

PATENT COOPERATION TREATY

From the
INTERNATIONAL SEARCHING AUTHORITY

PCT

WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

To: LETT'S, Nathan, P. Olive Law Group, PLLC 125 Edinburgh South Dr., Suite 220 Cary, North Carolina 27511 USA

Date of mailing (day/month/year) 18 December 2018 (18.12.2018)
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Applicant's or agent's file reference 121-53-PCT	FOR FURTHER ACTION See paragraph 2 below
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International application No. PCT/US2018/044781	International filing date (day/month/year) 01 August 2018 (01.08.2018)	Priority date(day/month/year) 01 August 2017 (01.08.2017)
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International Patent Classification (IPC) or both national classification and IPC B01J 20/06(2006.01)i, B01J 20/02(2006.01)i, B01J 20/28(2006.01)i, B01J 35/00(2006.01)i, B01D 53/02(2006.01)i
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Applicant RESEARCH TRIANGLE INSTITUTE

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 43bis.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 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 notified the International Bureau under Rule 66.1bis(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/KR International Application Division Korean Intellectual Property Office 189 Cheongsa-ro, Seo-gu, Daejeon, 35208, Republic of Korea Facsimile No. +82-42-481-8578	Date of completion of this opinion 18 December 2018 (18.12.2018)	Authorized officer NAM, EUI HO Telephone No. +82-42-481-5580
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**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.
PCT/US2018/044781

Box No. I Basis of this 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*. I(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*. I(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*. I(a)).
 - on paper or in the form of an image file (Rule 13*ter*. I(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:

WRITTEN OPINION OF THE
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Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non obvious), or to be industrially applicable have not been examined in respect of:

the entire international application

claims Nos. 9-30

because:

the said international application, or the said claims Nos. _____
relate to the following subject matter which does not require an international search (*specify*):

the description, claims or drawings (*indicate particular elements below*) or said claims Nos. 14-16,19,21,25,26,30
are so unclear that no meaningful opinion could be formed (*specify*):

Claims 14-16, 19, 21, 25, 26 and 30 each refer to one of claims which are not drafted in accordance with PCT Rule 6.4(a).

the claims, or said claims Nos. _____ are so inadequately supported
by the description that no meaningful opinion could be formed (*specify*):

no international search report has been established for said claims Nos. 9-30

a meaningful opinion could not be formed without the sequence listing; the applicant did not, within the prescribed time limit:

furnish a sequence listing in the form of an Annex C/ST.25 text file, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

furnish a sequence listing on paper or in the form of an image file complying with the standard provided for in Annex C of the Administrative Instructions, and such listing was not available to the International Searching Authority in the form and manner acceptable to it; or the sequence listing furnished did not comply with the standard provided for in Annex C of the Administrative Instructions.

pay the required late furnishing fee for the furnishing of a sequence listing in response to an invitation under Rule 13ter.1(a) or (b).

See Supplemental Box for further details.

**WRITTEN OPINION OF THE
INTERNATIONAL SEARCHING AUTHORITY**

International application No.

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

1. Statement

Novelty (N)	Claims	<u>1-8</u>	YES
	Claims	<u>NONE</u>	NO
Inventive step (IS)	Claims	<u>NONE</u>	YES
	Claims	<u>1-8</u>	NO
Industrial applicability (IA)	Claims	<u>1-8</u>	YES
	Claims	<u>NONE</u>	NO

2. Citations and explanations :

Reference is made to the following documents:

D1: US 6951635 B2 (GANGWAL, SANTOSH KUMAR et al.) 04 October 2005

D2: SASAOKA, EIJI et al., "Stability of zinc oxide high-temperature desulfurization sorbents for reduction", Energy & Fuels, 1994, vol.8, pp.763-769

[Note]

This Written Opinion has been established on the assumption that "the residual sodium level" of claim 1 is "a residual sodium level" and "the mixing and combining step" of claim 6 is "the combining step".

1. Novelty and Inventive Step

1.1. Claims 1-8

1.1.1. Claims 1 and 5

D1, which is considered to be the closest prior art to the subject matter of claims 1 and 5, discloses a fluidizable, attrition resistant sorbent for removing reduced sulfur species, particularly H₂S and COS from a feed stream, comprising: substantially spherical particles, said particles comprising at least about 75 wt% of an active zinc component consisting essentially of a zinc oxide phase and a zinc aluminate phase, each of said phases having a crystallite size of less than about 500 Angstroms as determined by x-ray diffraction line broadening analysis, said active zinc component having a total zinc oxide content, calculated based on the combined zinc oxide of said zinc oxide phase and said zinc aluminate phase, of from about 50 wt%, to about 80 wt %, based on the weight of said active zinc component (see paragraph [0002]; and claim 1 in D1).

The subject matter of claims 1 and 5 differ from that of D1 in that a residual sodium level in the solid phase is in the range of between 25 parts per million by weight of sodium and 2500

Continued on Supplemental Box

**WRITTEN OPINION OF THE
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International application No.

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Box No. VII Certain defects in the international application

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

Claims 9-13, 17, 18, 20, 22-24 and 27-29 do not comply with PCT Rule 6.4(a) because multiple dependent claims should not serve as a basis for any other multiple dependent claims.

