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**Datasheet for the decision
of 30 April 2024**

Case Number: T 0639/22 - 3.3.05

Application Number: 16788521.9

Publication Number: 3368194

IPC: B01D53/86

Language of the proceedings: EN

Title of invention:

A METHOD AND APPARATUS FOR REMOVING NOX AND N2O FROM A GAS

Patent Proprietor:

Casale SA

Opponent:

thyssenkrupp Industrial Solutions AG

Headword:

REMOVING NOX AND N2O FROM A GAS/Casale

Relevant legal provisions:

RPBA 2020 Art. 12(4)

EPC Art. 56

Keyword:

Inventive step - obvious alternative

Amendment to case - amendment admitted (yes)

Decisions cited:

T 1148/15, T 1564/07, T 0355/97

Catchword:



Beschwerdekammern
Boards of Appeal
Chambres de recours

Boards of Appeal of the
European Patent Office
Richard-Reitzner-Allee 8
85540 Haar
GERMANY
Tel. +49 (0)89 2399-0
Fax +49 (0)89 2399-4465

Case Number: T 0639/22 - 3.3.05

D E C I S I O N
of Technical Board of Appeal 3.3.05
of 30 April 2024

Appellant: Casale SA
(Patent Proprietor) Via Giulio Pocobelli, 6
6900 Lugano (CH)

Representative: M. Zardi & Co S.A.
Via G. B. Pioda, 6
6900 Lugano (CH)

Appellant: thyssenkrupp Industrial Solutions AG
(Opponent) ThyssenKrupp Allee 1
45143 Essen (DE)

Representative: Kutzenberger Wolff & Partner
Waidmarkt 11
50676 Köln (DE)

Decision under appeal: **Interlocutory decision of the Opposition
Division of the European Patent Office posted on
14 January 2022 concerning maintenance of the
European Patent No. 3368194 in amended form.**

Composition of the Board:

Chairwoman S. Besselmann
Members: J. Roider
P. Guntz

Summary of Facts and Submissions

I. The appeals by the patent proprietor (appellant 1) and the opponent (appellant 2) lie from the interlocutory decision of the opposition division to maintain European Patent EP 3 368 194 B1 on the basis of auxiliary request 15.

II. The following documents, which were already cited in the opposition proceedings, are relevant here:

D2 US 2003/0143142 A1
D19 DE 10 2010 022 775 A1

III. The following documents, which were cited in the statement of grounds of appeal, are relevant here:

D42 Suib: New and future developments in catalysis, Elsevier, 2013, pages 170-174, 177-180
D44 Brandenberger et al.: *The State of the Art in Selective Catalytic Reduction of NOx by Ammonia Using Metal-Exchanged Zeolite Catalysts*, Catalysis Reviews, Volume 50, 2008, pages 492-531

IV. Claim 1 of auxiliary request 17 reads as follows (feature numbers indicated on the left):

1 "1. A method for reducing the content of nitrogen oxides NO_x and nitrous oxide N₂O in an input gas (1), comprising the steps of:

- 2 *treating said gas (1) with a first amount of a NOx reducing agent (2) in a first de-NOx catalytic bed (3);*
- 3 *treating the effluent (4) of said first de-NOx catalytic bed (3) in at least one de-N2O catalytic bed (5) for removal of N2O;*
- 4 *treating the effluent (6) of said at least one de-N2O catalytic bed (5) with a second amount of a NOx reducing agent (7) in a second de-NOx catalytic bed (8),*
- 5 *wherein the majority of NOx contained in the input gas are removed in the first de-NOx catalytic bed,*
- 6 *and the residual amount of NOx in the effluent of said catalytic bed is determined as a minimum content which is required for the subsequent treatment over said de-N2O catalytic bed, and*
- 7 *wherein the second amount of NOx reducing agent is determined on the basis of the NOx contained in the gas at the outlet of the first de-NOx catalytic bed or at the outlet of the De-N2O catalytic bed,*
- 8 *wherein said second amount of NOx reducing agent is smaller than the first amount, and*
- 9 *wherein the concentration of NOx in the effluent of the first de-NOx catalytic bed is in the range 50 to 200 ppm, and*
- 10 *the catalyst of the first de-NOx bed is copper exchanged zeolite;*
- 11 *the catalyst of the de-N2O bed is iron exchanged zeolite, and the catalyst of the second de-NOx bed is Vanadium oxide, and*
- 12 *wherein the effluent of the second de-NOx bed has NOx < 25 ppm; N2O < 30 ppm; NH3 < 2 ppm."*

Claim 1 of auxiliary request 14 includes only features 1 to 9.

