PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

To:

see form PCT/ISA/220

PCT

WRITTEN OPINION OF THE INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43*bis*.1)

Date of mailing
(day/month/year) see form PCT/ISA/210 (second sheet)

Applicant's or agent's file reference
see form PCT/ISA/220

FOR FURTHER ACTION
See paragraph 2 below

International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP2017/074368	26.09.2017	28.10.2016

International Patent Classification (IPC) or both national classification and IPC
INV. B01D53/86

Applicant
CASALE SA

1. This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step and industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the international application
- ☒ Box No. VIII Certain observations on the international application

2. **FURTHER ACTION**

If a demand for international preliminary examination is made, this opinion will usually be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notifed the International Bureau under Rule 66.1*bis*(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

Name and mailing address of the ISA:	Date of completion of this opinion	Authorized Officer
European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Fax: +49 89 2399 - 4465	see form PCT/ISA/210	Pöhlmann, Robert Telephone No. +49 89 2399-0

Box No. I Basis of the opinion

1. With regard to the **language**, this opinion has been established on the basis of:

   ☒ the international application in the language in which it was filed.

   ☐ a translation of the international application into , which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1 (b)).

2. ☐ This opinion has been established taking into account the **rectification of an obvious mistake** authorized by or notified to this Authority under Rule 91 (Rule 43*bis*.1(a))

3. ☐ With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, this opinion has been established on the basis of a sequence listing:

   a. ☐ forming part of the international application as filed:

      ☐ in the form of an Annex C/ST.25 text file.

      ☐ on paper or in the form of an image file.

   b. ☐ furnished together with the international application under PCT Rule 13*ter*.1(a) for the purposes of international search only in the form of an Annex C/ST.25 text file.

   c. ☐ furnished subsequent to the international filing date for the purposes of international search only:

      ☐ in the form of an Annex C/ST.25 text file (Rule 13*ter*.1(a)).

      ☐ on paper or in the form of an image file (Rule 13*ter*.1(b) and Administrative Instructions, Section 713).

4. ☐ In addition, in the case that more than one version or copy of a sequence listing has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that forming part of the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

5. Additional comments:

Box No. V Reasoned statement under Rule 43*bis*.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	4, 8, 9
	No:	Claims	1-3, 5-7, 10-12
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-12
Industrial applicability (IA)	Yes:	Claims	1-12
	No:	Claims	

2. Citations and explanations

see separate sheet

Box No. VII Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

D1 US 2014/363359 A1 (SCHWEFER MEINHARD [DE] ET AL) 11 December 2014 (2014-12-11)

D2 US 4 571 329 A (KATO YASUYOSHI [JP] ET AL) 18 February 1986 (1986-02-18)

D3 US 2002/039550 A1 (SCHAFER-SINDLINGER ADOLF [DE] ET AL) 4 April 2002 (2002-04-04)

D4 US 2008/044331 A1 (SCHWEFER MEINHARD [DE] ET AL) 21 February 2008 (2008-02-21)

D5 US 2003/143141 A1 (SCHWEFER MEINHARD [DE] ET AL) 31 July 2003 (2003-07-31)

2 The present application does not meet the criteria of Article 33(2) PCT, because the subject-matter of claim 1 is not new.

2.1 D1 discloses a method for removing nitrogen oxides NOx from a gaseous current (see §0002), comprising the steps of:

passing the gaseous current through a de-NOx catalytic bed comprising a catalyst which is iron exchanged zeolite (see §0128 and 0129), with the addition of ammonia as a reducing agent (see §0102 and 0131),

wherein the molar ratio of NH3 over NOx in the gas admitted to said de-NOx catalytic bed is greater than 1.33 (see §0102 where at least 1.8 is disclosed).

Hence, D1 discloses all the features of claim 1. The subject-matter thereof is therefore not novel, Art. 33(2) PCT.

2.2 Also D2 discloses all the features of claim 1, see claims 1 plus 2, Art. 33(2) PCT.

2.3 Also D3 discloses all the features of claim 1, see fig. 1, claims 1-5 and §0035-0037, Art. 33(2) PCT.

3 The present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 does not involve an inventive step in the sense of Article 33(3) PCT.

