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**Datasheet for the decision
of 26 April 2012**

Case Number: T 0252/10 - 3.3.06

Application Number: 03257183.8

Publication Number: 1421986

IPC: B01D 53/04

Language of the proceedings: EN

Title of invention:

Apparatus for use in regenerating adsorbent

Patent Proprietor:

AIR PRODUCTS AND CHEMICALS, INC.

Opponent:

L'AIR LIQUIDE SOCIÉTÉ ANONYME POUR L'ÉTUDE ET L'EXPLOITATION
DES PROCÉDÉS GEORGES CLAUDE

Headword:

Regenerating adsorbent/AIR PRODUCTS

Relevant legal provisions (EPC 1973):

EPC Art. 56

Keyword:

"Inventive step (no): no problem invention"

Decisions cited:

-

Catchword:

-



Case Number: T 0252/10 - 3.3.06

DECISION
of the Technical Board of Appeal 3.3.06
of 26 April 2012

Appellant:
(Opponent)
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Decision under appeal: Interlocutory decision of the Opposition
Division of the European Patent Office posted
22 December 2009 concerning maintenance of the
European patent No. 1421986 in amended form.

Composition of the Board:

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

Summary of Facts and Submissions

I. This appeal is from the interlocutory decision of the Opposition Division concerning maintenance of the European patent No. 1 421 986 in amended form on the basis of the then pending auxiliary request containing one single independent Claim which reads:

"1. A method of air separation by cryogenic distillation to produce an oxygen rich gas and a nitrogen rich gas, comprising a pre-purification of the air to remove at least carbon dioxide and water which is conducted by a TEPESA swing adsorption method comprising:

in an adsorption phase, passing air in a first direction into an adsorber vessel comprising an inlet for said air and an outlet for purified air separated by a flow path including a flow chamber containing a body of adsorbent, and having an inlet for regeneration gas and an outlet for regeneration gas separated by a flow path including said flow chamber, said inlet for said air and said outlet for said purified air optionally constituting also said outlet for regeneration gas and said inlet for regeneration gas, said inlet for regeneration gas having an inlet nozzle containing at least one heater element, wherein said body of adsorbent has a first end which is adjacent to said inlet for regeneration gas and a second end which is remote from said inlet for regeneration gas, and the or each heater element is located so as not to penetrate through said first end of the body of adsorbent, so that said air is purified by the adsorption of water and carbon dioxide and after a period stopping said flow of air into the vessel, and

in a regeneration phase, passing regeneration gas into said vessel through said inlet for regeneration gas in an opposite flow direction whilst heating said regeneration gas by said heater element for a period so as to desorb the less strongly adsorbed of carbon dioxide and water, terminating heating of said regeneration gas and continuing to pass regeneration gas at a lower pressure than the pressure during the adsorption phase so as to desorb the more strongly adsorbed of carbon dioxide and water, stopping said flow of the regeneration gas and resuming said flow of air."

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

D2 US-A-4 601 114 and

D3 US-A-5 614 000.

III. In its decision, the Opposition Division held that the subject-matter claimed in accordance with the auxiliary request fulfilled the requirements of the EPC. The higher ranking request was not allowed for lack of inventive step in view of document D3 as the closest prior art when combined with document D2.

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

D5A M.A. Kalbassi, "Thermally Enhanced Pressure Swing Adsorption (TEPSA) Air Pre-Purification System, AIChE, November 1998.

V. Upon requests made by both parties, oral proceedings before the Board of Appeal were held on 26 April 2012 in the absence of the Appellant as announced by letter dated 24 February 2012.

VI. The Appellant, in writing submitted, inter alia, the following arguments:

The subject-matter of Claim 1 differed from the prior art disclosed in document D3 at best in that the heater was located in the inlet nozzle instead of beyond the manifold for supplying the regeneration gas. The technical effect of this location of the heater element closer to the adsorbent bed consisted in saving energy for regeneration. This effect was, however, already known from document D2. Since document D2 was concerned with a TSA process, a skilled person would have considered its teaching in combination with the modified TEPSA process of document D3, the more so as document D5A taught the relationship between the three processes for gas pre-purification TSA, PSA and TEPSA.

Therefore, the claimed subject-matter was not inventive over document D3 in combination with document D2.

VII. The Respondent, orally and in writing, argued as follows:

According to the patent it had been found that the process of document D3 was not ideal since it required

too much time for the regenerating gas to reach the adsorbent bed. None of documents D2, D3 or D5A contained a hint that this was a problem that needed a solution. Further, the efficiency of the claimed process was increased. Documents D3 and D2 related to very different fields and were, therefore, not combinable. Document D3 did not use a heater in a nozzle. Document D2 used two heaters in the inlets to the adsorber vessels, however, for the specific purpose of heating the produced dry air and at the same time the regeneration gas for the second bed. Unlike document D3, document D2 was further concerned with the problem of loss of heat. Therefore, a skilled person had no motivation to combine documents D3 and D2 to address the problem solved by the patent but reasons, such as the increased number of heaters, to reject document D2 as a basis for modifying document D3.

