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

(72) Inventors: **LANG DE OLIVEIRA, Armin**; Kurpfalzring 104, 69123 Heidelberg (DE). **REESINK, Bernard**; Strijkviertel 61, 3454 Meern (NL). **HIEBER, Gisela**; Carl-Bosch-Strasse 38, 67056 Ludwigshafen (DE). **MOONEY, Dana Rehms**; 109 Highway 131, Vidalia, LA 71373 (US). **REHMS, Garrett Dylan**; 109 Highway 131, Vidalia, LA

71373 (US). **VITYUK, Artem D.**; 25 Middlesex/Essex Turnpike, Iselin, NJ 08830 (US).

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

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(54) Title: DECHLORINATION OF LIQUID AND GAS STREAMS FROM PLASTICS PYROLYSIS PROCESSES WITH NICKEL-BASED ADSORBENT

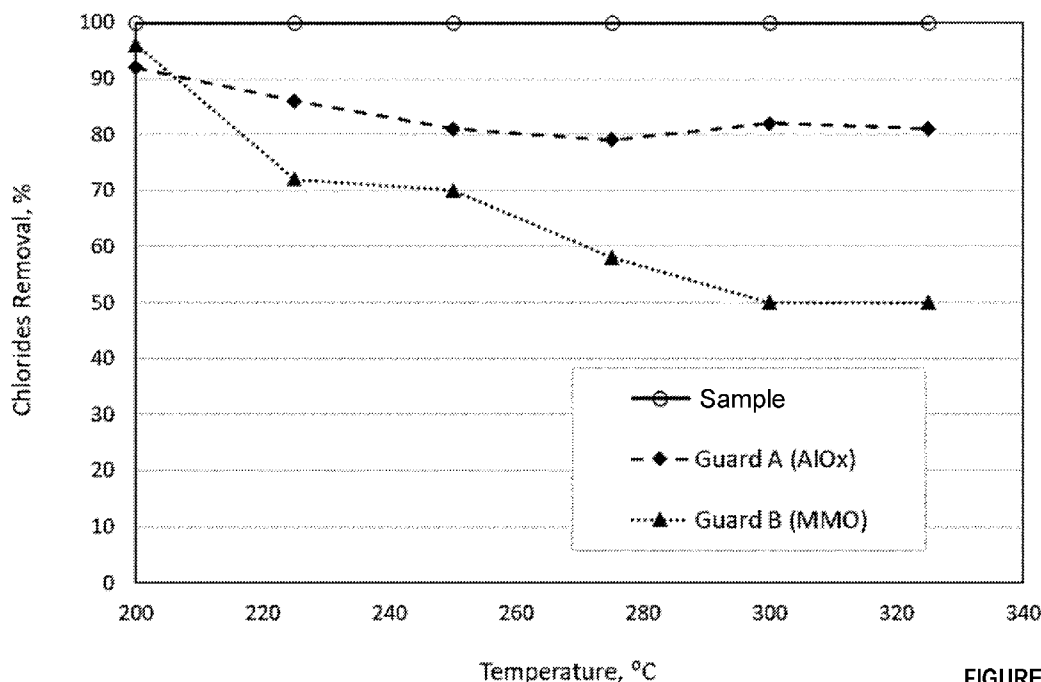


FIGURE 1

(57) Abstract: Described herein are processes and materials for dechlorination of liquid and gas streams. In at least one embodiment, a process comprises a contacting a plastics pyrolysis stream with an alumina adsorbent, the alumina adsorbent comprising precipitated nickel.

