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Datasheet for the decision of 28 February 2007

Case Number: T 0614/02 - 3.3.05

Application Number: 97934802.6

Publication Number: 0917491

IPC: B01D 53/62

Language of the proceedings: EN

Title of invention:
Method for removing carbon dioxide from gases

Applicant:
KVAERNER ASA

Opponent:
-

Headword:
CO_2 removal/KVAERNER

Relevant legal provisions:
EPC Art. 56

Keyword:
"Inventive step: no"

Decisions cited:
-

Catchword:
-

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Beschwerdekammern | Boards of Appeal | Chambres de recours

Case Number: T 0614/02 **-** 3.3.05

D E C I S I O N
of the Technical Board of Appeal 3.3.05
of 28 February 2007

Appellant: KVAERNER ASA
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Decision under appeal: **Decision of the Examining Division of the European Patent Office posted 11 January 2002 refusing European application No. 97934802.6 pursuant to Article 97(1) EPC.**

Composition of the Board:

Chairman: M. Eberhard
Members: B. Czech
J. Willems

Summary of Facts and Submissions

I. The appeal is from the decision of the examining division refusing European patent application No. 97934802.6, which is based on the international application published under the number WO 98/04339.

The refusal of the application by the examining division was based on the set of claims filed with letter dated 22 March 2000.

The examining division held that claim 1 on file was unclear in view of the expression "*said flue gases and said natural gas are passed to an absorber*" used therein. Moreover, it concluded that since D1 disclosed "a method suitable for removing carbon dioxide from flue gases as well as from natural gas with the same technically essential features", the process of claim 1 lacked novelty. Although the decision to refuse the application was not based on this particular ground, the examining division also considered the claimed method to lack an inventive step in view of a combination of document D3 (WO-A-95/21683) with document D1 (US-A-4 147 754). It also stated that the features of the dependent claims were either known from the cited prior art or lay within the scope of the skilled person.

II. With its statement of grounds of appeal, the appellant filed an amended set of claims replacing the ones previously on file. The appellant requested the reimbursement of the appeal fee on the ground that the contested decision was based on grounds on which it had been given no opportunity to comment. It considered the

subject-matter of the fresh claims to be clear, novel over D1, and non-obvious even in view of a combination of the closest prior art represented by D3 with the teaching of D1.

III. In the annex to the summons to oral proceedings, the board inter alia raised objections under Article 123(2) and 84 EPC against the claims then on file. The board pointed out that the claims concerned the removal of CO_2 from two different types of gas and commented on how this might affect the assessment of inventive step. Finally, the board gave a preliminary negative opinion concerning the request for reimbursement of the appeal fee.

IV. With its last letter dated 14 February 2007, the appellant filed a new set of amended claims replacing the ones previously on file. It considered that these claims overcame the objections raised in the annex to the summons to oral proceedings, and that their subject-matter was not obvious in view of D3 and D1.

V. During the oral proceedings which took place on 28 February 2007, the appellant expressly withdrew its request for reimbursement of the appeal fee and filed as main and auxiliary request two fresh sets of claims replacing the ones previously filed.

VI. Independent claim 1 according to the amended main request reads as follows (amendments with respect to claim 1 of the published PCT application **highlighted** by the board):

"*1. A method for removing and preventing discharge into the atmosphere of carbon dioxide from combustion gases* ***or*** *natural gas from installations for production of oil and/or gas, wherein* ***said*** *combustion gas* ***or natural gas*** *is passed to an absorber containing a solvent, where carbon dioxide is absorbed in said solvent, and the thereby purified combustion gas largely free of carbon dioxide is released into the atmosphere, where the $C0_2$-rich solvent is passed to a desorber where $C0_2$ is removed from the solvent, and the thereby largely $C0_2$-free solvent is recycled to the absorber, and the separated $C0_2$ is passed to a compression stage for compression and utilization and/or disposal in a suitable manner,*
characterized in that membrane gas/liquid contactors ***having a packing factor in the range 250-1000 m^2/m^3*** *are employed in both the absorber and the desorber, and that an external stripping steam is supplied to the desorber.*"

