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TITLE: SIMPLE GAS SCOURING METHOD AND APPARATUS

TECHNICAL FIELD

The present invention relates to membrane filtration systems and, more particularly, to an improved method and apparatus for gas scouring filtration
5 membranes.

BACKGROUND OF THE INVENTION

Gas scouring systems have been used with membrane filtration systems to clean membranes and allow such systems to operate effectively over long periods with a reduced need for regular backwashing or high backwashing
10 efficiency. Such systems typically employ pressurized gas generated by a blower or pump to produce gas bubbles which flow along the membrane surfaces and scour accumulated solids and impurities therefrom. The need for a pressurised source of gas normally requires an expensive pump and a power supply. While this is not of concern with large commercial systems, the cost of
15 the gas supply is seen as disadvantageous to be able to provide such scouring methods to smaller systems, for example home filter systems. Such advantages are seen as having application in remote areas (farms, remote villages, expeditions) where it is hard to get electricity and pressurized air but where sufficient water pressure (about 50 to 400 kPa) is available to operate the
20 system.

DISCLOSURE OF THE INVENTION

The present invention seeks to provide a gas scouring system to run without the need for a pressurized gas supply.

According to one aspect the present invention provides a method of
25 cleaning a membrane in a membrane filtration system by flowing gas bubbles

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past the surfaces of said membrane to scour accumulated solids therefrom, the method including :

- a) flowing a liquid past a supply of gas;
- b) creating a reduced pressure within said liquid flow to cause a flow of
5 gas from said supply of gas into said liquid flow and form gas bubbles therein;
- c) flowing said liquid containing said gas bubbles past the surfaces of said membrane to scour the surfaces thereof.

Preferably, the reduced pressure is created in an eductor or venturi device.

10 For preference, the liquid includes feed liquid supplied to the membrane filtration system.

BRIEF DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the invention will now be described, by way of example only, with reference to the accompanying drawing in which:

15 Figure 1 shows a schematic of the membrane filtration system according to one embodiment of the invention.

DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to Figure 1, the system comprises a membrane filtration module
5 having a plurality of membranes 6 mounted therein. A feed line 7 feeds
20 untreated water through valve V1 and eductor/venturi 8 to the module 5. Gas, typically air, is fed to the eductor 8 through gas line 9 and check valve V5. Filtrate is withdrawn from the membranes 6 through filtrate line 10 controlled by filtrate valve V4. The module 5 is provided with upper and lower drain lines 11 and 12 controlled by respective upper and lower drain valves V3 and V2. The
25 drain lines 11 and 12 feed into a drain tank 13.

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In use, the untreated water enters through valve V1 and through the eductor 8 into the membrane module 5. Under normal operating conditions the drain valves V2 and V3 are closed. When treated water (filtrate) is required valve V4 (tap) is opened and the water pressure pushes the water through the membranes 6 to the filtrate side and the filtrate produced flows through valve V4 and filtrate line 10. As the flow rate is limited by the membrane resistance, the speed of the water flowing in the eductor 8 is not high enough to suck air into the water stream. Instead the water pressure will cause the check valve V5 to close. If necessary, the flow rate can be further controlled by valve V4, V1 or an optional flow control valve installed between V4 and the module. If the membranes begin to block up, the following procedure may be used to clean the membranes:

a) The filtrate valve V4 is kept closed and to drain valve V3 is opened.

This causes water to flow at a high flow rate through valve V1, the eductor 8 and through the membrane module 5. The water exits through upper drain valve V3 and can optionally be collected in the tank 13 for further use like irrigation. As the water can pass along the membrane module without the restriction by the membranes 6, the flow rate in the eductor/venturi 8 is high enough to create a suction pressure. This causes air to enter through the check valve V5 through the eductor into the feed water stream producing bubbles therein. The air bubbles in combination with the strong water flow scours any fouling layer from the membranes and flushes the removed suspended solids out through valve V4.

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b) If a stronger cleaning action is required some or several of the following process steps can be added:

- i) Close Valve 3. This leads to the built-up of the water pressure in the system and compresses the air trapped in the module housing. After closing the feed valve V1 the bottom drain valve V2 is opened. This will make the air expand and sweep part of the remaining liquid out of the membrane module 5, carrying more solids out. Further compressed air is sometimes required to be applied to the vessel to assist removal of liquid from the module.
- ii) If necessary an additional sweeping step can follow by opening upper drain valve V3 until the membrane module 5 is completely drained.
- iii) The valves V2 and V3 are closed. By opening valve V1 the water pressure is applied and compresses the air in the filter housing. Feed water takes the space made available by the compression of the air. Repeating steps i) and ii) gives the membranes 6 an additional clean.
- iv) The valves V2 and V3 are closed. Opening valve V1 allows water to enter into the membrane module 5. Carefully purging through valve V3 allows the entrapped air to be removed. Then valve V3 is closed and the system is back on line and normal filtration resumes.

