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**Datasheet for the decision
of 20 November 2012**

Case Number: T 1077/11 - 3.3.07

Application Number: 99948614.5

Publication Number: 1115474

IPC: B01D 65/08, B01D 65/02,
B01D 63/04

Language of the proceedings: EN

Title of invention:
Apparatus and method for cleaning membrane filtration modules

Applicants:
Siemens Industry, Inc.

Headword:
-

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step ((no) - obvious solution - all requests)

Decisions cited:
-

Catchword:
-



Case Number: T 1077/11 - 3.3.07

D E C I S I O N
of the Technical Board of Appeal 3.3.07
of 20 November 2012

Appellants: Siemens Industry, Inc.
(Applicants) 3333 Old Milton Parkway
Alpharetta, GA 30005-4437 (US)

Representative: Murray, Adrian D'Coligny
WP Thompson
55 Drury Lane
London WC2B 5SQ (GB)

Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 16 December 2010
refusing European patent application
No. 99948614.5 pursuant to Article 97(2) EPC.

Composition of the Board:

Chairman: G. Santavicca
Members: F. Rousseau
D. T. Keeling

Summary of Facts and Submissions

I. The appeal lies from the decision of the Examining Division posted on 16 December 2010 refusing European application No. 99 948 614.5, filed as international application No. PCT/AU99/00817 on 24 September 1999 and published as WO 00/18498.

II. The decision under appeal was based on a single set of seven claims, submitted with letter of 18 June 2010, independent claims 1 and 5 of which read as follows:

"1. A method of removing fouling materials from the surface of a plurality of porous hollow fibre membranes (6) mounted and extending longitudinally in an array from at least one potting head (7) to form a membrane module (5), said membranes being arranged in close proximity to one another and mounted to prevent excessive movement therebetween and said module (5) including a venturi device (12) connected to the base of said potting head (7), the method comprising the steps of providing, from within said array, by means other than gas passing through the pore [sic] of said membranes, uniformly distributed gas bubbles entrained in a liquid flow, the liquid flow comprising a feed liquid, said gas bubbles being entrained in said liquid flow by flowing said liquid and a gas into the venturi device (12) so as to cause said gas to be drawn and/or mixed into said liquid, said distribution being such that said bubbles pass substantially uniformly between each membrane in said array to, in combination with said liquid flow, scour the surface of said membranes and

remove accumulated solids from within the membrane module."

- "5. A membrane module comprising a plurality of porous hollow fibre membranes (6) mounted and extending longitudinally in an array from at least one potting head (7), said membranes being arranged in close proximity to one another and mounted to prevent excessive movement therebetween, and means for providing, from within the module, by means other than gas passing through the pores of said membranes, gas bubbles entrained in a liquid flow such that, in use, said liquid and bubbles entrained therein move past the surfaces of said membranes to dislodge fouling materials therefrom, the membrane module including a venturi device being one of a venturi tube, jet, nozzle, ejector, eductor or injector (12) connected to the base of the potting head (7) by means of which said gas bubbles are entrained in said liquid."

III. The decision under appeal referred *inter alia* to the following documents:

- D1: JP-A-10-085565 and its abstract in Patent Abstracts of Japan (Vol. 1998, no. 09),
D4: JP-A-61-293504 and its abstract in Patent Abstracts of Japan (Vol. 011, no. 163), and
D5: JP-A-06-343837 and its abstract in Patent Abstracts of Japan (Vol. 199, no. 503).

IV. According to the decision under appeal:

- (a) The feature "*from at least one potting head*" contained in claims 1 and 5 was not disclosed in the passages of the application as filed indicated by the Applicants as forming the basis for amended claims 1 and 5, because those passages solely disclosed embodiments using two potting heads in combination with additional features which moreover were missing in amended claims 1 and 5. Furthermore, the feature "*a venturi device connected to the base of said potting head*", present in claims 1 and 5, found no basis in the general disclosure, the venturi device employed for the embodiment shown in Figure 1 being connected to the base of the module. Thus, claims 1 and 5 did not meet the requirements of Article 123(2) EPC.
- (b) The issue of novelty was not addressed.
- (c) As concerns inventive step, the reasoning given started from prior art document D1 and the method defined in claim 1 was held to differ from that disclosed in D1 in the venturi device being connected to the base of the potting head. The objective technical problem solved with respect to D1 by the method of claim 1 was the provision of an alternative way of attaching the venturi device to the membrane module. The solution to this problem, i.e. the connection of the venturi device to the base of the potting head, was however obvious in the light of any of documents D4 and D5, which taught to connect the air feeding pipes to