Independent claim 1 according to the said auxiliary request differs from claims 1 according to the main request in that the following phrase is appended at the end of the latter:

"***, and in that solvent is employed with a CO_2 mass transfer coefficient in the range of $(0.1-8.0)10^{-3}$ m/s for the adsorber and $(0.1-2.0)10^{-3}$ m/s for the desorber.***"

VII. The essential arguments of the appellant, as far as pertaining to the claims according to the two final requests presented during oral proceedings, can be summarised as follows:

The amendments carried out in the preamble of claim 1 were based on the application as originally filed, and claim 1 now clearly indicated the steps belonging to each of the two distinct processes covered.

A process with all the features of claim 1 was not disclosed in or suggested by the cited prior art documents. The closest prior art was the process disclosed in D3, where the desorption of CO_2 from the absorbent liquid was carried out in a stripping column or a "Higee" device, but not in a membrane separator. At the oral proceedings, the appellant argued that the technical problem consisted in reducing the weight and size of the equipment required to carry out the said process. D3 itself suggested the use of the "Higee" device in order to achieve savings in costs, weight and area requirements, and hence led away from the present invention. D1 was not concerned with separating and recovering CO_2. It concerned the selective removal of H_2S from gas mixtures containing CO_2 through membranes specifically designed to inhibit the simultaneous passage of CO_2 into the absorbent liquid. The object of D1 was thus very different and even opposite to the one of the present invention. Therefore, the skilled person seeking a solution of the said technical problem would not even consider D1. Although D1 disclosed in one embodiment a desorption in a membrane device using external steam, this desorption step served a different purpose, namely the desorption of H_2S selectively removed and absorbed in a previous step. Moreover, D1 did not indicate the packing factor of the multi-layer membrane assembly used. According to the appellant, such high packing factors were not available at the

time when the invention according to D1 was made. There was no document on file suggesting the use of a membrane desorption unit for contacting an amine absorbent with steam at packing factors in the claimed range.

Concerning the auxiliary request submitted at the oral proceedings, the appellant argued that further restricted amended claim 1 provided a process with good mass transfer in both the absorber and the desorber. The mass transfer ranges of claim 1, were broad (reference was made in this respect to document D4 = WO-A-95/26225, page 14, lines 28 to 33), but they were "operable" ranges "focussed" on the removal of CO_2 and not of H_2S. D1 was concerned with removing H_2S, did not refer to mass transfer values, and thus did not suggest that the system described therein could be used in removing CO_2 with mass transfer values in "operable" ranges.

VIII. The appellant requested that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 5 of the amended main request filed during the oral proceedings, alternatively on the basis of claims 1 to 4 of the auxiliary request filed during the oral proceedings, or expressly more alternatively, remittal of the case to the first instance for a further discussion of inventive step.

Reasons for the Decision

Main request

1. *Allowability of the amendments*

Claim 1 has been modified to clearly express that the method concerns the purification of either combustion gases or natural gas. From the indications concerning the background of the invention and the prior art discussion on page 1 to 4 of the published PCT application read in combination with the object of the invention stated in the second paragraph on page 5 with reference to Figure 3, the skilled person would directly and unambiguously derive the disclosure of a method concerning the treatment of one feed gas in a plant having one absorber and one desorber. Considering that the application does not refer to the treatment of the two gases in parallel, and also taking into account that the mixing of these two types of gases before removing their CO_2 content does not make technical sense, the board is satisfied that this amendment is clearly and unambiguously disclosed in the published PCT application. Claim 1 has been further modified by the incorporation of the features of claim 2 of the published PCT application (numerical range for "*packing factor*". The remaining dependent claims 2 to 5 correspond to claims 3 to 6 of the published PCT application. Amended claims 1 to 5 thus meet the requirements of Article 123(2) EPC.