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It will be appreciated by those skilled in the art of membrane filtration that a variety of sequencing of the valves can be used in order to achieve a desired outcome.

The eductor 8 is a piece of equipment that uses the dynamic flow of water
5 to create a partial vacuum which causes air to enter into the water flow.
Typically this is a venturi pipe or some kind of jet.

If a chemical clean of the membrane is required, an additional liquid
connection to the eductor 8 may be used to suck any cleaning chemical into the
liquid stream during cleaning. After a short period of time the liquid flow may be
10 stopped by shutting valve V1 in order to save chemicals and to allow the
membrane to soak in the solution of the chemical.

The cleaning system may be applied to any form of membrane including
fibre, flat sheet, spiral wound, pleated or plate types.

The filter system may be combined with an appropriate activated carbon
15 filter or the like to remove taste and odour.

It will be appreciated that further embodiments and exemplifications of the
invention are possible without departing from the spirit or scope of the invention
described.

CLAIMS:

1. A method of cleaning a membrane in a membrane filtration system by flowing gas bubbles past the surfaces of said membrane to scour accumulated solids therefrom, the method including:
 - 5 a) flowing a liquid past a supply of gas;
 - b) creating a reduced pressure within said liquid flow to cause a flow of gas from said supply of gas into said liquid flow and form gas bubbles therein;
 - c) flowing said liquid containing said gas bubbles past the surfaces of said
10 membrane to scour the surfaces thereof;wherein said creating of reduced pressure within said liquid flow is responsive to an increase in resistance of said membrane.
2. A method according to claim 1 wherein the reduced pressure is created in an eductor or venturi device having said liquid flowing therethrough.
- 15 3. A method according to claim 1 or claim 2 wherein the liquid includes feed liquid supplied to the membrane filtration system.
4. A method according to claim 1 including providing valve means responsive to said increase in resistance of said membrane to increase the flow of said liquid through said device.
- 20 5. A method according to claim 1 wherein during normal filtration operation of the membrane filtration system, the flow rate of said liquid is selected such that minimal pressure reduction is created.
6. A method according to claim 5 including providing further valve means to prevent flow of gas into said liquid flow during said normal filtration operation.

7. A method according to claim 6 wherein said further valve means is responsive to said flow rate of said liquid flow.
8. A method according to claim 1 further including the steps of flowing a liquid past a supply of chemical cleaning fluid such that said reduced pressure within
5 said liquid flow causes a flow of said chemical cleaning fluid from said supply of chemical cleaning fluid into said liquid flow.
9. Apparatus for cleaning a membrane in a membrane filtration system by flowing gas bubbles past the surfaces of said membrane to scour accumulated solids therefrom, the apparatus including :
- 10 a) means for flowing a liquid past a supply of gas;
b) means responsive to an increase in resistance of said membrane for creating a reduced pressure within said liquid flow to cause a flow of gas from said supply of gas into said liquid flow and form gas bubbles therein;
- 15 c) means for flowing said liquid containing said gas bubbles past the surfaces of said membrane to scour the surfaces thereof.
10. Apparatus according to claim 9 wherein the means for creating a reduced pressure is an eductor or venturi device having said liquid flowing therethrough.
11. Apparatus according to claim 9 or claim 10 wherein the liquid includes feed
20 liquid supplied to the membrane filtration system.
12. Apparatus according to claim 10 further including valve means responsive to said increase in resistance of said membrane to increase the flow of said liquid through said device.

13. Apparatus according to claim 9 wherein during normal filtration operation of the membrane filtration system, the flow rate of said liquid is selected such that minimal pressure reduction is created.

14. Apparatus according to claim 13 including further valve means to prevent
5 flow of gas into said liquid flow during said normal filtration operation.

15. Apparatus according to claim 14 wherein said further valve means is responsive to said flow rate of said liquid flow.

16. Apparatus according to claim 9 further including means for flowing a liquid past a supply of chemical cleaning fluid such that said reduced pressure within
10 said liquid flow causes a flow of said chemical cleaning fluid from said supply of chemical cleaning fluid into said liquid flow.

17. Apparatus according to claim 16 wherein said means for flowing a liquid includes said eductor or venture device.