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.

Reasons for the Decision

Inventive Step

1. The patent in suit relates to the pre-purification of air prior to cryogenic distillation which requires prior removal of water and carbon dioxide because these components would solidify during cryogenic distillation and cause a risk of damage (paragraphs 1 and 33).

2. The traditional prior art processes for this purpose referred to in the description of the patent in suit are the pressure swing adsorption (PSA) process and the temperature swing adsorption (TSA) process. In these processes water and carbon dioxide are removed by adsorption on solid adsorbents within a first and second bed which are periodically regenerated to strip off the adsorbed components from the adsorbent. For adsorption compressed air is passed through the adsorbent in both processes. In TSA this is done until the capacity of the adsorbent in the first bed is essentially used up. For regeneration, the air flow is stopped, the bed is depressurised and subjected to a counter-current flow of heated dry gas, usually followed by a flow of cool regeneration gas to displace the heat pulse from the bed which is thereafter repressurised for a new adsorption cycle. In PSA the adsorption cycle is shorter, since the adsorption capacity of the bed is not used up. However, this process does not require hot regeneration gas since it allows using for regeneration the heat produced during adsorption (paragraphs 4-6, 34 and 35).

It is known that both processes suffer from disadvantages. In TSA the main disadvantage consists in extra energy costs whereas the shorter cycle times in PSA bring about an increased loss of feed gas (document D3, column 2, lines 18 to 38, document 5A, page 2, line 11 to page 3, line 3).

A modification of the classical TSA/PSA processes is the temperature enhanced pressure swing absorption (TEPSA) process disclosed in document D3 wherein similar as in TSA a heated regeneration gas is used to

desorb the less strongly adsorbed components, whereas the more strongly adsorbed components are desorbed by reflecting back the heat of adsorption as in PSA. The advantages of the TEP SA process consist essentially in that the regeneration temperature is lower than in TSA and the cycle time is longer than in PSA (paragraphs 8, 9 and 32 of the patent, document D5A, page 2, line 11 to page 4, line 3 and page 5, lines 5 to 16).

According to the patent in suit, these processes are usually carried out in an apparatus comprising a heater for the regeneration gas which is provided at a location downstream of the manifold to a source of regenerating gas so that it serves to provide heated gas to either of the two adsorber vessels (paragraphs 10 and 11).

In an alternative arrangement, a heater is provided inside each of the adsorber vessels upstream of or within the adsorbent (paragraph 12).

3. According to the patent it had been found that the disadvantages of the arrangement comprising one common heater for both adsorber vessels consist in that it takes time for the heated gas to reach and heat the adsorbent in the beds and, in particular, to warm up the intervening pipe and valve work before the full temperature of the gas reaches the adsorbent. The alternative arrangement with heaters within the adsorber vessels gives rise to difficulties in access to the heaters and the adsorbents in the vessels and difficulty due to lack of mixing and maldistribution of heat (paragraphs 13 and 14).

Hence, while not expressly stated, the technical problem underlying the patent in suit consists in providing a process which overcomes these disadvantages.

As a solution to this technical problem, it is suggested to conduct the process in an arrangement where the heater is contained in the inlet nozzle of the inlet for regenerating gas and does not penetrate into the body of adsorbent (paragraph 16 and Claim 1).

4. Both parties considered document D3 as the closest prior art. The Board agrees since this document relates to a TEPESA process for removing contaminating gas components from a gas stream, in particular for removing water and carbon dioxide from air prior to cryogenic distillation (column 1, lines 6 to 9 and column 3, lines 17 to 67).

Document D3 discloses a TEPESA process for removal of at least two components from a feed gas stream, specifically of water and carbon dioxide from air as a necessary precondition to the separation of air into oxygen and nitrogen in a cryogenic air separation unit. The TEPESA process is conducted in an apparatus having one single heater downstream of the manifold used for supplying regenerating gas (column 3, lines 16 to 67, Figure 1 and corresponding description).

5. The claimed process differs from that disclosed in document D3 in that it is conducted in an apparatus where the heater is contained in the inlet nozzle of the inlet for regeneration gas.

The Board notes that more than one heater is required if the usual arrangement for the TEPESA process comprising at least two adsorber vessels connected in parallel is used (paragraphs 10, 35 to 38 and Figure 2 of the patent).

6. It is immediately plausible that the claimed process does not show the disadvantages of an arrangement with one single heater located downstream of the manifold as in document D3, hence at a distance from the adsorber vessels. Therefore, the technical problem derivable from the patent in suit (point 3 above), namely to shorten the period of time needed to provide in the adsorption bed regeneration gas at its full temperature, is credibly solved by the claimed process when compared with that of document D3. Further, the Board agrees with the Respondent that the technical effect of shortening the time of arrival of the heat pulse in the TEPESA process consists in that the efficiency of the regeneration step is increased.
7. 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 this technical problem by providing the heater in the inlet nozzle of the adsorber vessel for regeneration gas instead of at a location beyond the manifold for supplying the regeneration gas.
8. The Board agrees with the Respondent that neither document D3 nor any other cited prior art mentions that the time needed to provide in the adsorption bed regeneration gas at its full temperature might be a problem needing to be solved.