2. *Inventive step*

2.1 Closest prior art

2.1.1 The board shares the view of the appellant and of the examining division that the disclosure of D3 represents the closest prior art. D3 discloses a method for removing and preventing discharge into the atmosphere of CO_2 from combustion gases from an installation for the production of oil and/or gas, and in particular from gas turbines installed on offshore platforms. The CO_2 is removed in an absorption column, preferably in a membrane gas/liquid contactor and using monoethanol amine ("MEA") as the absorbing solvent. To prevent its emission into the atmosphere, the CO_2 stripped from the absorption liquid using heat is either disposed of or used as a raw material for the chemical industry, which uses all require a previous compression. The regenerated absorption liquid is recycled to the absorption column, see claims 1 and 3, page 6, line 19 to page to page 9, line 21.

2.1.2 D3 is silent about the packing factor of the membrane gas/liquid contactor used in the absorber. Moreover, D3 does not disclose the use of a membrane gas/liquid contactor using external stripping steam for the desorption of CO_2. Instead, according to a preferred embodiment of D3, CO_2 is desorbed from the absorption liquid by means of a "Higee" gas/liquid contactor permitting an extremely efficient mass transfer. The gas/liquid contactor comprises a housing wherein a rotating packing is arranged for distributing and contacting the absorption liquid with stripping steam

fed to the housing. Compared to the use of conventional stripping columns, the use of this contactor is stated to result in savings with regard to costs, weight and area requirements, see page 8, lines 1 to 25, claim 4 (page 13) and Figure 4.

2.2 Technical problem:

2.2.1 It appears to be plausible that, as indicated in the description (see page 5, lines 4 to 9 and page 8, lines 6 to 10 of the published PCT application), the use of membrane gas/liquid contactors having high packing factors (m^2/m^3) in both the absorption and the desorption, may lead to a reduction in weight and volume as compared to the use of conventional columns.

2.2.2 D3 explicitly refers to the higher compactness of the equipment achievable by using hollow fibre membranes in the adsorber and a "Higee" contactor in the desorber instead of the conventional packed columns (page 7, lines 24 to 27 for the absorber and page 8, lines 1 to 4 for the desorber). The appellant has not demonstrated that, starting from D3, the method as now claimed would lead to a further size and weight reduction of the equipment. However, starting from D3 as closest prior art, the technical problem may in any case be seen in the provision of a further method involving the use of equipment having a reduced size and weight as compared to the use of conventional stripping columns.

2.3 Obviousness

2.3.1 D1 concerns the selective removal of hydrogen sulphide ("H_2S") from a mixture of gases including carbon dioxide,

in particular from gasified coal. According to one embodiment, the gas mixture is contacted with a membrane system through which hydrogen sulphide is transported into an ethanol amine sweep solution whilst the absorption of CO_2 in the sweep solution is minimised. According to this embodiment, the stripping of the H_2S from the absorbent solution may be carried out in two ways, either by contacting it with steam in a tower or, alternatively, by contacting it with external steam in a membrane desorber, see column 6, lines 5 to 68, figures 5 and 6, and claims 1 and 2.

2.3.2 D1 belongs to the technical field of gas separation and also concerns the separation of a so-called "sour" gaseous component from a gas mixture by means of absorption through a membrane into an ethanol amine absorbing liquid. Therefore, the board is convinced that, contrary to the appellant's opinion, the skilled person looking for a solution to the stated technical problem would consider the content of D1. The fact that according to D1 measures are taken for limiting the passage of one "sour" component (i.e. CO_2) into the absorbent solution whilst facilitating the passage of another "sour" component (H_2S) would not deter the skilled person from seeking in this document a solution to the particular technical problem stated.

2.3.3 D1 expressly points out advantages of the alternative making use of a multi-layer membrane desorber with steam as sweep fluid as compared to steam stripping in a tower, namely its smaller size and its better steam utilisation leading to a reduced heat requirement, see column 6, lines 43 to 44 and lines 63 to 68. The skilled person could thus gather from D1 that by

stripping a sour gas component from an ethanol amine solution using a membrane gas/liquid contactor supplied with external stripping steam the advantage of a smaller size of the equipment could be achieved. D1 contains no element of information suggesting that microporous gas permeable membranes could not be used for desorbing CO_2 in the same manner as H_2S from an ethanol amine solvent. Starting from D3, the skilled person is thus induced by the teaching of D1 to replace the "Higee" contactor of D3 by a membrane desorber in order to solve the stated technical problem.