Claim 1 of auxiliary request 15 corresponds to claim 1 of the patent as maintained by the opposition division and includes features 1 to 10.

Claim 1 of auxiliary request 16 includes features 1 to 11.

Claim 1 of the main request (patent as granted) corresponds to the combination of features 1 to 4. It is identical to claim 1 of auxiliary request 9.

Compared with claim 1 as granted, claim 1 in the other requests (auxiliary requests 1 to 8 and 10 to 13) has been limited on the basis of some or all of features 5 to 12. Claim 1 in auxiliary request 8 is identical to claim 1 in auxiliary request 17.

V. The key arguments of appellant 1 (patent proprietor) can be summarised as follows:

Auxiliary request 14, inventive step, Article 56 EPC
D2 disclosed measures to reduce the emissions by other means than with an additional de-NOx bed. Starting from D2, the skilled person would not consider D19. Moreover, D2 and D19 were incompatible.

Auxiliary request 16, inventive step, Article 56 EPC
The selection of copper-exchanged zeolite had a functional consequence on the downstream catalytic beds. The specific combination of three catalysts was not rendered obvious by the prior art.

Auxiliary request 17, inventive step, Article 56 EPC
No combination of documents suggested feature 12.

Admittance of D42 and D44

These documents should have been filed in the proceedings leading to the decision under appeal.

- VI. The key arguments of appellant 2 (opponent) can be summarised as follows:

Auxiliary request 14, inventive step, Article 56 EPC

The subject-matter of claim 1 did not involve an inventive step starting from D2 in view of D19.

Auxiliary request 16, inventive step, Article 56 EPC

The selection of the catalysts was arbitrary.

Auxiliary request 17, inventive step, Article 56 EPC

Feature 12 corresponded to a result that could be achieved by the skilled person through standard design considerations alone.

Admittance of D42 and D44

D42 and D44 were excerpts from textbooks and should be taken into account as proof of the skilled person's common general knowledge in response to the impugned decision.

- VII. Substantive requests:

- (a) The patent proprietor (appellant 1) requested that the decision under appeal be set aside and the opposition be rejected or, in the alternative, that the patent be maintained on the basis of one of auxiliary requests 1 to 14 filed on 16 September 2021 or that the appeal by the opponent be dismissed or that the patent be maintained on the basis of auxiliary requests 16 or

17 filed on 16 September 2021.

- (b) The opponent (appellant 2) requested that the decision under appeal be set aside and the patent be revoked.

Reasons for the Decision

1. Auxiliary request 14, inventive step, Article 56 EPC

Claim 1 of auxiliary request 14 encompasses features 1 to 9 as outlined above.

- 1.1 Document D2, cited by the opponent, discloses a process, in particular for treating tail gas from nitric acid production (paragraph [0001]), which allows not only high levels of NO_x decomposition but also satisfactory N₂O decomposition (paragraph [0021]). Document D2 is thus a suitable starting point.

- 1.2 The technical problem that the patent in suit aims to solve is to facilitate the control of the addition of ammonia in the second de-NO_x catalytic bed (patent in suit, paragraph [0019]).

- 1.3 It is proposed to solve this technical problem through the method of claim 1, which differs from Example 2 of D2 in features 4, 7 and 8. This was not contested. The features read:

4 *treating the effluent (6) of said at least one de-N₂O catalytic bed (5) with a second amount of a NO_x reducing agent (7) in a second de-NO_x catalytic bed (8),*

7 *and wherein the second amount of NO_x reducing agent*
is determined on the basis of the NO_x contained in
the gas at the outlet of the first de-NO_x catalytic
bed or at the outlet of the de-N₂O catalytic bed,
8 *wherein said second amount of NO_x reducing agent is*
smaller than the first amount,

The effect produced by these differing features is a reduction in the NO_x concentration in the tail gas.

