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D E C I S I O N
of 6 September 2002

Case Number: T 0124/99 - 3.3.5

Application Number: 93310393.9

Publication Number: 0604198

IPC: B01D 53/36

Language of the proceedings: EN

Title of invention:
Method for treating ammonia

Applicant:
MITSUBISHI JUKOGYO KABUSHIKI KAISHA

Headword:

-

Relevant legal provisions:
EPC Art. 123(2), 52(1), 56

Keyword:
"Amendments - explanatory"
"Inventive steps (yes): would/could approach - non-obvious
combination of known features"

Decisions cited:

-

Catchword:

-



Case Number: T 0124/99 - 3.3.5

D E C I S I O N
of the Technical Board of Appeal 3.3.5
of 6 September 2002

Appellant: MITSUBISHI JUKOGYO KABUSHIKI KAISHA
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Representative: Ackroyd, Robert
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Decision under appeal: Decision of the Examining Division of the
European Patent Office posted 19 August 1998
refusing European patent application
No. 93 310 393.9 pursuant to Article 97(1) EPC.

Composition of the Board:

Chairman: R. K. Spangenberg
Members: A. T. Liu
J. H. van Moer

Summary of Facts and Submissions

- I. The appeal is from the decision of the examining division refusing the European patent application No. 93 310 393.9.
- II. The decision was based on a set of claims 1 to 5 as filed by letter of 3 July 1998.
- III. The examining division held that the subject-matter of claim 1 did not involve an inventive step. Reference was made to the following documents in the course of the examining proceedings:
- D1 JP-A-57 190 640 (abstract)
 - D2 JP-A-50 026 797 (abstract)
 - D3 JP-A-02 241 515 (abstract)
 - D4 JP-A-55 023 069 (abstract)
 - D5 JP-A-53 125 962 (abstract)
- IV. With the statement of the grounds of appeal, the appellant submitted that the examining division's finding on inventive step was incorrect.
- V. With the communication annexed to the summons to attend oral proceedings, the Board introduced a new document into the proceedings:
- D6 JP-32-38 019 (abstract)
- VI. By letter of reply dated 8 August 2002, the appellant contested the relevance of document D6.
- VII. By communication of 3 September 2002, the appellant was notified that the two following documents which were

cited in the search report would be discussed at the oral proceedings:

D7 EP-A-0 290 947

D8 EP-A-0 261 610

VIII. At the oral proceedings which took place on 6 September 2002, the appellant filed a newly amended claim 1 which read as follows:

"A method of reducing the level of or removing ammonia from the exhaust gas of a dry denitration process which takes place in a denitration zone and which uses ammonia at an elevated temperature as a reducing agent, comprising

contacting the ammonia-containing exhaust gas at a temperature of 200°C or less in an adsorption zone with an ammonia-adsorbent material whereby to adsorb ammonia in/on the adsorbent material,

desorbing the adsorbed ammonia from the ammonia-adsorbent material at a temperature of at least 300°C, whereby to release the ammonia from the adsorbent material, and

decomposing the released ammonia by contact thereof with an ammonia-decomposition catalyst in a decomposition zone separate from the denitration and adsorption zones."

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

- D1 related to a recirculatory method with drawbacks as discussed in the description.
- D2 and D5 were not relevant to the subject-matter of claim 1. Moreover, an arbitrary combination of

D1 with either of D2 or D5 would not lead to the process as claimed.

- The advantage of the process of claim 1 as compared to the process of D7 was that the volume of catalyst required for the ammonia decomposition was reduced. The volume problem was not perceived, let alone solved in the prior art.

X. The appellant's request was that the decision under appeal be set aside and that a patent be granted on the basis of claims 1 to 5 filed at the oral proceedings.

Reasons for the Decision

1. *Amendments*

1.1 Claim 1 is essentially based on claim 1 as originally filed, with the following further stipulations that:

- (i) the dry denitration process "takes place in a denitration zone",
- (ii) the desorption of ammonia is "from the ammonia-adsorbent material, .. whereby to release the ammonia from the adsorbent material", and
- (iii) the decomposition of ammonia is carried out "in a decomposition zone separate from the denitration and adsorption zones".

