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Datasheet for the decision of 28 July 2016

Case Number: T 1438/14 - 3.3.05

Application Number: 05754582.4

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Language of the proceedings: EN

Title of invention:
CONTINUOUS CLOSED-CIRCUIT DESALINATION APPARATUS WITHOUT CONTAINERS

Applicant:
Desalitech Ltd

Headword:
Continuous closed circuit desalination/ Desalitech

Relevant legal provisions:
EPC Art. 84, 123(2), 54, 56, 111(1)

Keyword:
Claims - clarity (yes)
Amendments - allowable (yes)
Novelty - (yes)
Inventive step - (yes)

Decisions cited:

Catchword:

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Boards of Appeal
Chambres de recours

European Patent Office
D-80298 MUNICH
GERMANY
Tel. +49 (0) 89 2399-0
Fax +49 (0) 89 2399-4465

Case Number: T 1438/14 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 28 July 2016

Appellant: (Applicant)	Desalitech Ltd 4 Mevo Hashaked Street 90836 Har Adar (IL)
Representative:	Beyer, Andreas Wuesthoff & Wuesthoff Patentanwälte PartG mbB Schweigerstrasse 2 81541 München (DE)
Decision under appeal:	**Decision of the Examining Division of the European Patent Office posted on 7 February 2014 refusing European patent application No. 05754582.4 pursuant to Article 97(2) EPC.**

Composition of the Board:

Chairman	A. Haderlein
Members:	G. Glod
	C. Vallet

Summary of Facts and Submissions

I. The present appeal lies from the decision of the examining division to refuse European patent application EP 05 754 582.4 for non-compliance with Articles 84 and 123(2) EPC. The following documents were cited in Annex 1 to the decision:

D1: DE-A-43 31 102
D2: DE-A-101 12 719
D3: US-A-5 647 973
D4: WO-A-03 013704
D5: DE-A-26 22 461
D6: WO-A-02 098527
D7: DE-A-195 20 917

II. With the statement of grounds of appeal, the appellant (applicant) filed a new set of claims.

III. In a communication dated 3 August 2015, the board among other things raised objections under Articles 123(2), 84 and 56 EPC.

IV. By letter of 11 November 2015, the appellant submitted a new request and filed several documents (in particular Annex B1) in support of its case.

V. In the communication pursuant to Article 15(1) RPBA the board raised objections under Articles 123(2), 84 and 56 EPC.

VI. By letter of 20 June 2016, the appellant filed a new request and further documents in support of its case.

VII. Oral proceedings before the board took place on 28 July 2016. There the appellant submitted a new set

of claims. Claims 1 and 7 read as follows:

"*1. An apparatus for continuous closed-circuit consecutive sequential desalination of a salt water solution by reverse osmosis, the apparatus comprising:*
a closed circuit system comprising one desalination module (M) having an inlet, a concentrate outlet, a permeate outlet, or a plurality of desalination modules (M_1, ..., M_n) having their respective inlets and outlets connected in parallel, and a concentrate recycling line connecting each concentrate outlet to each inlet of the one or more desalination modules (M_1, ..., M_n), each of said desalination modules (M_1 , ..., M_n) comprising one or more membrane elements;a feed line (F) for supplying fresh feed of salt water solution to the closed circuit system,
a pressurizing pump (PP) in said feed line (F) for pressurizing the fresh feed of salt water solution into the closed circuit system and for creating counter pressure to enable reverse osmosis desalination in the closed circuit system and replacement of released permeate by fresh feed;
a circulation pump (CP) in said concentrate recycling line for recycling pressurized concentrate from each concentrate outlet to each inlet of the one or more desalination modules (M_1, ..., M_n);
a permeate conducting line (P) for permeate collection from the at least one desalination module of said closed circuit system;
an effluent conducting line (B) connected to the concentrate recycling line for removing brine effluent from the closed circuit system;
a valve system (V3) in the concentrate recycling line downstream of the circulation pump (CP) and configured to divert concentrate flow from the concentrate recycling line into the effluent conducting line (B) to