It does not seem, however, that the differing features provide for an easier process control. Example 2 of D2, example 2, discloses an NO_x concentration downstream of the de-NO_x catalytic bed of 200 ppm, which anticipates the range in feature 9 of claim 1 (50-200 ppm). As can be seen from paragraph [0020] of the patent in suit, for the treatment of a tail gas with 200 ppm NO_x in a de-NO_x catalytic bed, only a low degree of precision of the control of the ammonia flow is required.

Hence, the difficulty described in the patent in suit does not arise.

1.4 The technical problem must thus be reformulated as a less ambitious problem, which is in view of the effect provided by the differing features, a method to further reduce the emissions.

If seeking to further reduce emissions, a skilled person would immediately contemplate adding a de-NO_x catalytic bed downstream of the de-N₂O catalytic bed as shown in D19 (e.g. paragraph [0090]; in Figure 3, reference 6), without involving an inventive step, thus arriving at feature 4.

D19 also discloses, in paragraphs [0064] and [0065],

adding the NO_x reducing agent in a sufficient amount to decrease the NO_x concentration in the de-NO_x catalytic bed to the desired level, thus implying feature 7.

It is immediately apparent from Example 2 of D2 that the required amount of NO_x reducing agent is smaller in the downstream de-NO_x catalytic bed than in the upstream de-NO_x catalytic bed, thus implying feature 8.

1.5 The patent proprietor argued that the opposition division inappropriately considered the effect of NO_x reduction in isolation and did not take into account that the patent in suit proposes to remove the NO_x in a first de-NO_x catalytic bed upstream and in a second de-NO_x catalytic bed downstream of the de-N₂O catalytic bed, with the majority of the NO_x being removed in the first bed.

However, it is inherent in Example 2 of D2 that the majority of the NO_x is removed in the first bed. The effect achieved and the technical problem must be formulated by considering only the features distinguishing the claimed subject-matter from prior art (T 1148/15 point 5.1).

1.6 The patent proprietor argued that the skilled person would rather increase the size of the first de-NO_x catalytic bed to further reduce the NO_x content.

However, while it is correct that the conversion in the first de-NO_x catalytic bed may be increased, this is only available to a limited extent, because it compromises the N₂O conversion. According to D2, the provision by the first de-NO_x catalytic bed of a sufficiently high remaining NO_x content is intentional

and it is even essential (paragraphs [0026], [0049] and [0050]). Indeed, reducing the NO_x content upstream of the de- N_2O catalytic bed would lead to the N_2O emissions increasing, because the N_2O decomposition would not have an adequate amount of NO_x to provide for the co-catalytic effect. This measure would go against the teaching of D2.

- 1.7 The patent proprietor argued that D2 and D19 were incompatible. D19 disclosed a two-bed system, in which NO_x was almost entirely left up to the last bed, apart from a possible initial NO_x reduction in the de- N_2O catalytic bed, with the same catalyst which is also used for decomposing the N_2O . Also, the reactors in D19 were arranged in the opposite order to those in D2, because D19 guided the gas first to a de- N_2O catalytic bed.

However, D19 discloses adjusting the $\text{N}_2\text{O}/\text{NO}_x$ -ratio to the value required in the de- N_2O catalytic bed by appropriate means (paragraph [0038]), which can (only) preferably take place in the de- N_2O catalytic bed (paragraph [0039]). The method according to D19 is thus entirely compatible with a separate de- NO_x catalytic bed upstream of the de- N_2O catalytic bed.

In D19, the de- NO_x catalytic bed downstream of the de- N_2O catalytic bed is adapted to treat a gas with an NO_x content similar to that of the gas in D2, Example 2 (see D19, paragraph [0036] and Examples 1a to 3).

