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Datasheet for the decision of 15 April 2009

Case Number: T 0680/06 - 3.3.06

Application Number: 98307188.7

Publication Number: 0901807

IPC: B01D 53/04

Language of the proceedings: EN

Title of invention:
Purification of gases using solid adsorbents

Patentee:
AIR PRODUCTS AND CHEMICALS, INC.

Opponent:
L'AIR LIQUIDE S.A.

Headword:
Purification of gases/AIR PRODUCTS

Relevant legal provisions:
EPC Art. 56

Relevant legal provisions (EPC 1973):
-

Keyword:
"Inventive step - no (main and auxiliary request)

Decisions cited:
-

Catchword:
-

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Case Number: T 0680/06 - 3.3.06

D E C I S I O N
of the Technical Board of Appeal 3.3.06
of 15 April 2009

Appellant: (Opponent)
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Respondent: (Patent Proprietor)
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Decision under appeal:
Decision of the Opposition Division of the European Patent Office posted 01 March 2006 rejecting the opposition filed against European patent No. 0901807 pursuant to Article 102(2) EPC 1973.

Composition of the Board:

Chairman: P.-P. Bracke
Members: G. Dischinger-Höppler
U. Tronser

Summary of Facts and Submissions

I. European patent No. 0 901 807 was granted on the basis of a set of 13 claims containing one single independent method claim which reads:

"1. A method for removing a component from a gas stream comprising

a) passing the gas stream in a first direction in contact with an adsorbent to adsorb the component from the gas stream on the adsorbent with liberation of heat of adsorption,
b) ceasing passing said gas stream in contact with said adsorbent,
c) heating a regenerating gas to add heat thereto and to raise the temperature of the regenerating gas to a temperature above that of said gas stream,
d) passing said heated regenerating gas in a second direction opposite to said first direction to desorb said gas stream component from said adsorbent for a period such that the heat added to the regenerating gas so passed in contact with the adsorbent is no more than 70% of the heat of the heat of adsorption liberated during the adsorption of the said gas component,
e) ceasing to heat said regenerating gas and continuing to pass regenerating gas in an unheated state to continue to desorb said gas stream component from said adsorbent and allowing said added heat to be consumed in the desorption process, and
f) repeating steps (a) to (e)."

II. A notice of opposition had been filed against the granted patent, wherein the Opponents sought revocation of the patent on the grounds of, inter alia, Article 100(a) EPC for lack of inventive step (Article 56 EPC). The opposition was based, amongst others, on document

D1 EP-A-0 766 989.

III. The Opposition Division rejected the opposition for the reason that the patent and the invention claimed fulfilled the requirements of Article 100(a) to (c) EPC. Concerning inventive step, it was held that the subject-matter of Claim 1 was not obvious in the light of document D1 as the closest prior art since none of the cited prior art documents contained any teaching that considerable energy could be saved in the process by adding less heat for regeneration than was liberated during adsorption due to the fact that the cold gas stream was able to desorb the remaining gas.

IV. This decision was appealed by the Opponent, now Appellant, who filed during the appeal proceedings document

D4 M. Grenier et. al., "Adsorption Purification for Air Separation Units" in Cryogenic Processes and Equipment - 1984, presented at the fifth intersociety cryogenics symposium - the winter annual meeting of the American Society of Mechanical Engineers, pages 143 to 148

amongst other documents.

The Patent Proprietor, now Respondent, filed an amended set of claims in an auxiliary request.

V. Upon request made by both parties, oral proceedings before the Board of Appeal were held on 15 April 2009 in the absence of the Appellant as announced by letter dated 13 March 2009.

During the oral proceedings, the Appellant filed an amended set of claims to replace its previous auxiliary request.

Claim 1 of the auxiliary request differs from that of the main request in that the features of Claim 2 of the main requests had been added at the very end of the claim, namely the term ", wherein step (b) further comprises reducing the gas pressure over said adsorbent and wherein the said gas pressure is restored prior to or at the commencement of repeating step (a)".