enable periodic discharge of brine from the closed circuit system at a desired recovery level without stopping desalination; and
a monitoring and control system including a first solution conductivity monitoring device (CM(1)) arranged in the concentrate recycling line upstream of the module inlet(s) for monitoring the reached recovery level, a second solution conductivity monitoring device (CM(2)) arranged in the effluent conducting line (B) for determining brine rejection completion, a first pressure monitoring device (PM(1)) arranged in the concentrate recycling line upstream of the first solution conductivity monitoring device (CM(1)) and downstream of the valve system (V3) as well as downstream of the pressurizing pump (PP), and a second pressure monitoring device (PM(2)) arranged in the concentrate recycling line downstream of the circulation pump (CP) and upstream of the valve system (V3) to enable continuous closed circuit desalination of desired recovery proceed in consecutive sequential steps under variable pressure conditions by switching from a concentrate recycling mode to a concentrate discharge mode upon reaching the desired recovery level and by reactivating the concentrate recycling mode once brine rejection completion is determined."

"*7. A method for continuous consecutive sequentially closed circuit desalination of salt water solution by reverse osmosis taking place in an apparatus according to any one of claims 1 to 6, the method involving:*
- operating the apparatus in a concentrate recycling mode, recycling pressurized concentrate in the closed circuit system through the one or more desalination modules (M_1, ..., M_n) while releasing permeate from the one or more desalination modules (M_1, ..., M_n) and supplying pressurized fresh salt water solution feed to

the closed circuit system to replace released permeate;
- measuring a reached recovery level in the closed circuit system by monitoring conductivity;
- deactivating, without stopping desalination, the concentrate recycling mode in favor of a concentrate discharge mode upon reaching a desired recovery level in the closed circuit system, effecting brine rejection from the closed circuit system while supplying pressurized fresh salt water solution feed to the closed circuit system to replace rejected brine;
- determining brine rejection completion by monitoring conductivity in an effluent conducting line; and
- reactivating the concentrate recycling mode once brine rejection is completed, wherein a variable pressure is supplied controllably during said consecutive sequentially closed circuit desalination such that the difference between applied pressure and osmotic pressure during said closed circuit desalination process is maintained substantially constant."

Claims 2 to 6 and 8 are directed to specific embodiments of the apparatus of claim 1 and the method of claim 7 on which they respectively depend.

VIII. The appellant's arguments may be summarised as follows:

Article 123(2) EPC

The specific sequence of technical elements shown in figures 1A and 1B was precisely reflected in claim 1. In claim 1, the positions of the monitoring devices were unambiguously defined in relation to their control functions.

Article 56 EPC

D4 taught to use containers if continuous closed circuit desalination operation was to be effected and therefore depressurisation resulted. There was no teaching towards the present apparatus and method that eliminated the need for depressurisation and the need for containers. The use of containers was disadvantageous, especially when working with highly salted water such as brackish or sea water.

Figure 6 of D6 described a conventional plug flow desalination (PFD) system with options for external partial recycling of concentrate and/or external partial recycling of permeate, and this design did not enable partial internal recycling for concentrate or for closed circuit desalination (CCD) in which the entire concentrate was recycled. In order to allow for partial or complete recycling of pressurised concentrate, a circulation pump was required. In D6 the recycled brine was mixed with the fresh feed prior to reaching the pressurising pump.

The inventive step was that of making batch CCD continuous through consecutive CCD sequences with brief PFD steps in between for brine replacement with fresh feed without stopping desalination.

In continuous consecutive CCD the entire concentrate was recycled to one or more module inlets after dilution with fresh pressurised feed with progressive batch RO recovery manifested by increased applied pressure and salinity of the concentrates. No pressurised brine was released and therefore no brine energy was lost.

D6 was unrelated to CCD technology and did not make the subject-matter of the independent claims of the present application obvious.

IX. The appellant requests that the decision of the examining division be set aside and that a patent be granted on the basis of the set of claims 1 to 8 submitted during oral proceedings before the board on 28 July 2016.