The teaching of D2 as well as that of D19 are thus compatible.

1.8 The requirements of Article 56 EPC are not met.

2. Admittance of D42 and D44

D42 and D44 are extracts from textbooks and therefore form part of the skilled person's common general knowledge. They were submitted in response to the impugned decision because the opposition division did not accept the opponent's argument that copper-exchanged zeolite catalysts would be known to a person skilled in the art for use in the technical field of the patent in suit.

It is thus a legitimate response to the decision under appeal.

D42 and D44 are therefore admitted into the proceedings (Article 12(4) RPBA).

3. Auxiliary request 16, inventive step, Article 56 EPC

Claim 1 of auxiliary request 16 includes features 1 to 11 as outlined above.

Example 2 of D2 was again cited as the starting point for an inventive-step objection.

3.1 The technical problem that the patent in suit aims to solve is to facilitate the control of the addition of ammonia in the second de-NO_x catalytic bed (patent in suit, paragraph [0019]).

3.2 It is proposed to solve this technical problem by the method of claim 1, which differs from Example 2 of D2 in features 4, 7, 8, 10 and 11. This was not disputed.

These features read:

- 4 *treating the effluent (6) of said at least one de-N₂O catalytic bed (5) with a second amount of a NO_x reducing agent (7) in a second de-NO_x catalytic bed (8),*
- 7 *and wherein the second amount of NO_x reducing agent is determined on the basis of the NO_x contained in the gas at the outlet of the first de-NO_x catalytic bed or at the outlet of the de-N₂O catalytic bed,*
- 8 *wherein said second amount of NO_x reducing agent is smaller than the first amount,*
- 10 *the catalyst of the first de-NO_x bed is copper exchanged zeolite;*
- 11 *the catalyst of the de-N₂O bed is iron exchanged zeolite, and the catalyst of the second de-NO_x bed is Vanadium oxide.*

3.3 Features 4, 7, 8 relate to the arrangement of the catalytic beds and the operation thereof, while features 10 and 11 relate to the catalysts used for the catalytic beds.

The patent proprietor argued that it was particularly the selection of copper-exchanged zeolite that had a functional consequence on the downstream catalytic beds, but did not thereby set out the details of this alleged impact.

It cannot be seen that features 4, 7, 8 provide a joint effect in combination with features 10 and 11.

The purpose of the use of copper-exchanged zeolite is to remove a substantial amount of NO_x, but not all of it. This effect is also achieved by the V₂O₅-WO₃-TiO₂ catalyst used in Example 2 of D2. It is neither

apparent nor convincing that the use of a copper-exchanged zeolite in the first de-NO_x bed had an impact on the downstream processes that differed from or was in addition to that of the catalyst used in Example 2 of D2. In particular, in Example 2 of D2, the reducing agent (ammonia) added to the first de-NO_x bed is completely converted, and there is no indication of any difficulty in controlling the NH₃ concentration in this bed. It cannot, therefore, be seen how a possibly higher activity for NH₃ oxidation with oxygen of Cu-zeolite catalysts could be seen as desirable in the context of the claimed process, contrary to the patent proprietor's view. The patent proprietor also failed to provide evidence supporting the purported effect - an impact on the downstream beds - relied upon. This cannot therefore be taken into account (T 355/97, catchword).

- 3.4 Features 4, 7, 8 must hence be considered separately from features 10 and 11 when formulating the technical problem.
- 3.5 As the assessment of auxiliary request 14 shows, features 4, 7, 8 do not involve an inventive step.
- 3.6 As far as features 10 and 11 are concerned, it cannot be seen that the specific selection of catalysts for the respective catalytic beds would solve the problem as stated in the patent in suit (see point 3.1 above). or otherwise provide an improvement. The patent in suit merely states in paragraph [0022] that the claimed catalysts are preferred. The example also contains these catalysts but it does not compare the performance of the claimed catalysts with other catalysts. Consequently, an improvement cannot be derived.

3.7 The technical problem must thus be reformulated as a less ambitious problem, which is to provide an alternative method.