the base of the potting heads. Hence, claim 1 lacked an inventive step, contrary to the requirements of Article 56 EPC.

(d) Based on the same reasoning, an inventive step was also denied for the apparatus defined in claim 5.

(e) The decision under appeal also contained *obiter dicta* in respect of clarity issues (Article 84 EPC).

V. With their statement setting out the grounds of appeal of 15 April 2011, the Applicants (hereinafter the Appellants) submitted two sets of claims as their Main and First Auxiliary Requests.

VI. In a communication faxed on 8 October 2012, in preparation of oral proceedings, the Board addressed the issues concerning the requirements of Articles 123(2), 84 and 56 EPC and indicated in particular that each of the prior art documents D4 and D5, both cited in the contested decision, as well as prior art document WO 98/28066 (hereafter D6), acknowledged in the present application, rather than D1, might constitute the closest prior art for assessing inventive step.

VII. In response to the Board's communication, the Appellants submitted by their letter dated 22 October 2012 three sets of amended claims as their Main, First and Second Auxiliary Requests to replace the claims Requests then on file. Claim 1 of each of those requests respectively read as follows, claim 4 of the Main Request being also indicated:

Main Request

"1. A method of removing fouling materials from the surface of a plurality of porous hollow fibre membranes (6) comprising porous hollow fibres; said fibres being mounted in and extending in an array between an upper (7) and a lower (8) potting head to form a membrane module (5); at least one of said headers having one or more holes formed therein through which gas/liquid flow may be introduced; said membranes being arranged in close proximity to one another and mounted to prevent excessive movement therebetween and said module (5) including a venturi device (12) connected to the base of said potting head (7), the method comprising the steps of providing, from within said array, by means other than gas passing through the pore [sic] of said membranes, uniformly distributed gas bubbles entrained in a liquid flow, the liquid flow comprising a feed liquid, said gas bubbles being entrained in said liquid flow by flowing said liquid and a gas into the venturi device (12) so as to cause said gas to be drawn and/or mixed into said liquid, said distribution being such that said bubbles pass substantially uniformly between each membrane in said array to, in combination with said liquid flow, scour the surface of said membranes and remove accumulated solids from within the membrane module."

"4. A membrane module comprising a plurality of porous hollow fibre membranes (6) comprising porous hollow fibres; said fibres being mounted in and extending

in an array between an upper and a lower one [sic] potting head (7), at least one of said headers having one or more holes formed therein through which gas/liquid flow may be introduced; said membranes being arranged in close proximity to one another and mounted to prevent excessive movement therebetween, and means for providing, from within the module, by means other than gas passing through the pores of said membranes, gas bubbles entrained in a liquid flow such that, in use, said liquid and bubbles entrained therein move past the surfaces of said membranes to dislodge fouling materials therefrom, the membrane module including a venturi device being one of a venturi tube, jet, nozzle, ejector, eductor or injector (12) connected to the base of the potting head (7) by means of which said gas bubbles are entrained in said liquid."

