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D E C I S I O N
of 15 January 1997

Case Number: T 0747/95 - 3.4.2

Application Number: 89200367.4

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IPC: B01D 53/14, C01B 17/04

Language of the proceedings: EN

Title of invention:
Process for removing H_2S from a gas stream

Patentee:
SHELL INTERNATIONALE RESEARCH MAATSCHAPPIJ B.V.

Opponent:
Metallgesellschaft AG, Frankfurt/M
LINDE AKTIENGESELLSCHAFT

Headword:
-

Relevant legal provisions:
EPC Art. 123(3), 123(2), 84, 56, 102(3)

Keyword:
"Protection extended: no"
"Subject-matter extended: no"
"Clarity: yes"
"Inventive step: yes"

Decisions cited:
-

Catchword:
-

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Case Number: T 0747/95 - 3.4.2

D E C I S I O N
of the Technical Board of Appeal 3.4.2
of 15 January 1997

Appellant: (Proprietor of the patent)
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Representative: -

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Decision under appeal: **Decision of the Opposition Division of the European Patent Office posted 30 June 1995 revoking European patent No. 0 331 228 pursuant to Article 102(1) EPC.**

Composition of the Board:

Chairman: E. Turrini
Members: M. Chomentowski
B. J. Schachenmann

Summary of Facts and Submissions

I. European patent No. 0 331 228, which had been granted on the basis of European patent application No. 89 200 367.4, was opposed by two opponents on the grounds that its subject-matter lacked an inventive step having regard to inter alia D1 = EP-A-0005572, D6 = "Acid and Sour Gas Treating Processes", Stephen A. Newman, Gulf Publishing Company, Book Division, Huston*London*Paris*Tokyo, 1985, pages 370-387 and D7 = "Sour-Gas Processing and Sulfur Recovery", The Petroleum Publishing Company, Tulsa, Oklahoma 74101, 1979, pages 22-24, "Improve economics of acid-gas treatment", Robert S. Smith, respectively.

II. The patent, in particular on the basis of a main request with an amended text of the claims, was revoked on said grounds.

The Opposition Division took the following view:

Starting from the process of D1, which was for removing H2S from a gas stream by absorption, whereby at least part of the off-gas removed from a regenerator for the regenerable absorbent was supplied to a sulphur recovery plant (35) in which elemental sulphur (36) was produced and in which a plant off-gas (37) was formed containing SO2 and H2S, the advantage of the process of the opposed main claims was that the tail gas of the sulphur recovery plant, the reduced plant off-gas, was better purified in a second absorption zone than in D1. The main problem to be solved was thus to better purify the reduced plant off-gas which, according to D1, was discharged to the atmosphere. The background to this problem was the development in the meantime of increased laws for environment protection. The problem of energy consumption mentioned in the patent was of

mere secondary importance. D1 taught the use of the same regenerator for both absorption zones in the system, and it was thus obvious to a skilled person that he needed two different qualities for the same absorbent, which were processed at different pressures in the different absorption zones. In consequence, the skilled person would consider a split-regeneration, wherein two streams of regenerated absorbent were removed from the regenerator and which is in principle known in the art. However, lack of inventive step of the opposed processes was not based on a combination of D1 and D6 or D7, but on the integration of the general knowledge of the skilled person about split-regeneration regenerators, as for instance applied in D6 or D7, in the known system of D1, which had been proved to be very worthwhile in the art by using the same regenerator for both absorption zones.

III. The appellant (proprietor of the patent) lodged an appeal against this decision.

IV. In the communication accompanying the summons to the orals proceedings which had been requested auxiliarily by the appellant and respondent II (opponent II), the Board of appeal expressed the opinion that claim 1 in dispute, which was identical with amended claim 1 of the main request having formed the basis of the impugned decision, appeared to lack clarity and, moreover, taking into account the arguments of respondent II, to lack an inventive step having regard to D1 and D6.