3.8 Both Example 2 of D2 (paragraph [0041]) and the embodiment according to Figure 3 of D19 (paragraph [0090]; reference number 3; also paragraph [0044] and claim 9) already use an iron-exchanged zeolite for the de-N₂O catalytic bed.

The use of a vanadium oxide-based catalyst for the de-NO_x catalytic bed of D19 is particularly preferred (paragraph [0069]; claim 11). Consequently, it will be considered by the skilled person when adding the second de-NO_x bed and faced with the task of providing an alternative.

Faced with the problem of providing an alternative, the skilled person would also consider using a copper-exchanged zeolite catalyst for the first de-NO_x catalytic bed, instead of the V₂O₅-WO₃/TiO₂ exemplified in D2. The choice of the de-NO_x catalyst is not an essential feature of the process of D2 and is not limited in any way. In the examples of D2, it is merely presented as "*a conventional SCR catalyst*".

As indicated in D19 (paragraph [0069] mentioning "klassische DeNOx-Katalysatoren", i.e. classical de-NO_x catalysts) and as shown in D42 (section 7.3.2.5) and D44 (page 516), copper-exchanged zeolites are generally known to be active as de-NO_x catalysts. It was under discussion whether the skilled person would consider using them in the context of the claimed method due to concerns concerning hydrothermal stability.

It is acknowledged that D42 (section 7.3.2.5) and D44

(page 516) refer to the poor hydrothermal stability of these catalysts. D2 also mentions (in relation to de-N₂O) that copper-exchanged zeolite catalysts are highly sensitive to water vapour (paragraph [0013]).

However, the subject-matter of claim 1 does not contain any measure which could address this concern although D2 and D19 relate to the same application as the patent in suit. In fact, the patent in suit as a whole is silent in this regard. The first de-NO_x catalytic bed is therefore exposed to the same physio-chemical stress in all three processes.

Thus, at the time of filing of the patent in suit, the state of the art copper-exchanged zeolite catalysts were likely to have overcome this disadvantage, in line with the explicit reference in D42 to *recent progress in the formulation of Cu-zeolite based catalysts* (section 7.3.2.5, last sentence of the first paragraph), showing that technical development was ongoing.

The skilled person would thus consider using copper-exchanged zeolite for the de-NO_x catalytic bed of document D2, Example 2 (paragraph [0039]).

Even if hydrothermal stability was still an issue, this would mean that the patent in suit merely accepted that known disadvantage and the subject-matter of claim 1 does not involve an inventive step (T 1564/07, reasons 3.3).

3.9 Thus, the requirements of Article 56 EPC are not met.

4. Auxiliary request 17, inventive step, Article 56 EPC

Claim 1 of auxiliary request 17 includes the features 1 to 12 as outlined above. Feature 12 requires that the treated tail gas must comply with the claimed specifications.

Features 1 to 11 do not guarantee, however, that these limits are met since they also depend on other process parameters not specified in claim 1, as is also apparent from the example of the patent in suit. It thus defines the subject-matter in terms of a result to be achieved.

The patent in suit does not disclose any difficulties in obtaining the claimed specifications of the treated tail gas with the method which is rendered obvious by D2, in view of D19, i.e., features 1-11 (see auxiliary request 16).

Emission limits are determined by environmental regulations, which may become increasingly stringent, as acknowledged also in the patent in suit (paragraphs [0003] and [0010]).

The claimed low emissions are obviously desirable, depending on the specificity of the environmental regulations.

The skilled person would therefore also seek to obtain the low emissions according to claim 17, with the non-inventive method according to auxiliary request 16, without involving an inventive step.

The requirements of Article 56 EPC are not met.

5. Claim 1 in the main request and in auxiliary requests 1 to 13 and 15 is broader than claim 1 of auxiliary

request 17, or identical to it (auxiliary request 8). There is consequently no need to address these requests separately. The same conclusion of lack of inventive step applies.

Order

For these reasons it is decided that:

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

The Registrar:

The Chairwoman:



C. Vodz

S. Besselmann

Decision electronically authenticated