Reasons for the Decision

1. Article 123(2) EPC

The subject-matter of claims 1 to 8 is directly and unambiguously derivable from the application as filed for the following reasons:

Claim 1 is based on claim 1 of the application as filed in combination with figures 1a and 1b and the corresponding passages in the description, especially page 2, line 6; page 5, lines 1 to 28; page 7, lines 30 to 32.

Claims 2 to 5 are based on claims 6 to 9 as filed.

Claim 6 is based on claim 11 as filed.

Claim 7 is based on claims 2 and 12 as filed in combination with figures 1a and 1b and the corresponding passages in the description, especially page 2, line 6; page 5, lines 1 to 28; page 7, lines 30 to 32.

Claim 8 is based on claim 13 as filed.

2. Article 84 EPC

2.1 Claim 1 is understood as being directed towards an apparatus that has a desalination module, a permeate outlet and a concentrate outlet that is connected to the desalination module inlet such that the concentrate can be recycled in a closed circuit. To this so-called closed circuit containing a circulation pump is connected a feed line and an effluent conducting line. It is understood by the skilled person that a circulating pump does not pressurise the water, but circulates it within the closed circuit and only overcomes the friction of the piping system. The pressurising pump is in the feed line, which means that it is outside of the concentrate recycling line. The features of the monitoring and control system are positioned as in figures 1A and 1B and allow the apparatus to be operated such that it is possible to switch between a recycling mode and a discharge mode of the concentrate.

Now that details of the position of the elements of the monitoring and control system have been included, the objection raised by the examining division at 2.1 of the impugned decision concerning an allegedly missing essential feature no longer applies to the claims on file.

2.2 The objection raised at 2.2 of the impugned decision regarding the presence of process features ("is actuated", "is carried out") in apparatus claims is also moot because the corresponding features are now present in the claims as functional features ("a monitoring and control system... to enable").

2.3 Claim 6 refers to a plant including more than one apparatus according to any of the preceding claims. This claim is therefore worded as suggested by the examining division and therefore the corresponding objection of lack of clarity (at 2.3) has been overcome.

2.4 The expression "to enable effective reverse osmosis" is no longer present in independent method claim 7, so the objection raised at 2.4 of the impugned decision is also moot. Equally, the claim objected to at 2.5 of the impugned decision has been deleted.

2.5 In the course of the proceedings before the department of first instance, the examining division was also of the opinion that, in view of the passage on page 1, lines 7 to 9, of the application as filed, it was essential that the apparatus did not comprise containers (see communication dated 26 March 2010, at 2.1).

The board however finds that it is clear from the description (see in particular page 1, last paragraph) that the apparatus disclosed in the application and in particular the one depicted in figures 1A and 1B did not require the presence of containers, but could also comprise containers. The absence of containers in the apparatus is thus not an essential feature of the apparatus of claim 1.

2.6 In addition, it is accepted that the expression "substantially constant" with respect to the pressure difference between the applied pressure and the osmotic pressure present in claim 7 is understood by a skilled person to mean that this difference is kept constant as far as the system variations allow. Small and short

variations in pressure are still within the meaning of the used terminology. The pressure is supposed to increase steadily from the point in time where closed circuit desalination starts until brine rejection starts.

2.7 For the above reasons, the claims comply with the requirement for clarity of the claims as set forth in Article 84.

3. Article 111(1) EPC

Although the decision of the examining division is based only on objections under Articles 123(2) and 84 EPC, the board also deals with the questions of novelty and inventive step for the following reasons:

The appellant did not request remittal to the examining division.

The examining division had already given an opinion on the questions of novelty and inventive step in an *obiter dictum* attached to the decision under appeal. It appears to the board that the deficiencies indicated by the examining division under these points are closely related to the objections raised under Articles 84 and 123(2) EPC. Since the current set of claims renders the objections under Articles 84 and 123(2) moot, thereby also facilitating the discussion of novelty and inventive step, the board is in a position to deal with the substantive merits of the case. In addition, this also avoids a further delay which could ensue from a remittal without examination of novelty and inventive step.