V. During the oral proceedings of 15 January 1997, the appellant submitted a new text of claim 1 reading as follows:

"1. Process for removing H2S from a gas stream comprising the steps of a) contacting the gas stream (4) in a first absorption zone (1) with regenerable aqueous absorbent (5; 5, 49) to obtain first purified gas (7) and an H2S-containing loaded absorbent (9); b) supplying the loaded absorbent (9) from the first absorption zone (1) to a regenerator (11) provided with a reboiler (25) where the absorbent is regenerated producing an H2S-containing regenerator off-gas (15); c) supplying at least part of the regenerator off-gas (15) to a sulphur recovery plant (35) in which elemental sulphur (36) is produced and in which a plant off-gas (37) is formed containing SO2 and H2S; d) converting (39) SO2 in plant off-gas to H2S to obtain reduced plant off-gas (41);
e) contacting reduced plant off-gas (41) in a second absorption zone (32) with regenerable aqueous absorbent (30) to obtain a second purified gas (45) and an H2S-containing semi-loaded absorbent (47; 49); and f) passing the semi-loaded absorbent (47; 49) from the second absorption zone (32) to the regenerator (11) where the absorbent is regenerated,
characterized in that the process further comprises removing regenerable totally regenerated absorbent (30) from the regenerator (11) and supplying the totally regenerated absorbent to the second absorption zone (32) and to the reboiler (25) only; and removing partly regenerated absorbent (5) from the regenerator (11) and supplying this to the top of the first absorption zone (1)."

VI. The appellant requested that the decision under appeal be set aside and the patent be maintained in amended form on the basis of claim 1 filed during the oral proceedings of 15 January 1997, claims 2 and 3 and the drawings as granted, and the description to be adapted

with the provision that the passage on column 5 of the patent specification, lines 18 to 26, should be cancelled. The appellant submitted the following arguments in support of its request:

Claim 1 in dispute comprises all the features essential to the performance of the invention, in particular supplying at least some of the absorbent to the top of the respective absorption zones, and is clear. Starting from D1, the problem to be solved is the problem of energy consumption mentioned in the patent in suit. The second distinguishing feature of the process in dispute, that the partly regenerated absorbent is supplied to the top of the first absorption zone, is derivable neither from D6 nor from D7, which both show the partly regenerated absorbent being supplied to the middle part of the first absorption zone. In this respect, it is derivable from results of comparative measurements filed with the statement of grounds of appeal that, although generally totally regenerated absorbent is supplied to the top of absorption zones, however, the process in dispute, wherein absorbent regenerated only partially is supplied to the top of the first absorption zone anyway surprisingly shows advantageous values of the amount of steam needed, i.e. of the energy consumption in the process, without the removal efficiency of H2S being lessened. Moreover, there was no available prior art showing a process of the type known from D1 comprising the first distinguishing feature, i.e. removing regenerable totally regenerated absorbent from the regenerator and supplying said totally regenerated absorbent to the second absorption zone and to the reboiler only. Therefore, the subject-matter of claim 1 in dispute involves an inventive step.

VII. Respondent I (opponent I) has only declared in its letter dated 31 October 1996 that it adopted the arguments of respondent II, but was not present at the oral proceedings. Respondent II requested that the appeal be dismissed and argued substantially as follows:

The person skilled in the art of D1 generally knows, for instance from Figure 4 and the corresponding text of D6 that a reduction of the amount of heat required to regenerate loaded adsorbent can be obtained by using a regenerator wherein a totally regenerated absorbent is removed from the bottom of the regenerator and a partially regenerated absorbent is removed from an intermediate part of said regenerator; thus, starting from the system of D1 with at least two absorption zones, wherein the first absorption zone is supplied with a mixture of totally regenerated absorbent (removed from the regenerator) with semi-loaded absorbent (removed from another absorption zone), the skilled person would realize that, for supplying with semi-loaded absorbent the first absorption zone of Figure 1 of D1, he could transpose the configuration of D6 or of D7, wherein partially regenerated absorbent is removed from the regenerator, for supplying the first absorption zone and that, thus, he would reduce the heat needed in the process; this could indeed solve the problem of reducing the amount of heat required to regenerate loaded adsorbent mentioned in the patent in suit, in column 1, lines 39 to 41, and would be obvious in so far as it is not specified in the process of claim 1 in dispute in which way the different absorbents mentioned differ from each other. Therefore, since already this essential feature of the process in dispute is obvious, said process lacks an inventive step.