VI. The Appellant, in writing submitted objections under Article 100a) to c) EPC. Concerning inventive step, the Appellant considered document D1 as a suitable starting point whose teaching differed from the claimed subject-matter only in that it was not mentioned that the time during which heated regeneration gas was passed over the adsorbent for desorption should be such that the heat added to the regeneration gas was no more than 70% of the heat liberated during the adsorption. The technical problem solved by that feature could be seen in the optimisation of the process of document D1 so that the energy consumption during the regeneration step was reduced. However, it was obvious for someone skilled in the art to reduce for that purpose the

heating energy since it was proposed in document D1 to stop the heat pulse anywhere within the more downstream portion of the adsorbent. Also document D4 suggested reducing the energy costs by reducing the amount of heat supplied during regeneration. Therefore, the subject-matter of Claim 1 was not inventive in view of document D1 alone or in combination with document D4.

VII. The Respondent, orally and in writing, disputed all the objections under Article 100a) to c) EPC.

Concerning inventive step, the Respondent was of the opinion that the conventional TSA (temperature swing adsorption) process mentioned in the patent in suit as HTTSA process was the most suitable starting point since the claimed process was closer to that process than to the process disclosed in document D1. However, if document D1 was considered as the closest prior art, it was held that the features distinguishing the claimed process from that disclosed in document D1 consisted in that the flow of regeneration gas was conducted so as to result in the consumption of the heat pulse and in that the quantity of added heat was less than 70% of the heat of adsorption liberated and, hence, lost from the adsorbent during the on-line period.

By adding during regeneration no more than 70% of the heat liberated during adsorption, the claimed process when compared with that of document D1 solved the technical problem of reducing the heat energy and by allowing the added heat to be consumed in the desorption process, the technical problem that was solved was to increase the cycle time.

In contrast, the instructions in document D1 were to retain the regeneration heat pulse within the upstream portion of the bed, not to consume it and there was no teaching to restrict the amount of heat added for regeneration.

Document D4 was also unsuitable to give any incentive how to save heat in the process of document D1.

Therefore, the claimed subject-matter was not obvious in the light of documents D1 and D4.

VIII. The Appellant requested in writing that the decision under appeal be set aside and that the patent be revoked.

The Respondent requested that the appeal be dismissed or that the decision under appeal be set aside and the patent be maintained on the basis of the auxiliary request submitted during oral proceedings.

Reasons for the Decision

Inventive Step (main and auxiliary requests)

1. The patent in suit relates to the removal of component(s) from a gas stream, such as air, by adsorption onto a solid adsorbent with regeneration of the adsorbent at intervals (paragraphs 1 and 20).

2. Two different prior art processes are referred to in the description of the patent in suit, namely the pressure swing adsorption (PSA) process and the TSA process and it is stated that the adsorption process generates heat of adsorption causing a heat pulse to progress downstream through the adsorbent, and that heat must be supplied during regeneration to desorb the gas component which has been adsorbed on the bed.

It is said that in the PSA process, where the adsorbent is depressurised for regeneration whilst passing a regeneration gas through the bed counter-current to the product feed, regeneration begins before the heat pulse has reached the downstream end of the bed. Thus, the heat of adsorption retained in the bed is used again for desorption, so that no heat must be added during regeneration. However, this results in a short cycle time for adsorption (on-line period) and regeneration. In the TSA process, the cycle time is extended by allowing the heat pulse produced by the adsorption to proceed out of the downstream end of the adsorbent bed during the on-line period. However, it is necessary in this case to add high temperature heat to the regenerating gas.

Thus, the TSA process suffers from the disadvantages linked to the required high temperature, namely the need of special material and equipment as well as extra energy cost, whereas the PSA process suffers from a loss in feed gas during depressurisation ("switch loss") due to the fact that at short cycle times the depressurisation and re-pressurisation steps are more frequent (page 2, paragraphs 3 to 8).

It follows that - in spite of being not specifically identified in the patent in suit - the technical problem underlying the claimed process consists in the provision of a process overcoming those deficiencies of the TSA and PSA processes.