First Auxiliary Request

[compared to Claim 1 of the Main Request, passages in bold and passages in strikethrough, respectively, indicate amendments in form of insertion or deletion]

"1. A method of removing fouling materials from the surface of a plurality of porous hollow fibre membranes (6) comprising porous hollow fibres; said fibres being mounted in and extending in an array between an upper ~~(7)~~ and a lower ~~(8)~~ potting head **(7,8)** to form a membrane module (5); at least one of said headers having one or more holes formed therein through which gas/liquid flow may be introduced~~r~~, said membranes being arranged in close proximity to one another and mounted to prevent

excessive movement therebetween and said module (5) including a venturi device (12) **in connection with** ~~connected to~~ the base of said potting head (7), the method comprising the steps of providing, from within said array, by means other than gas passing through the pore of said membranes, uniformly distributed gas bubbles entrained in a liquid flow, the liquid flow comprising a feed liquid, said gas bubbles being entrained in said liquid flow by flowing said liquid and a gas into the venturi device (12) so as to cause said gas to be drawn and/or mixed into said liquid, said distribution being such that said bubbles pass substantially uniformly between each membrane in said array to, in combination with said liquid flow, scour the surface of said membranes and remove accumulated solids from within the membrane module."

Second Auxiliary Request

- "1. A method of removing fouling materials from the surface of a plurality of porous hollow fibre membranes (6) comprising porous hollow fibres; said fibres being mounted in and extending in an array between an upper ~~(7)~~ and a lower ~~(8)~~ potting head **(7,8)** to form a membrane module (5); at least one of said headers having one or more holes formed therein through which gas/liquid flow may be introduced, said membranes being arranged in close proximity to one another and mounted to prevent excessive movement therebetween and said module (5) including a venturi device (12) connected to ~~the base of said potting head (7)~~ **via a potting sleeve**, the method comprising the steps

of providing, from within said array, by means other than gas passing through the pore of said membranes, uniformly distributed gas bubbles entrained in a liquid flow, the liquid flow comprising a feed liquid, said gas bubbles being entrained in said liquid flow by flowing said liquid and a gas into the venturi device (12) so as to cause said gas to be drawn and/or mixed into said liquid, said distribution being such that said bubbles pass substantially uniformly between each membrane in said array to, in combination with said liquid flow, scour the surface of said membranes and remove accumulated solids from within the membrane module."

VIII. Oral proceedings were held on 20 November 2012, at the end of which the decision was announced.

IX. The arguments of the Appellants, as far as they are relevant for the present decision, can be summarised as follows:

- (a) The amended claims were based on the application as originally filed, in particular the feature that the venturi device (12) was connected to the base of the lower potting head. It was in this respect implicit that the gas source had to be beneath the potting head and connected to it, otherwise gas provided from the gas source would not be passed through the potting head into the fibre membranes and would be lost to regions outside of the fibre membranes. Furthermore, the application as filed indicated that gas bubbles were mixed with a liquid flow before being fed through holes or slots in the

potting head, which strongly suggested connection between the gas bubble source and the potting head, otherwise there would be nothing to feed the gas through the potting head.

- (b) Concerning inventive step, any of documents D4 to D6 might represent the closest prior art. However, D4 and D6 simply disclosed an arrangement in which the only flow past the membrane surfaces was that of the bubbles and the slight flow of liquid caused by the airlift effect of the bubbles. The disadvantages of such arrangements were acknowledged in detail in the application as filed. As the fluid transfer in this approach was limited to the effectiveness of the gas lifting mechanism, more gas had to be supplied to enhance the scrubbing effect, which consumed large amounts of energy, possibly formed mist or froth flow, reduced effective membrane filtration area or could be destructive to membranes. Moreover, in an environment of high concentration of solids, the gas distribution system might gradually become blocked by dehydrated solids or simply be blocked when the gas flow ceases, especially in the proximity of two potted heads. In contrast, the claimed subject-matter used a liquid flow to entrain gas bubbles and produce a two-phase gas/liquid mixture which was uniformly distributed into the fibres bundles by having the mixture producing device, i.e. the venturi device, connected to the base of the potting head.
- (c) The problem solved by the claimed method over D4 or D6 was therefore either to provide an improved

method, in the sense that it overcame all disadvantages encountered with the method of D4 or D6, or to obtain an alternative method which overcame some of those disadvantages.