3.1 D4 as closest prior art

3.1.1 D4 could be considered as the prior art closest to the subject-matter of claim 1 and discloses a method for removing nitrogen oxides NOx from a gaseous current (see §0001 and 0002), comprising the steps of:

passing the gaseous current through a de-NOx catalytic bed comprising a catalyst which is iron exchanged zeolite (see claim 16 and §0066, 0067), with the addition of ammonia as a reducing agent (see claim 16a),

wherein the molar ratio of NH3 over NOx in the gas admitted to said de-NOx catalytic bed is 1.33 (see claim 16a) and §0074).

3.1.2 The subject-matter of claim 1 therefore differs from this known D1 in that the molar ratio of NH3 over NOx in the gas admitted to said de-NOx catalytic bed is **greater than** 1.33.

3.1.3 The technical effect resulting from this difference is considered to be a higher NOx conversion in the gas to be treated.

3.1.4 The problem to be solved by the present invention may therefore be regarded as how to modify the method of D4 in order to increase the conversion of NOx in the gas to be treated.

3.1.5 The solution proposed in claim 1 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT) for the following reasons:

In view of D4 alone, it is considered that the skilled person would at least contemplate to slightly increase the ratio of 1.33 or the ratio may be increased by chance slightly over 1.33. As D4 discloses this exact value of 1.33 and claim 1 is directed to a ratio of greater than 1.33, meaning the exact value of 1.33 is excluded, a method acc. to D4 with a ratio of 1.331 would inevitably fall under the scope of claim 1. Hence, the distinguishing feature does not justify an inventive step, as the effect apparent at a ratio 1.331 is equally present at 1.33 without any substantial difference, Art. 33(3) PCT.

Furthermore, D1 and D2 hint the skilled person to apply molar NH3 to NOx ratios above 1.33 for the better conversion of NOx without having ammonia slippage, see D1, §0102 and 0131 and D2, col. 5, lines 57-63. Hence, by

applying e.g. a ratio of 1.6 acc. to D2 or 1.8 acc. to D1 in the method of D4, the skilled person would arrive at the subject-matter of claim 1 without being inventive, Art. 33(3) PCT.

3.2 D5 as closest prior art

3.2.1 Also D5 could be considered as the prior art closest to the subject-matter of claim 1 and discloses a method for removing nitrogen oxides NOx from a gaseous current (see §0001), comprising the steps of:

passing the gaseous current through a de-NOx catalytic bed comprising a catalyst which is iron exchanged zeolite, with the addition of ammonia as a reducing agent (see fig. 1 and §0042-0046).

3.2.2 The subject-matter of claim 1 therefore differs from this known D1 in that the molar ratio of NH3 over NOx in the gas admitted to said de-NOx catalytic bed is greater than 1.33.

3.2.3 The technical effect resulting from this difference is considered to be a higher NOx conversion in the gas to be treated.

3.2.4 The problem to be solved by the present invention may therefore be regarded as how to modify the method of D4 in order to increase the conversion of NOx in the gas to be treated.

3.2.5 The solution proposed in claim 1 of the present application cannot be considered to involve an inventive step (Article 33(3) PCT) for the following reasons:

D5 does not specify specific ratios of NH3 to NOx but only talks about "adequate proportion" (see e.g. claim 8 and §0019).

When looking for appropriate amounts, the skilled person finds in D1 and D2 the teaching to apply molar NH3 to NOx ratios above 1.33 for the better conversion of NOx without having ammonia slippage, see D1, §0102 and 0131 and D2, col. 5, lines 57-63. Hence, by applying e.g. a ratio of 1.6 acc. to D2 or 1.8 acc. to D1 in the method of D5, the skilled person would arrive at the subject-matter of claim 1 without being inventive, Art. 33(3) PCT.

4 Dependent claims 2-12 do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of the PCT in respect of novelty and/or inventive step.

4.1 Claims 2 and 3: The additional features are disclosed by D1-D3, see passages above, Art. 33(2) PCT, and furthermore obvious in view of D4 and D5, see points 3.1 and 3.2 above, Art. 33(3) PCT.

