(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 June 2024 (20.06.2024)

WIPO | PCT

(10) International Publication Number
WO 2024/129987 A3

(51) International Patent Classification:
C01F 7/02 (2022.01) *C01F 7/441* (2022.01)
B01J 20/28 (2006.01) *B01J 20/08* (2006.01)
B01J 21/04 (2006.01)

(21) International Application Number:
PCT/US2023/084053

(22) International Filing Date:
14 December 2023 (14.12.2023)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
63/432,735 15 December 2022 (15.12.2022) US
63/432,737 15 December 2022 (15.12.2022) US
63/432,739 15 December 2022 (15.12.2022) US

(71) Applicant: **BASF CORPORATION** [US/US]; 100 Park Avenue, Florham Park, NJ 07932 (US).

(72) Inventors: **MOONEY, Dana, Rehms**; 109 Highway 131, Vidalia, LA 71373 (US). **DOLAN, William, B.**; 25 Middlesex Turnpike, Florham Park, NJ 07932 (US).

(74) Agent: **CAMPOLONGO, Michael, J.** et al.; Lowenstein Sandler LLP, One Lowenstein Drive, Roseland, NJ 07068 (US).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CV, CZ, DE, DJ, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IQ, IR, IS, IT, JM, JO, JP, KE, KG, KH, KN, KP, KR, KW, KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, MG, MK, MN, MU, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, WS, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, CV, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SC, SD, SL, ST, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, ME, MK, MT, NL, NO, PL, PT, RO, RS, SE,

(54) Title: LOW SODIUM ACTIVATED ALUMINA MATERIALS

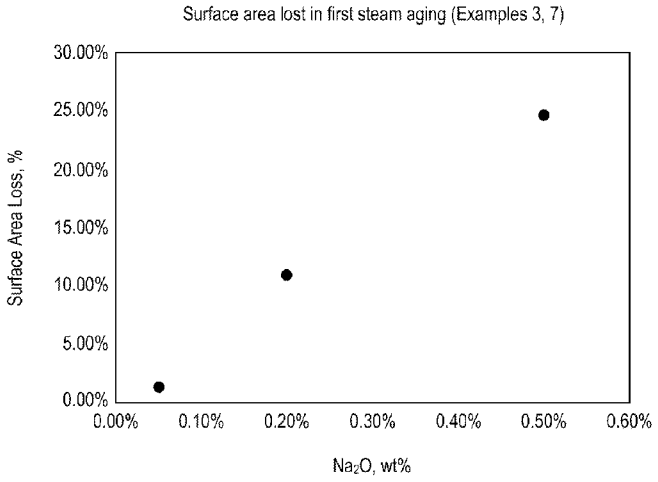


FIG. 1

(57) Abstract: Disclosed in certain embodiments are activated alumina materials having an Na_2O content of no more than about 4000 ppm.

WO 2024/129987 A3

[Continued on next page]

SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

(88) Date of publication of the international search report:
25 July 2024 (25.07.2024)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 23/84053

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. C01F 7/02, B01J 20/08 (2024.01)
ADD. B01J 21/04, C01F 7/441, B01J 20/28 (2024.01)

CPC - INV. C01F 7/02, B01J 20/08
ADD. B01J 21/04, C01F 7/441, C01P 2006/80, B01J 20/28057

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
See Search History document

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
See Search History document

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
See Search History document

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 2020/0030773 A1 (AXENS) 30 January 2020 (30.01.2020); abstract, para [0001], [0012], [0023], [0026]-[0027], [0030]	1-2, 5, 7-8 --- 3-4, 6
Y	US 2021/0213423 A1 (BASF SE) 15 July 2021 (15.07.2021); abstract, para [0022], [0057], claim 23	3-4, 6
A	US 2017/0225144 A1 (IFP Energies nouvelles) 10 August 2017 (10.08.2017); entire document	1-8
A	WO 2013/037054 A1 (ORBITE ALUMINAE INC.) 21 March 2013 (21.03.2013); entire document	1-8
A	Safaei "Effect of phase type in the alumina precursor on the flash calcination synthesis" Boletin de la Sociedad Espanola de Ceramica y Vidrio. 15 May 2021 (15.05.2021) vol 61, pg. 552-560; entire document	1-8

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
16 April 2024	MAY 10 2024
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Kari Rodriquez Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 23/84053

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 9
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
(see supplemental page)

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-8

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

--continued from Box No. III--

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-8, directed to an activated alumina comprising a chi alumina phase.

Group II: Claim 10, directed to an activated alumina having been formed from flash calcined gibbsite.

Group III: Claims 11-18, directed to a method of producing low-soda activated alumina.

The group of inventions listed above do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features:

Group I includes the technical feature of an activated alumina comprising a chi alumina phase, which is not required by any other invention of Group II or III.

Group II includes the technical feature of an activated alumina having been formed from flash calcined gibbsite, which is not required by any other invention of Group I or III.

Group III includes the technical feature of a method of producing low-soda activated alumina, which is not required by any other invention of Group I or II.

Common technical features:

The inventions of Groups I-III share the technical feature of an activated alumina having an Na2O content of no more than about 4000 ppm.

These shared technical features, however, do not provide a contribution over the prior art, as being anticipated by US 2020/0030773 A1 to AXENS (hereinafter Axens). Axens discloses an activated (para [0030]: rapid calcination... treatment in aqueous medium) (heating and treatment of alumina comprises an activated alumina) alumina having an Na2O content of no more than about 4000 ppm (para [0030]: Na2O content of the alumina according to the invention is between 400 and 1500 ppm by weight).

As said compound was known in the art, these cannot be considered special technical features that would otherwise unify the inventions of Groups I-III. The inventions of Group I-III thus lack unity under PCT Rule 13.

Item 4 Cont.: Claim 9 has been found to be unsearchable because it is not drafted in accordance with the second and third sentences of Rule 6.4(a).

Note: Claims 8-9 lacks clarity; claim 8-9 is assumed to be "any one of the preceding claims".