- (d) As to obviousness, none of the cited prior art documents showed, suggested or even hinted at such an arrangement. In D1, a gas/liquid mixture was obtained with a venturi device, but was produced remotely from the potting head of the modules and passed through diffusers which dissipated any energy produced by the liquid flow from the ejector. The diffusers were positioned along a pipe such that the flow was maldistributed along the length of the pipe and thus the modules. Further, as the diffusers were spaced some way below the different modules, there was no means of controlling the distribution of bubbles or flow of liquid to the base of the module. Only by providing a connection to the base of each module could one ensure a uniform distribution of two phase gas liquid flow. There was however no hint in any of the references cited of a venturi device being part of the module or the gas bubbles entrained in a liquid flow being provided from within the module. Thus, D1 would teach away from the present invention. The teaching of D1 would be rather to use a venturi device in combination with an additional source of bubbles, namely a blower, which however presented higher risks of damage than in D4 or D6. There was nothing suggesting to a skilled person to chose the particular solution provided by the current invention. Thus, an inventive step should be acknowledged.

- X. The Appellants requested that the decision under appeal be set aside and that a patent be granted on the basis of the claims of the Main Request or of the First or Second Auxiliary Request, all submitted by letter of 22 October 2012.

Reasons for the Decision

1. The appeal is admissible.

Preliminary remarks

2. In response to formal objections raised by the Board at the oral proceedings (lack of conciseness and clarity), the Appellants acknowledged that:

- (a) the wording "comprising porous hollow fibres" on line 3 of Claim 1 (Main, First and Second Auxiliary Requests) which follows the expression "porous hollow fibre membranes (6)" was redundant and should be deleted, as the terms "porous hollow fibre membranes (6)" designated membranes made of a porous material which are in the form of hollow fibres;
- (b) reference signs (7) and (8) in line 5 of Claim 1 (Main Request) should be inverted, as reference sign (7) is that of the lower potting head throughout the present application;
- (c) Claim 1 (Main, First and Second Auxiliary Requests) should specify that "*the at least one*

of said headers having one or more holes formed therein through which gas/liquid flow may be introduced" was the lower potting head (7), as it was an essential feature of the method according to Claim 1 in order to obtain scouring of the surface of the membranes and removal of the accumulated solids from within the module;

- (d) the wording in Claim 1 (Main, First and Second Auxiliary Requests) "*said module (5) including a venturi device (12)*" was not appropriate, as the venturi device was not part of the module in view of the first part of Claim 1, but should indicate that the venturi device was "connected to the base of potting head (7)" which itself was part of the module.

3. Hence, the Board and the Appellants considered that the Main, First and Second Auxiliary Requests should read as if they contained the above necessary modifications. However, the Board agreed to the Appellants' request to submit a new version of those claims requests containing the above modifications, subject to acknowledgement by the Board of an inventive step for their respective claimed subject-matter.

Main Request

4. Taking account of the above modifications, the Board has no formal objections against the claims of the Main Request (Articles 123(2) and 84 EPC). The Board is also satisfied that the subject-matter of the claims according to the Main Request meets the requirements of Article 54 EPC. As Claim 1 of the Main Request is not

allowable for lack of an inventive step, there is, however, no need in the present appeal decision to give a reasoning in respect of those issues.

Inventive step

Closest prior art

5. The present invention relates to a method for cleaning membrane filtration modules used in the treatment of waste water.

5.1 As acknowledged on page 9, lines 17-19 of the present application, D6 (claim 24 and Figure 1) too relates to a membrane module of the same type of those disclosed in the present application, namely a membrane module which comprises a bundle of hollow fibre membranes extending longitudinally between upper and lower potting heads, said membranes being arranged in close proximity to one another and mounted to prevent excessive movement therebetween.

5.2 As the present application, D6 too aims at providing a method of removing accumulated solids from the surface of porous hollow fibre membranes (see page 3, lines 18-27). In D6, this is achieved by using a lower potting head (7) having a number of holes (10) uniformly distributed therein to enable gas/air to be supplied therethrough. The fibres are fixed uniformly at the two potting heads and the holes are formed uniformly relative to each fibre so as to provide, in use, a uniform distribution of gas bubbles between the fibres. According to D6, this configuration ensures an efficient scouring of the hollow fibre membranes,

accumulated solids being removed from the membrane module (page 3, lines 18-27).