4. Article 54 EPC

The subject-matter of claims 1 to 8 is considered novel for the following reasons:

Neither D1 nor D2 discloses the presence of a circulation pump - i.e. a pump which, unlike a pressurising pump, does not substantially pressurise the water, but circulates it within the closed circuit and serves only to overcome friction in the piping system - in the recycling line and of a conductivity monitoring device in the effluent conducting line of the concentrate.

None of D3, D6 and D7 disclose a circulation pump in the concentrate recycling line.

D4 does not disclose a conductivity monitoring device in the effluent conducting line of the concentrate and a conductivity monitoring device upstream of the module inlet. In addition, the valve system allowing concentrate to be diverted to the effluent line is not present in the concentrate recycling line, but in outlet lines D_1 and D_2 of containers CN_1 and CN_2 respectively.

D5 does not disclose a pressure monitoring device in the concentrate recycling line.

5. Article 56 EPC

5.1 Invention

The invention concerns an apparatus and a method for continuous consecutive sequential desalination in closed circuit of salt water solution by reverse

osmosis (page 1, lines 7 to 9, claim 1 (apparatus) and claim 7 (method)).

5.2 Closest prior art

It is established jurisprudence that the closest prior art is normally a prior-art document disclosing the same purpose or aiming at the same objective as the claimed invention and having the most features in common with the claimed subject-matter.

D4 is regarded as the closest prior art, since it discloses in figure 2a continuous closed circuit desalination wherein feed water is fed from the container CN_2 to the desalination modules. The permeate is removed via line (A) while the entire concentrate is pumped via continuous pump CP back to the container CN_2 and again to the desalination modules. The desired hydrostatic pressure in the container CN_2 and in the desalination modules is created by means of a pressurising pump PP that feeds sea water into the apparatus, replacing the volume of released permeate by fresh sea water supply (page 17 of description, last sentence), the pressurising pump being located outside the closed circuit. This cycle is repeated several times until the concentrate and its osmotic pressure manifest the desired recovery level of the desalination process (page 16, second paragraph, lines 9 to 11). The container CN_2 is depressurised and refilled with feed water, while the cycle continues through container CN_1.

D5 discloses a pressurising pump 4 outside the circuit and a circulation pump inside the circuit, but it is not unambiguously derivable from this document that it relates to the recycling of the entire concentrate (page 6, lines 15 to 28) and thus to a closed circuit.

Rather, D5 aims at providing concentrate at a constant concentration (page 5, penultimate paragraph, and page 6, last sentence), requiring an open circuit.

D6 does not qualify as closest prior art, since the concentrate is recycled into the feed line prior to entering the pressurising pump. It therefore does not disclose a closed circuit within the meaning of claim 1 of the present application.

5.3 Problem

According to the application, the problem to be solved is to provide a simple inexpensive design with low specific energy demand without any need for energy recovery (page 2, lines 30 to 33).

5.4 Solution

As a solution to this problem the application proposes an apparatus according to claim 1 characterised in that a valve system (V3) is present in the concentrate recycling line downstream of the circulation pump (CP), configured to divert concentrate flow from the concentrate recycling line into the effluent conducting line (B), and a monitoring and control system is present that includes a first solution conductivity monitoring device (CM(1)) arranged in the concentrate recycling line upstream of the module inlet(s), a second solution conductivity monitoring device (CM(2)) arranged in the effluent conducting line (B), a first pressure monitoring device (PM(1)) arranged in the concentrate recycling line upstream of the first solution conductivity monitoring device (CM(1)) and downstream of the valve system (V3) as well as downstream of the pressurising pump (PP), and a second

pressure monitoring device (PM(2)) arranged in the concentrate recycling line downstream of the circulation pump (CP) and upstream of the valve system (V3).

5.5 Success of the solution

It is accepted that the problem indicated in the application is solved, since the example present in the application and the documents submitted by the appellant, especially Annex B1 of the letter of 11 November 2015, show that efficient desalination is obtained with relatively low energy requirements. In addition, the design is simpler than in D4, because a container is not needed in the closed circuit system.