However, a prior art document cannot be expected to indicate its own deficiencies, in particular if one considers that improvement, e.g. of the efficiency, is an elementary problem existing throughout all technical fields, hence also in the field of gas separation. The absence of a hint in the prior art that there might still be a desire for further improvement does not mean that an unrecognized problem has been discovered (see Case Law of the Boards of Appeal, 6th edition 2010, chapter I.D.8.10). It is, therefore, irrelevant that document D3 does not identify its process as less than optimal.

On the other hand, document D2 discloses a TSA process which clearly does not have the disadvantages inherent in the arrangement of document D3, since each adsorber vessel comprises a heater element located in the inlet nozzle for regeneration gas (see Figure 3).

9. The Respondent argued that a skilled person would not have considered combining documents D3 and D2 since they related to different technical fields and even if they were combined, this would not make the invention obvious.

This was due to the fact that the process of document D2 was intended to provide hot dry air to be used for drying plastic material, whereas document D3 related to the pre-purification of air in advance to cryogenic distillation.

Hence, in document D2 where only water was separated from air, loss of heat was a concern since the product

has to be hot. Further, the two heaters were required for the purpose to heat both, the dried air from the first bed and the regeneration gas supplied to the second bed at the same time.

In contrast, in the process of document D3 not only water had to be removed but also carbon dioxide. In this process loss of heat was not a problem since it was not desirable that the product gas of this process is hot.

Therefore, the skilled person had no motivation to consider document D2 in order to improve the process of document D3. Rather, the increased number of heaters in document D2 would discourage a skilled person to use this arrangement in the process of document D3.

10. The Respondent's arguments are not convincing.

Firstly, documents D2 and D3 are in the same technical field insofar as they both concern gas separation by adsorption on a solid adsorbent with periodic regeneration of the adsorbent (document D3, column 1, lines 7 to 11 and Document D2, abstract).

The Board agrees with the Respondent that the disclosures of these documents differ from each other insofar as the process of documents D3 is a TEPESA process and carried out so as to remove water and carbon dioxide in order to produce a gas suitable for cryogenic separation (column 3, lines 16 to 67), whereas the process of document D2 is a TSA process and carried out so as to remove only water. After separation the demoinsturised air has to be heated in

document D2 in order to produce heated drying air (e.g. Figure 3 and abstract).

However, it is known from documents D5A and D3 that both, the TSA and TEP SA process are suitable for removal of water and carbon dioxide from air, hence for the pre-purification of air, prior to cryogenic separation (document D5A, page 1, line 1 to page 2, line 10; document D3, column 2, lines 10 to 16 and column 3, lines 52 to 57; see also paragraphs 1, 3, 6 and 8 of the patent).

Hence, a skilled person has no reason to disregard document D2 simply because its aim is to produce a purified gas suitable for another purpose than that of document D3. The fact that in document D2 a second heater was required since the separated dry air has to be heated in order to make it suitable for drying a synthetic material is not really correlated with the separation and regeneration process.

To the contrary, bearing in mind that this same heater is also used to heat the regeneration gas during the regeneration cycle (e.g. Figure 3 and corresponding description) and further that the arrangement of an own heater in each adsorber vessel was known in the art as an alternative to an arrangement with one heater downstream the manifold as in document D3 (columns 11 and 12 of the patent), the Board concludes that a skilled person seeking to improve the process of document D3 had ample reasons to consider document D2.

In the present case, it is already apparent from the prior art acknowledged in the patent in suit that the

provision of one heater in both adsorber vessels would not have the disadvantage of a delayed heat pulse. The same is true for document D2 where the heater elements are arranged within the inlet nozzle for regeneration gas.

This arrangement is thus one option which a skilled person would consider in order to improve the process of document D3 with respect to the arrival of the heat pulse within the adsorption bed.

The final argument of the Respondent that the increased number of heaters in document D2 would discourage a skilled person to use this arrangement in the process of document D3 is irrelevant in the present case since any disadvantages related to that are accepted in the patent too.

11. The Board concludes, therefore, that for the purpose of improving the process of document D3 with respect to the arrival of the heat pulse and thus the efficiency of the regeneration step, someone skilled in the art would have considered arranging one heater in each inlet nozzle for regeneration gas as suggested in the arrangement for gas separation disclosed in document D2.
12. For these reasons, the Board finds that the subject-matter of Claim 1 of the request maintained by the Opposition Division does not comply with the requirements of Articles 52(1) and 56 EPC.

Order

For these reasons it is decided that:

1. The decision under appeal is set aside.
2. The patent is revoked.

The Registrar:

The Chairman:

D. Magliano

P.-P. Bracke