- 5.3 As acknowledged by the Appellants, D4 also provides an equivalent teaching.
- 5.4 The Board, in agreement with the Appellants' opinion, is satisfied that any of documents D4 and D6 can represent the closest prior art, thus the starting point for assessing inventive step.

Problem solved

6. In the arrangement employed in the closest prior art, the bubbles used for scouring the hollow fibre membranes are generated by means of a blower. Disadvantages of such an arrangement, to which the Appellants referred, are mentioned on page 2, line 6 ff of the application as filed. According to said passage, the shear force produced largely relied on the initial gas bubble velocity, bubble size and the resultant of forces to the bubbles. The fluid transfer in this approach is limited to the effectiveness of the gas lifting mechanism. To enhance the scrubbing effect, more gas has therefore to be supplied, which however, consumes large amounts of energy, possibly forms mist or froth flow reducing effective membrane filtration area and may be destructive to membranes. Moreover, in an environment of high concentration of solids, the gas distribution system may gradually become blocked by dehydrated solids or simply be blocked when the gas flow ceases. Furthermore, when the tubular membrane modules are used in an environment containing high concentrations of suspended solids, solids are easily

trapped within the membrane bundle, especially in the proximity of two potted heads.

- 6.1 The Appellants thus alleged that the claimed method solved the problem of overcoming all these disadvantages, encountered in prior art documents such as D4 or D6, i.e. when injecting gas with a blower.
- 6.2 As a solution to this problem, the claimed method proposes to use uniformly distributed gas bubbles entrained in a liquid flow, the liquid flow comprising a feed liquid, said gas bubbles being entrained in said liquid flow by flowing said liquid and a gas into a venturi device connected to the base of potting head (7) so as to cause said gas to be drawn and/or mixed into said liquid. According to Claim 4 of the present Main Request and to the paragraph bridging pages 3 and 4, the wording "venturi device" includes a venturi tube, jet, nozzle, ejector, eductor or injector.
- 6.3 The advantages allegedly achieved over the methods of the closest prior art concern the efficacy of the method, i.e. better scrubbing effect, absence of formation of mist or froth flow, reduction of a blockage of the distribution apertures and of the amount of solids trapped within the membrane bundle, especially in the proximity of two potted heads.
- 6.4 Whether these advantages are actually obtained by the claimed method, obviously depends on the configuration of the membrane module employed in the closest prior art and in the claimed method, in particular on the partitioning of the membranes bundles.

- 6.5 It has not been evidenced that an additional supply of gas in order to improve, if needed, the efficacy of the membranes' cleaning according to the method of D6, necessarily would form a mist or froth flow in the context of D6.
- 6.6 Moreover, as indicated in above point 5.2, D6 employs a uniform distribution of aeration holes formed in the lower potting head and a uniform distribution of the hollow fibre membranes relative to said aeration holes, which measures ensure an efficient scouring of the hollow fibre membranes, accumulated solids being removed from the membrane module.
- 6.7 The Appellants, who bear the onus of proof for their allegations, have not provided evidence that the method presently claimed attains all above mentioned advantages.
- 6.8 Hence, the claimed method has not been shown to provide a successful solution to the problem defined by the Appellants indicated in above point 6.1.
- 6.9 The Appellants also argued that the problem solved by the claimed subject-matter could be defined as the provision of an alternative method in the sense that it overcomes some of the disadvantages indicated in point 6. above. Which of these disadvantages are considered to be overcome by the claimed method has not been specifically defined, however.
- 6.10 It is conspicuous to the Board that the use of a venturi device provides benefits to the process of D6, inasmuch as it reduces operating costs, while providing

a thorough mixing of gas bubbles and liquid medium, with the ability to independently adjust flow rates of gas and liquid.

- 6.11 Thus, in line with the passage on page 3, lines 13-15 of the application as filed, the technical problem successfully solved by the claimed subject-matter vis-à-vis the method of D6 or D4 is merely seen as the provision of a useful alternative method for removing fouling materials from the surface of a plurality of porous hollow fibre membranes.