Features (i) and (ii) are self-explanatory and in accordance with the description of the claimed process on pages 3 and 4 as originally filed. Feature (iii) is

based on the original disclosure of the ammonia decomposition catalyst filling tower being disposed on a desorption ammonia gas line, thus separate from the adsorption-desorption tower (see page 4, lines 3 to 5; lines 21 to 24; page 7, line 24 to page 8, line 10 and Figure 1).

1.2 Except for some clerical corrections, claims 2 to 5 are essentially unchanged with respect to claims 2 to 5 as originally filed. Consequently, the requirements of Article 123(2) EPC are met.

2. *Novelty*

The novelty of the subject-matter of present claim 1 has not been questioned. The reason for this will also be clear from the following discussion on inventive step.

3. *Inventive step*

3.1 Claim 1

Claim 1 is directed to a method of removing excess ammonia from the exhaust gas of a dry denitration process comprising the steps of:

- (i) contacting the exhaust gas at a temperature of 200°C or less with an ammonia-adsorbent material ,
- (ii) desorbing the ammonia from the adsorbent material at a temperature of at least 300°C, and
- (iii) decomposing the released ammonia by contact thereof with an catalyst.

The method of claim 1 is thus a sequential process, in which excess ammonia used in a denitration process is separated from the exhaust gas by adsorption and desorption according to a temperature regime, and catalytically decomposed in the final step.

3.2 Closest prior art document

D7 is directed to a method for removing ammonia from an exhaust gas on the downstream side of a dry denitration device in which the ammonia containing gas is contacted with a catalyst to decompose ammonia (column 1, lines 18 to 28 with column 2, lines 31 to 45). Since this prior art process is in the same technical area as the process of claim 1 and also requires the decomposition of ammonia in the final step, the Board holds that it should be the starting point for inventive step considerations. A similar process is also discussed in the introductory part of the present description as originally filed (page 1, second paragraph) and disclosed in D8 (see abstract, claim 1 and Figure 1).

D1 discloses a process to prevent leakage of excess NH_3 used in a denitration process. For this purpose, the denitrating reactor 19 is connected to a rotary cylinder 2 which is filled with a denitration catalyst and divided by partition plates into an adsorbing zone 13 and a desorbing zone 12. According to the text of the document, "the exhaust gas after denitration is introduced into the adsorbing zone 13 through a conduit 22 and the unreacted NH_3 in the exhaust gas is adsorbed by the catalyst layer". "When an untreated gas is introduced into the desorbing zone 12, it is contacted with the catalyst layer, saturated and adsorbed with

NH₃, moved from the adsorbing zone 13 and NH₃ generates denitrating reaction with an exhaust gas to be desorbed and consumed (sic)". As far as can be understood from the document, NH₃ containing gas is thus supplied to the rotary drum whereupon a further denitration reaction takes place and, once the drum 2 has rotated, the resulting gas is returned via line 21 to the denitrating reactor 19. The Board therefore concurs with the appellant in that D1 is directed to a recirculatory process. For this reason, the Board holds that D1 is less suitable than D7 as the starting point for the evaluation of inventive step (see also point 3.6.3 below).

3.3 Technical problem with regard to D7

The Board accepts the appellant's submission that, with respect to D7, the problem to be solved can be seen in an improvement of that process.

3.4 Solution proposed in claim 1.

In order to solve the above stated technical problem, claim 1 proposes that, prior to the catalytic decomposition of ammonia, the exhaust gas be contacted at a temperature of 200°C or less with an ammonia-adsorbent material, and the ammonia be desorbed at a temperature of at least 300°C for further reaction.

3.5 The applicant has submitted that at the prescribed temperature of at least 300°C, ammonia can be desorbed from the adsorbent with a minimum amount, if any, of a sweeping gas. The amount of gas fed to the catalyst in the ammonia decomposition zone is thus reduced with respect to the initial amount of exhaust gas directly

downstream of the denitration zone. As a result, a smaller amount of catalyst is required in this case, in contrast to the prior art where the exhaust gas is directly contacted with the catalyst. The advantage obtained with the claimed process is discussed in the description and thus supported by the original disclosure (see single Example, in particular page 9, lines 4 to 10). The Board therefore accepts that the present technical problem is solved by the incorporation of ammonia adsorption/desorption steps prior to its decomposition.