4.2 Claim 4: D5 discloses a NOx amount of 78 ppm, see table in §0049. In any case, the claimed values are only a result of external requirements and design options and not of a surprising or unexpected technical effect. For example, D1 discloses in §0110 several NOx ppm-levels which should be achieved by the method. By applying the teaching of D1 and D2 to D5 the NOx amount will also further decrease to lower ppm-levels. The additional features do hence not justify an inventive step, Art. 33(3) PCT.

4.3 Claim 5: D1 discloses in §0106 a temperature of 400°C in the deNOx catalyst. D2 discloses in example 10 in col. 8 a reaction temperature of 450°C. D4 discloses in table 1 in §0073 reaction temperature of 400 and 425 °C. D5 discloses in §0043 a reaction temperature to be <450°C and in particular 400°C in §0049. Hence, the subject-matter of claim 5 is neither new, Art. 33(2) PCT, nor does it involve an inventive step, Art. 33(3) PCT.

4.4 Claims 6 and 7: the additional features are disclosed in D1 and D3-D5 and obvious in view of D2, see passages above. Hence, the subject-matter of claims 6 and 7 is neither new, Art. 33(2) PCT, nor does it involve an inventive step, Art. 33(3) PCT.

4.5 Claims 8 and 9: the space velocity and the feed gas pressure are only a result of either design optimization which the skilled person would carry out during every process design or external circumstances, e.g. at which pressure the feed gas is available. Furthermore, D4 (see §0069) and D5 (see §0048) disclose a space velocity of 10.000 h^{-1}. The additional features do hence not justify an inventive step, Art. 33(3) PCT.

4.6 Claim 10: D1 and D2 disclose the gas to be treated to be the offgas of a nitric acid plant (see passages above). It is considered that the gas is withdrawn from the absorption column thereof. Hence, the subject-matter is not new, Art. 33(2) PCT. Also D4 (see §0064) and D5 (see §0001) disclose this feature for which reason the subject-matter of claim 10 does not involve an inventive step either, Art. 33(3) PCT.

4.7 Claim 11: D2 (see fig. 5 and 6), D3 (see fig. 1) and D5 (see fig. 1) disclose a catalytic bed upstream of the bed acc. to claim 1. It is considered that at least some NOx present in the gas are converted therein. Hence, the subject-matter of claim 11 is neither new, Art. 33(2) PCT, nor does it involve an inventive step, Art. 33(3) PCT.

4.8 Claim 12: D2 discloses in fig. 4 only one catalytic bed. Hence, the subject-matter of claim 12 is not new, Art. 33(2) PCT. Also D4 discloses the conversion of NOx and N2O in only one catalytic bed, see claim 16. The subject-matter of claim 1 does therefore also not involve an inventive step, Art. 33(3) PCT.

Re Item VII

Certain defects in the international application

5 Formal Points

The requirements of Rule 6.3(b) PCT (two-part form of independent claims) and Rule 5.1(a)(ii) and (ii) PCT (acknowledgement of prior art D1-D5) are not met.

Re Item VIII

Certain observations on the international application

6 Clarity - Art. 6 PCT

6.1 Claims 11 and 12

6.1.1 It is not clear from claims 11 and 12, Art. 6 PCT, what has to be understood by the feature of the absence of a "deN2O catalytic bed". The claims define that such a bed should not be present. However, it is considered that if N2O is present in the gas (as for example in an exhaust of a nitric acid plant) it will be catalyzed in at least one of the beds of claims 11 or 12 if operated at temperatures between 400 and 450°C as claimed in claim 5 for example. The feature "deN2O catalytic bed" has to be defined in terms of structural features of the bed, e.g. the type of catalyst which should not be present.

6.1.2 Claim 12 provokes an inconsistency with claims 10 and 11, Art. 6 PCT. The gas to be treated cannot be withdrawn from an absorption column of a nitric acid plant and at the same time be a flue gas of a combustion process (claim 10). Also, claim 12 excludes any other deNOx or deN2O catalytic beds whereas claim 11 defines another deNOx catalytic bed to be present.