Reasons for the Decision

1. The appeal is admissible.

2. *Allowability of the amendments*

The amendments resulting in present claim 1, whereby it is specified in particular that the regenerator (11) is provided with a reboiler (25), that the process comprises supplying the totally regenerated absorbent to the second absorption zone (32) and to the reboiler (25) only, and that there is a step of removing partly regenerated absorbent (5) from the regenerator (11) and supplying this to the top of the first absorption zone (1), define a more closely limited process than the granted claim 1 and are at least shown in the original drawings. Deletion of the passage in column 5 of the published specification corresponds to the cancellation of an embodiment not shown. Therefore, the present European patent satisfies the requirements of Article 123(3) and (2) EPC that the claims of the patent may not be amended during opposition proceedings in such a way as to extend the protection conferred and that the patent may not be amended in such a way that it contains subject-matter which extends beyond the content of the application as filed.

3. *Clarity*

Present claim 1 specifies that, in step (a), regenerable aqueous absorbent (5; 5, 49) is used for contacting the gas stream (4) in a first absorption zone (1) to obtain first purified gas (7), and this is in accordance with for instance Figures 1 and 2 and corresponding passages of the description. The same remark applies to the features of the second part of the claim, in particular that there is a step of

removing partly regenerated absorbent (5) from the regenerator (11) and supplying this to the top of the first absorption zone (1), which is shown in the drawings. Since moreover it is directly and unambiguously derivable from present claim 1 that it is the same regenerable aqueous absorbent, in different states, i.e. loaded, semi-loaded, totally or partially regenerated, which is circulated in the system, and since this information is in accordance with the teaching of the specification as now amended, present claim 1 is clear in the sense of Article 84 EPC.

4. *Novelty*

It is to be noted that novelty was not questioned in the decision under appeal and that the amendments resulting in present claim 1 are not of a nature to modify the situation.

5. *Inventive step*

5.1 The process known from D1 (see column 3, line 10 to column 4, line 22; column 13, lines 51 to 56; column 13, line 62 to column 15, line 45; Figure 1) is for removing H2S from a gas stream and comprises the steps of

a) contacting the gas stream (1) in a first absorption zone (2a, 2b) with regenerable aqueous absorbent provided by the conduits (8, 8a and 21) to obtain first purified gas (4) and an H2S-containing loaded absorbent removed by the conduit (6);

b) supplying, through the conduit (6), the loaded absorbent from the first absorption zone (2a, 2b) to a regenerator (7) provided with a reboiler where the absorbent is regenerated producing an H2S-containing regenerator off-gas, removed by a conduit (9);

c) supplying at least part of the regenerator off-gas removed by the conduit (9) to a sulphur recovery plant (10) in which elemental sulphur is produced and removed at (12) and in which a plant off-gas is formed containing SO2 and H2S, removed by conduit (16);

d) converting in the appliance (17) SO2 in plant off-gas to H2S to obtain reduced plant off-gas, removed by conduit (18);

e) contacting reduced plant off-gas, supplied by conduit (18), in a second absorption zone (20) with regenerable aqueous absorbent, provided by conduit (8b), to obtain a second purified gas, removed by conduit (22), and an H2S-containing semi-loaded absorbent, removed by conduit (21); and

f) passing the semi-loaded absorbent, removed by conduit (21) from the second absorption zone (20), to the regenerator (7), directly by conduit (25) and, for another part of said absorbent, over the first absorption zone (2a, 2b) and the conduit (6), whereby in said regenerator the absorbent is regenerated.

5.2 However, contrary to the process in dispute, in the process of D1 (Figure 1), the totally regenerated absorbent is supplied, by the conduits (8, 8b), to the second adsorption zone (20) and, by the conduits (8, 8a), to the first absorption zone (2a, 2b), and thus, the known process does not further comprise removing regenerable totally regenerated absorbent from the regenerator and supplying the totally regenerated absorbent to the second absorption zone and to the reboiler only;

Moreover, contrary to the presently claimed process, in the process of D1, there are steps of removing, by the conduit (8), the totally regenerated absorbent from the

regenerator (11), but there is no step of removing partly regenerated absorbent from the regenerator (7) and supplying this to the first absorption zone (2a, 2b), and in particular not to the top thereof. Thus, contrary to the presently claimed process, there is in the known process no further step of removing partly regenerated absorbent from the regenerator and supplying said particular absorbent to the top of the first absorption zone.