3.6 The question that remains to be elucidated is whether the method as claimed is obvious in view of the available prior art.

3.6.1 In D7, the ammonia containing exhaust gas is either directly contacted with a catalyst having a specified composition or it is first passed over a heater in order to reach a temperature within the range of 150° to 300° C which is optimal for the catalytic decomposition of ammonia (column 8, lines 23 to 43 with Figure 1 and column 8, line 53 to column 9, line 22 with Figure 2). Thus, D7 is focussed on the nature of the catalyst and the temperature of the gas to be decomposed. The Board concurs with the appellant in that D7 does not mention that the volume of gas to be contacted with the catalyst poses a problem which should be alleviated. The skilled person, seeking to solve the present technical problem, cannot deduce from D7 that the process disclosed would be improved by reducing the amount of gas to be passed over the catalyst.

3.6.2 **D6** discloses a process for removing ammonia from a

reductive gas by adsorption in a reactor packed with zeolite. The ammonia is then desorbed by using a sweeping gas and changing the temperatures or pressures of the reactor. Although it is stated in D6 that "ammonia ... can be concentrated and recovered" in the process, the prior art does not suggest that the concentration is to avoid a volume problem for a specific downstream purpose. The advantage of incorporating this particular process into the process of D7 would therefore only become evident via hindsight, with knowledge of the present application.

3.6.3 As is indicated earlier, the adsorption and desorption steps are carried out in **D1** in a partitioned rotary drum 2 (see point 3.2 above). The Board therefore concurs with the appellant in that this particular design of the reactor does not lend itself to a process in which the adsorption and desorption steps are to take place at substantially different temperatures as stipulated in present claim 1. Since this temperature regime is essential for an efficient removal of ammonia and the subsequent step of catalytic decomposition, D1 is not appropriate for a combination with D7 to provide a solution to the present technical problem.

3.6.4 Although **D2** also concerns the removal of ammonia from waste gas, this gas mixture is generated from a copy machine and not from a denitration process. It addresses the problem of treating this gas mixture containing low concentrations of ammonia by passing the gas mixture through an adsorbent for ammonia, releasing the ammonia from the adsorbent by heating (at a temperature between 150 and 250°C) and decomposing it by passing it through an oxidizing catalyst. In the absence of any indication of the existence of the same

problem in the field of exhaust gas denitration process, this prior art document does not provide any incentive for the skilled person to apply its teaching to that different feed, let alone to modify the processing parameters for that different purpose (desorption temperature of at least 300°C instead of 150 to 250°C).

The other documents on file are more remote from the application. **D3** concerns a method for enriching oxygen based on an adsorption-desorption rotation system. **D4** discloses a method in which the ammonia is first decomposed and the resulting gas is passed into an adsorption tower "to adsorption-remove undecomposed NH₃ gas and moisture". **D5** relates to the deodorisation of offensive gases. In this process, odour components (such as ammonia) in offensively-odoured gases are adsorbed then desorbed with air at a high (but not further defined) temperature to be catalytically decomposed. The remarks with respect to document D2 apply at least to the same extent to document D5.

4. As a consequence of the above, the Board has come to the conclusion that there are no convincing reasons indicating that the skilled person, starting from D7, not only could, but would, without the benefit of hindsight, have proceeded in the direction claimed. On the basis of the available evidence, it is thus accepted that the subject-matter of claim 1 involves an inventive step. The dependent claims 2 to 5 are directed to preferred embodiments of the process of claim 1. Their subject-matter is also new and involves an inventive step.

Order

For these reasons it is decided that:

The decision under appeal is set aside.

The case is remitted to the first instance with the order to grant a patent with the following documents:

1. claims 1 to 5 filed at the oral proceedings
2. a description to be adapted
3. drawings as originally filed

The Registrar:

The Chairman:

P. Martorana

R. Spangenberg