Supplemental Box

In case the space in any of the preceding boxes is not sufficient.

Continuation of : Box No. V

parts per million by weight of sodium. However, concerning the difference, D2 discloses that when preparing a zinc oxide adsorbent, raw salts comprising $Zn(NO_3)_2$ and $Al(NO_3)_3$ are precipitated with NaOH solution, and an adsorbent prepared using NaOH is more active than that prepared using NH_3 (see page 764 in D2). D1 also discloses washing the precipitate to remove a residual precipitant (see paragraph [0054] in D1), and the difference can be easily optimized by repeated experiments practiced by a person skilled in the art, considering the property of zinc oxide-based sorbent.

Accordingly, it would be obvious for a person skilled in the art to apply the features of D2 to the sorbent of D1, thereby arriving at the technical features of claims 1 and 5. Therefore, claims 1 and 5 do not involve an inventive step under PCT Article 33(3) over the combination of D1 and D2.

1.1.2. Claims 2-4

The additional features of claims 2 and 3 are not explicitly disclosed in D1. However, they can be easily derived by repeated experiments practiced by a person skilled in the art from washing the precipitate to remove the residual precipitant of D1, and no unexpected effect has been achieved compared to D1.

Concerning the additional feature of claim 4, D1 discloses that reduced sulfur species is H_2S (see paragraphs [0002], [0073]-[0075]).

Therefore, claims 2-4 do not involve an inventive step under PCT Article 33(3) over the combination of D1 and D2.

1.1.3. Claim 6

D1, which is considered to be the closest prior art to the subject matter of claim 6, discloses a process for preparing a fluidizable, attrition resistant, active zinc oxide containing sorbent comprising the steps: forming a first slurry by mixing the an aqueous solution of a zinc oxide precursor and aluminum oxide precursor with an aqueous solution of ammonium hydroxide such that a solids content comprises a precipitated zinc oxide precursor and a precipitated aluminum oxide precursor, said zinc oxide precursor and said aluminum oxide precursor being present in an amount, calculated as ZnO , and Al_2O_3 , respectively, such that said zinc oxide precursor constitutes between about 50 wt%, and about 80 wt%, of the total solids content of said zinc oxide precursor and said aluminum oxide precursor in said slurry, and such that the pH of this slurry during the mixing step is controlled at a pH of 6.0 ± 0.2 ; filtering the precipitate from the first slurry; washing the filtered precipitate with deionized water, to remove residual ammonia

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Supplemental Box

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hydroxide, and creating a wet cake; reslurrying the wet cake with deionized water; treating the second slurry with HNO_3 to reduce pH to be between 3.6 and 4.2; spray drying the second slurry to form spray dried particles; and, converting said zinc oxide precursor and said aluminum oxide precursor in said spray dried particles to provide fluidizable, attrition resistant, active zinc oxide containing sorbent particles comprising a two phase component consisting essentially of a zinc oxide phase and a zinc aluminate phase (see paragraph [0054]; and claim 20 in D1).

The subject matter of claim 6 differs from that of D1 in that (1) an aqueous solution of alkali metal hydroxide is used in a forming step and (2) a residual sodium level in the solid phase is in the range of between 25 parts per million by weight of sodium and 2500 parts per million by weight of sodium. However, concerning the difference (1), D2 discloses that when preparing a zinc oxide adsorbent, raw salts comprising $\text{Zn}(\text{NO}_3)_2$ and $\text{Al}(\text{NO}_3)_3$ are precipitated with NaOH solution, and an adsorbent prepared using NaOH is more active than that prepared using NH_3 (see page 764 in D2), and the difference (1) can be easily derived by a person skilled in the art from D2. Concerning the difference (2), D1 discloses washing the precipitate to remove the residual precipitant (see paragraph [0054] in D1), and the difference (2) can be easily optimized by repeated experiments practiced by a person skilled in the art, considering the property of zinc oxide-based sorbent.

Accordingly, it would be obvious for a person skilled in the art to apply the feature of D2 to the process of D1, thereby arriving at the technical feature of claim 6. Therefore, claim 6 does not involve an inventive step under PCT Article 33(3) over the combination of D1 and D2.

1.1.4. Claims 7 and 8

Concerning the additional feature of claim 7, D1 discloses that the spray drying step is conducted under conditions sufficient to provide green spray dried particles having a size range of between 35 μm and 175 μm (see claim 21 in D1).

Concerning the additional feature of claim 8, D1 discloses that the zinc oxide constitutes at least about 58 wt% of the total solids content of said zinc oxide precursor and said aluminum oxide precursor in slurry (see claim 22 in D1).

Therefore, claims 7 and 8 do not involve an inventive step under PCT Article 33(3) over the combination of D1 and D2.

2. Industrial Applicability

Claims 1-8 meet the requirements of industrial applicability under PCT Article 33(4).