.1997
JR 11-169683 A	29.06.1999	None	
US 2003-098274 A1	29.05.2003	KR 10-2003-0032652 US 6887380 BB	26.04.2003 03.05.2005
KR 10-1997-0059224	12.08.1997	KR 0165749 B1	15.12.1998