3. In the Respondent's view, the claimed process was closer to the conventional TSA process mentioned in the patent in suit as HHTSA process than to the process of document D1. Therefore, the conventional TSA process should be the starting point for the assessment of inventive step.

4. The Board does not share this opinion for the following reasons:

4.1 According to the established Case Law of the Boards of Appeal of the European Patent Office (see I.D.3.1), the most suitable starting point is normally a prior art document disclosing subject-matter conceived for the same or a similar purpose as the claimed invention and having the most relevant technical features in common, in the sense that a minimum of structural modifications is required.

4.2 The technical problem underlying document D1 is exactly the same as in the patent in suit (point 2.) since this document also relates to the removal of component(s) from a gas stream (e.g. air) by adsorption onto a solid adsorbent with regeneration of the adsorbent at intervals (page 2, lines 3 to 4 and page 3, lines 44 to 45) and refers to the same prior art processes (PSA and TSA) and to the same disadvantages of that prior art (page 2, lines 12 to 56).

In contrast, it is evident that the conventional TSA process is not conceived for the purpose of overcoming its own deficiencies. Hence, the technical problem underlying the TSA process must be different to that underlying the claimed invention.

4.3 Apart from that, the conventional TSA process has no more features in common with the claimed invention than the process claimed in document D1 which comprises all the process steps of Claim 1 of the patent in suit (Claims 1, 7 and 8) with the exception that it is not mentioned that

- heat of adsorption is liberated in step a);

- the quantity of heat added during regeneration is less than 70% of the heat of adsorption liberated in step a) and

- the heat added during regeneration is consumed in the desorption process.

4.4 The Respondent did not contest that heat of adsorption is also liberated in the process of document D1, in the sense that some of the heat generated by the adsorption reaction is carried out of the adsorbent bed during the on-line period.

The Board agrees since, otherwise, it would not be necessary to add heat for regeneration (see paragraph 4 of the patent). Further, compared with the PSA process, the cycle time is extended in the process of document

D1 which means that heat is allowed to leave the bed during the on-line cycle (page 4, lines 10 to 12).

4.5 Hence, the claimed process differs from both, the process of document D1 and the conventional TSA process in that less than 70% of the liberated heat is reintroduced during regeneration and consumed by desorption.

Concerning the latter feature, the Board notes that in the process of document D1 some of the heat added during regeneration is certainly also consumed in the desorption process, or else the hot regenerating gas would not cool down by giving up heat for desorption (page 5, lines 53 to 55). However, document D1 does not disclose that all of that heat is used up for this purpose in the sense of the patent in suit where it states that the heat pulse is allowed to die in the bed or, respectively, fully dissipated during regeneration (paragraphs 19 and 39 of the patent).

Whilst Claim 1 is not restricted to this latter definition of the term "consumed", the Board - in the Respondent's favour - will base the line of argument on this particular meaning.

4.6 The Board concludes therefore that the process disclosed in document D1 qualifies more as a suitable starting point for the assessment of inventive step than the conventional TSA process.

5. The technical problem underlying the patent in suit (point 2.), namely to overcome the drawbacks linked to the high temperatures necessary in the TSA process and

the short cycle times in the PSA process has been solved already by the process of document D1 in that those processes are combined into a new single system of operation where part of the adsorbate is desorbed by TSA using hot regenerating gas and the other part is desorbed by PSA due to the lower pressure (page 3, lines 36 to 56 and page 4, lines 17 to 19).

According to the problem and solution approach applied by the Boards of Appeal for assessing inventive step, the technical problem actually solved by the claimed invention in view of the closest prior art derives from the technical results obtained by the claimed invention when compared with the prior art (Case Law of the Boards of Appeal of the European Patent Office, chapter I.D.2.).

6. It is immediately plausible that the technical result and, hence, the technical problem actually solved by the feature that less than 70% of the liberated heat is reintroduced during regeneration (cf. point 4.5) consists in that heat energy is saved during regeneration.