2.3.4 The appellant has not invoked any unexpected effect to be achieved in addition to size reduction by using membrane contactors having a packing factor in the claimed range of 250-1000 m^2/m^3. Moreover, the claimed range has to be considered as broad in view of the appellant's statement that such membrane arrangements were not even available at the time the invention of D1 was made. As confirmed by the appellant during the oral proceedings, membranes with packing factors in the claimed range were commercially available at the time the present invention was made. The size of a membrane contactor being dependent on the packing factor, the skilled person will select higher packing factors for achieving more important size reduction.

2.4 For the skilled person aiming at providing a method which can be carried out with equipment of reduced size compared with the conventional stripping columns, using packing factors lying within the claimed broad range would thus be an obvious measure for achieving the desired size reduction, involving merely routine engineering considerations.

3. Since the method of claim 1 is not based on an inventive step, the appellant's main request cannot be allowed.

Auxiliary request

4. *Allowability of the amendments*

Claim 1 according to this request differs from claim 1 according to the main request in that it further requires that a solvent is employed having CO_2 mass transfer coefficients within specific numerical ranges for the absorber and the desorber, respectively. Basis for this additional amendment of claim 1 can be found in claim 3 of the published PCT application, which has been entirely incorporated into claim 1, and on page 8, lines 11 to 14, of the published PCT application. The remaining dependent claims 2 to 4 correspond to claims 4 to 6 of the published PCT application. The amendments thus meet the requirements of Article 123(2) EPC.

5. *Inventive step*

5.1 As confirmed by the appellant during the oral proceedings, both mass transfer coefficient ranges indicated in claim 1 are broad. Moreover, upon being questioned by the board, the appellant has not put forward, let alone demonstrated, any unexpected effect to be achieved by working within the broad claimed ranges. The board notes that monoethanol amine ("MEA" hereinafter) is a preferred solvent according to the present application (see the sole example on page 8, lines 26 to 30 of the published PCT-application), i.e.

a solvent providing "operable" mass transfer coefficients.

5.2 D3 also relies on the use of MEA as the solvent for absorbing CO_2 through a membrane and subsequently desorbing it from the MEA solution using steam (see page 7, line 3 and line 20). Moreover, D1 confirms that a sour gas component can be desorbed from an amine (e.g. MEA) solution in a membrane contactor using external steam (claim 1 and column 6, lines 33 to 68). Therefrom, the board concludes that the skilled person putting into practice the process suggested by the combination of D3 and D1 would retain MEA for reversibly absorbing CO_2 or use other CO_2 absorbing solvents with similar mass transfer properties. It lies within the competence of the skilled person confronted with the technical problem stated above (point 2.2.2) to choose by routine experimentation and/or routine engineering considerations, those absorbing solvents having "operable" or adequate mass transfer coefficients. The skilled person would thereby arrive at the claimed method without the exercise of inventive skills.

6. The appellant's auxiliary request can thus not be allowed either.

Request for remittal of the case

7. Concerning the appellant's last request, it is noted that the appellant did not submit a further set of claims as a basis for a "further discussion of inventive step". In the absence of one or more further sets of claims, there is no longer a case to be remitted for further prosecution according to the

appellant's last request. This request must thus be rejected. The board however observes that the contested decision, although not being based on the ground of lack of inventive step, also contains a negative opinion of the examining division concerning the subject-matter of the dependent claims then on file, including the dependent claim referring to the mass transfer coefficients. The appellant thus had the opportunity to consider this negative opinion and to prepare further arguments possibly supporting the patentability of a fresh independent claim containing additional features taken from former dependent claims or from the description.

Order

For these reasons it is decided that:

The appeal is dismissed.

The Registrar The Chairman

C. Vodz M. Eberhard