Obviousness of the claimed solution

7. It remains to be decided whether or not the skilled person starting from the method described in either D6 or D4 and wishing to solve the above defined problem would have been guided by the available prior art to use uniformly distributed gas bubbles entrained in a liquid flow, the liquid flow comprising a feed liquid, said gas bubbles being entrained in said liquid flow by flowing said liquid and a gas into a venturi device which is in connection with the base of the lower potting head so as to cause said gas to be drawn and/or mixed into said liquid.
- 7.1 D1 (Figure) concerns a method for cleaning membrane filtration modules used in the treatment of waste water. It relates to the treatment of flat film modules and teaches that gas bubbles used for scouring the membranes can be effectively generated by the use of an ejector, i.e. a venturi device within the meaning of the present application, which uses as operating fluid the water to be treated. The fine gas bubbles generated

from the venturi device are supplied to the vertical flat film modules through a diffuser located below the modules. The fine bubbles are used in addition to larger bubbles generated from a separate diffuser, also located under the membrane modules. Fine and large bubbles move upward along both sides of the vertical membrane modules and generate turbulent flow, which prevents the growth of slag or removes slag which is likely to adhere to the membrane surface.

7.2 Consequently, the skilled person starting from the method described in either D6 or D4 and wishing to provide a useful alternative method for removing fouling materials from the surface of the plurality of porous hollow fibre membranes described in D6 or D4, would have been motivated by the teaching of D1 to use fine gas bubbles generated by a venturi device as a mean to scour the surface of the porous hollow fibre membranes, while keeping the uniform distribution of the gas bubbles which is required in D6 or D4 to obtain an efficient scouring of the hollow fibre membranes, in order to remove the accumulated solids from the membrane module.

7.3 In this respect, obviously, the teaching of D6 according to which appropriate distribution and sizing of holes ensure that the flow of bubbles around the fibres is uniform across the bundle is also applicable when the flow of bubbles is generated by a venturi device. That the venturi device should be connected to the base of the lower potting head is also an obvious measure for the skilled person in order to maximize the amount of minute bubbles reaching and going through the apertures of the lower potting head. Furthermore, the

fact that a venturi device reduces operating costs, while providing a thorough mixing of gas bubbles and liquid medium, with the ability to independently adjust flow rates of gas and liquid is well known in the art and would for this reason rather encourage the skilled person to use such a device.

7.4 The Appellants' argument that the claimed method is not obvious, as it does not necessitate a pressurised gas supply such as that from a blower, fails to convince, because the claimed method is openly defined, i.e. allows such a possibility, which is explicitly foreseen by the present invention as indicated on page 11, line 2 of the application. The Appellants' argument that the gas/liquid mixture obtained in D1 with a venturi device passed then through a diffuser which dissipated any energy produced by the liquid flow from the ejector is also not convincing, as claim 1 as presently worded does not exclude the use of a diffuser, which in fact is even shown in Figure 1, as representing a preferred embodiment of the present invention.

7.5 In view of the above, it can thus be concluded that the skilled person starting from the method of D6 or D4 and wishing to provide a useful alternative method for removing fouling materials from the surface of a plurality of porous hollow fibre membranes, would arrive in view of the teaching of D1 in an obvious manner at the presently claimed solution.

8. Consequently, the subject-matter of claim 1 according to the Main Request does not involve an inventive step

within the meaning of Article 56 EPC. The Main Request is therefore rejected.

First and Second Auxiliary Requests

9. The subject-matter of claim 1 of the First and Second Auxiliary Requests differs from that of the Main Request in the wording "connected to the base of said potting head" being replaced by "in connection with the base of said potting head" or "connected to said potting head via a potting sleeve", respectively.
- 9.1 The considerations in respect of inventive step given for the Main Request are not affected by these changes of wording, which merely seek to express the proximity of the venturi device to the potting head, as this proximity is an obvious measure as shown in point 7.3 above.
- 9.2 Thus, the claimed subject-matter of each of the First and Second Auxiliary Requests is also not allowable for lack of inventive step.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar

The Chairman

A. Counillon

G. Santavicca