5.6 Obviousness

One of the key elements of D4 is that the entire concentrate is recycled and the solution exiting the containers CN_1 or CN_2 is sent to the modules directly, without passing through a pressurising pump, thereby forming a closed circuit (page 8 of the description, first and second paragraphs). This allows for internal recycling of the concentrate. Therefore the skilled person trying to optimise the design would turn to a system having a similar setup.

D1 does not relate to such a system, since the recycled concentrate mixes with the feed prior to entering the pressurising pump. D1 teaches to recycle a maximum of concentrate, but does not mention that the entire concentrate is recycled (column 2, lines 14 to 19). The skilled person does not find any teaching in D1 that would be of relevance when starting from D4 and trying to solve the posed problem.

D2 also relates only to partial recycling of the concentrate that is consecutively mixed with the feed prior to pressurising (column 3, lines 60 to 63). D2 does not provide a closed circuit within the meaning of D4.

The same applies to D3, since concentrate is recycled via line 62, which is connected to valve 76 and check valve 78 before being connected to inlet line 22 (column 3, lines 50 to 52, and figure 1). Thereafter the water passes through a three-way valve 54 prior to being fed to a booster pump 56 (column 3, lines 39 and 40, in combination with figure 1).

D4 itself is completely silent about a monitoring and control system that allows switching between a concentrate recycling mode and a concentrate discharge mode. There is no mention of a valve in the concentrate recycling line such that the concentrate could be directly diverted from the recycling line to an effluent line. D4 discloses that the concentration could be monitored to control the sequential desalination (page 28 of the description, last sentence of first paragraph), but this is not related to the periodic discharge of brine from the closed circuit system. D4 also discloses pressure control means, but only in the context of constant and variable pressure modes (page 28 of the description, penultimate sentence). D4 even discloses that containers could be viewed as pressure pipes of somewhat wider diameters connecting the closed circuit between the circulation pump and the desalinisation unit (sentence bridging pages 29 and 30 of the description), but this still means that a recipient is present for receiving the concentrate. There is no teaching towards the valve

system in the concentrate recycling line and the monitoring and control system that allows periodic discharge from the closed circuit to the effluent conducting line.

As indicated above, D5 does not teach the recycling of the entire concentrate or a monitoring and control system that would allow switching between a concentrate recycling mode and a concentrate discharge mode to enable periodic discharge of brine.

D6 discloses the recycling of concentrate that is mixed at combination tee 47 with a volume of raw water equal to that which permeates the reverse osmosis membrane 16 (page 10, lines 15 to 17). The mixing of the raw water and the recirculating concentrate occurs prior to entering the pressurising pump 13 (page 10, lines 18 to 21). This setup does not allow the internal recycling of the concentrate. Therefore it is of no help to the skilled person starting from D4 and trying to solve the posed problem.

D7 also discloses the recirculation of concentrate via line 20. However, only part of the concentrate is recycled back to the feed line 10a, 10b, while the other part is rejected via line 23 (column 2, lines 19 to 23). In addition, the recycled concentrate mixes with new feed prior to entering the pressurising pump. D7 thus relates to a setup different to D4.

To summarise, the prior art does not teach the proposed solution to the posed problem.

5.7 This line of argument also applies to claim 7, which relates to a method taking place in an apparatus according to any one of claims 1 to 6. Claims 2 to 6

include the features of claim 1, while claim 8 includes the features of claim 7.

5.8 Therefore the board concludes that the requirements of Article 56 EPC are fulfilled.

Order

For these reasons it is decided that:

1. The decision of the examining division is set aside.

2. The case is remitted to the examining division with the order to grant a patent on the basis of the set of claims 1 to 8 submitted during oral proceedings before the board of appeal on 28 July 2016 and a description and figures to be adapted.

The Registrar: The Chairman:

C. Vodz A. Haderlein

Decision electronically authenticated