5.3 Therefore, in the process of D1 (see Figure 1), the absorbent supplied to the first absorption zone is a partly regenerated absorbent which is not removed from the regenerator, but which results from the mixing of semi-loaded absorbent removed from the second absorption zone (20) by conduit (21) and a part of the totally regenerated absorbent removed from the regenerator, i.e. the part supplied by conduit (8, 8a).

5.4 Respondent II has pointed out that the person skilled in the art of D1 generally knows, for instance from D6 (see Figure 4 and page 379, second paragraph) that a reduction of the amount of heat required to regenerate loaded adsorbent can be obtained by using a regenerator wherein a totally regenerated absorbent is removed from the bottom of the regenerator and a partially regenerated absorbent is removed from an intermediate part of said regenerator; thus, starting from the system of D1 with at least two absorption zones, wherein the first absorption zone is supplied with a mixture of totally regenerated absorbent (removed from the regenerator) with semi-loaded absorbent (removed from another absorption zone), the skilled person would realize that, for supplying with semi-loaded absorbent the first absorption zone of Figure 1 of D1, he could transpose the configuration of D6, wherein partially regenerated absorbent is removed from the regenerator and that, thus, he would reduce the heat needed in the

process; this corresponds indeed to the problem of reducing the amount of heat required to regenerate loaded adsorbent mentioned in the patent in suit (see column 1, lines 39 to 41); this would be obvious in so far as it is not specified in the process of claim 1 in dispute in which way the different cited absorbents (semi-loaded absorbent, partly regenerated absorbent,...) differ from each other.

Respondent II has also pointed out that Figure 3 of D7 also shows a regenerated absorbent removed from an intermediate part of a regenerator and supplied to an absorption zone.

5.5 However, as convincingly argued by the appellant, the second distinguishing feature of the process in dispute, that the partly regenerated absorbent is supplied to the top of the first absorption zone, is derivable neither from D6 nor from D7, which both show the partly regenerated absorbent being supplied to the middle part of the first absorption zone. In this respect, the appellant has further argued that it was derivable from results of comparative measurements filed with the statement of grounds of appeal that, although in general totally regenerated absorbent is supplied to the top of absorption zones, however, the process in dispute, wherein absorbent regenerated only partially is supplied to the top of first absorption zone anyway surprisingly shows advantageous values of the amount of steam, i.e. of the energy consumption in the process without the removal efficiency of H2S being lessened. Respondent II did not contest these results.

Moreover, it is to be noted that respondent II has admitted that there was no available prior art showing a process of the type known from D1 comprising the first distinguishing feature, i.e. removing regenerable

totally regenerated absorbent from the regenerator and supplying the totally regenerated absorbent to the second absorption zone and to the reboiler only.

5.6 Incidentally, it is to be noted that, since no argument has been provided during the appeal procedure concerning the relevance in the present case of a different problem to be solved, and in particular of the problem of complying with more severe laws on environmental protection, and since the combination of the teachings of D1 and D6 or D7 already does not result in the process in dispute, the arguments put forward in this context during the opposition procedure have been disregarded.

5.6 Therefore, having regard to the state of the art, the subject-matter of claim 1 in dispute is not obvious to a person skilled in the art and thus involves an inventive step in the sense of Article 56 EPC, so that it is patentable (Article 52 EPC).

5.7 Hence, the patent can be maintained in amended form on said basis (Article 102(3) EPC).

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.

2. The case is remitted to the Opposition Division with the order to maintain the patent in amended form on the basis of the following documents:

   claim 1 filed during the oral proceedings of 15 January 1997, claims 2 and 3 as granted
   the drawings (Figures 1 and 2) as granted, and
   the description to be adapted with the provision that the passage on column 5 of the patent specification, lines 18 to 26, should be cancelled.

The Registrar:

P. Martorana

The Chairman:

E. Turrini

MCH

B. Sch.