It is, however, not immediately plausible that the other feature distinguishing the claimed process from the known one, namely that the reintroduced heat is consumed by desorption (cit. loc.), brings about an increase in the cycle time as stated by the Respondent. In particular, the Respondent argued that according to document D1 the flow of regeneration gas is not continued to result in the consumption of the heat pulse produced by the hot regeneration gas but rather the heat pulse is prematurely stopped and retained in

the bed. Therefore, the cycle time would be shorter in document D1.

The Board is not convinced by that argument since in order to return to the conditions required in the on-line period for adsorption, any heat left in the bed has to be removed and recycled (document D1, page 6, lines 7 to 8) which means that in the prior art a time-consuming extra step is necessary.

The Board further notes that the cycle time depends on process conditions, such as the temperature of the regeneration gas and size of the bed (see e.g. document D4, page 144, right-hand column, line 15 to page 145, left-hand column, line 4). However, no such process conditions are specified in Claim 1.

Therefore, the alleged effect of increased cycle time is not supported by evidence. Rather, the only effect credibly achieved by the feature of allowing the heat pulse to be consumed during regeneration is seen in that a surplus of heat energy supplied for regeneration is avoided. In other words, the consumption of the heat pulse also saves heat energy during regeneration as compared with a process according to document D1 where residual heat is left in the bed.

7. Hence, it is accepted that the technical problem actually solved by the claimed process in view of the disclosure of document D1 consists in that heat energy is saved during regeneration.

8. It remains to be decided whether, in view of the available prior art documents, it was obvious for someone skilled in the art to solve the technical problem of saving heat energy during regeneration by limiting the heat reintroduced for desorption to 70% of the heat liberated during the on-line period and by allowing that reintroduced heat to be consumed during desorption.

9. The Board is convinced that saving energy is an elementary problem existing throughout all technical fields. It also exists in the field of gas separation such as the purification and separation of air by adsorption. This is shown in document D4 where it is suggested to save energy for example by reducing the heat needed for regeneration (e.g. page 143, left-hand column, lines 28 to 29).

The Board agrees with the Respondent insofar as document D4 does not give any specific instructions how to save the energy.

However, in the Board's opinion, it is apparent to those skilled in the art and also from document D4 that the overall energy costs in a process for purifying air by adsorption are not only linked to the heat needed for desorption but also to any pressure drop during regeneration, to the proportion of adsorbent bed which is actually regenerated and to the need of recycling any heat left in the bed after regeneration.

Hence, the skilled person knows that heat energy can be saved during regeneration at the expense of desorption if part of the bed is not regenerated since the heat

pulse has died in the bed too early (see also paragraph 18 of the patent and document D4, page 144, left hand column, lines 18 to 26 and right-hand column, lines 28 to 40) and/or at the expense of energy required for re-pressurising if part of the bed is regenerated by depressurisation, i.e. PSA, as in document D1 (page 4, lines 17 to 19).

It is noted that Claim 1 of both requests does not exclude that a part of the bed is regenerated by PSA. On the contrary, dependent Claim 2 of the main request, the features of which have been added to Claim 1 of the auxiliary request (see point V above), explicitly mentions depressurisation of the bed during regeneration and re-pressurisation for adsorption (see also paragraphs 22 and 37 of the patent).

Further, the Respondent never relied on any other relevance of the specific limit of heat reintroduced during regeneration of less than 70% of the heat liberated in the on-line period than that of saving heat energy during regeneration. However, it has never been argued, let alone shown by evidence that reintroducing more that 70% but less than 100 % of the liberated heat would not be suitable for saving heat energy during regeneration. Hence, it was at the disposal of a skilled person to select the amount of heat reintroduced for desorption in accordance with the amount of heat energy desired to be saved.

10. The Board concludes, therefore, that for the purpose of saving energy during regeneration someone skilled in the art would have reintroduced in the process of document D1 less heat energy for desorption than was

liberated during adsorption and allowed that heat to be consumed during regeneration.

11. For these reasons, the Board finds that the subject-matter of Claim 1 of the Respondent's main and auxiliary requests does not comply with the requirements of Articles 52(1) and 56 EPC.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The patent is revoked.

The Registrar: The Chairman:

G. Rauh P.-P. Bracke