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,
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/22245

A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. B01J 20/08, B01J 20/02, B01J 23/755 (2024.01)

ADD. B29B 17/04 (2024.01)

CPC - INV. B01J 20/08, B01J 20/02, B01J 23/755

ADD. B29B 17/04

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	US 2019/0062646 A1 (SABIC GLOBAL TECHNOLOGIES B.V.) 28 February 2019 (28.02.2019) - entire document especially para [0016], [0068], [0044], [0011], [0056] and abstract	1-13
X	US 2020/0362248 A1 (ANELLOTECH, INC.) 19 November 2020 (19.11.2020) - entire document especially para [0120], [0110], [0019], [0020], [0083], [0095], [0096], and abstract	1, 14-17
L	EP 0,835,687 A2 (AIR PRODUCTS AND CHEMICALS, INC.) 15 April 1998 (15.04.1998) - entire document especially page 2	1-17
A	US 2019/0161683 A1 (SABIC GLOBAL TECHNOLOGIES B.V.) 30 May 2019 (30.05.2019) - entire document	1-17
A	US 2013/0012605 A1 (KAIGEN ZHOU) 10 January 2013 (10.01.2013) - entire document	1-17
A	US 2014/0330057 A1 (SHELL OIL COMPANY) 6 November 2014 (06.11.2014) - entire document	1-17
A	US 2020/0017773 A1 (SABIC GLOBAL TECHNOLOGIES B.V.) 16 January 2020 (16.01.2020) - entire document	1-17



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

"I" 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

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Authorized officer

Kari Rodriguez

Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/22245

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.:
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 extra sheet

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.:
1-17

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.

Continuation of Box III (Observations where unity of invention is lacking)

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 1-17 are directed towards a method of removing chlorides from a plastics pyrolysis stream comprising an initial chloride concentration of at least about 10 ppmw, the method comprising: contacting the stream with an alumina adsorbent, the alumina adsorbent comprising precipitated nickel, wherein a final chloride concentration of the treated stream is less than about 10 ppmw.

Group II: Claims 18-20 are directed towards an adsorbent comprising: an alumina adsorbent; and precipitated nickel supported on the alumina adsorbent, wherein the nickel is present from 50-70 wt% based on the total weight of the adsorbent.

The inventions listed as Groups I-II 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 requires a method of removing chlorides from a plastics pyrolysis stream comprising an initial chloride concentration of at least about 10 ppmw, the method comprising: contacting the stream with an alumina adsorbent, the alumina adsorbent comprising precipitated nickel, wherein a final chloride concentration of the treated stream is less than about 10 ppmw, not required by Group II.

Group II requires an adsorbent wherein the nickel is present from 50-70 wt% based on the total weight of the adsorbent, not required by Group I.

Shared Technical Features:

Group I-II share the common technical features of an adsorbent comprising: an alumina adsorbent; and precipitated nickel supported on the alumina adsorbent. However, these shared technical features do not represent a contribution over prior art because the shared technical features are anticipated by US 2019/0062646 A1 to SABIC Global Technologies B.V. (hereinafter "SABIC"). SABIC teaches an adsorbent (para [0068], As examples of this application, hydrodechlorination experiments were carried out using hydrogenation catalysts as described in Table 1; Table 1, Ni/Al₂O₃ catalyst; Abstract, A process for reducing a chloride content of a hydrocarbon feed stream involving contacting a hydrocarbon feed stream comprising a chloride containing pyrolysis oil obtained by cracking a chloride containing thermoplastic material comprising at least one of...Ni...on a catalyst support; see instant specification para [0026], The adsorbents described may utilize a porous support and one or more active metal components supported thereon. Exemplary supports include metal oxides...the support may include...alumina. Hence, the alumina catalyst composition is an applicable adsorbent.) comprising: an alumina adsorbent; and precipitated nickel supported on the alumina adsorbent (para [0068], As examples of this application, hydrodechlorination experiments were carried out using hydrogenation catalysts as described in Table 1; Table 1, Ni/Al₂O₃ catalyst; Abstract, A process for reducing a chloride content of a hydrocarbon feed stream involving contacting a hydrocarbon feed stream comprising a chloride containing pyrolysis oil obtained by cracking a chloride containing thermoplastic material comprising at least one of...Ni...on a catalyst support; para [0044], the catalyst used to dechlorinate the hydrocarbon stream may be made by co-precipitating the catalytic metal with the catalyst support; see instant specification para [0026], The adsorbents described may utilize a porous support and one or more active metal components supported thereon. Exemplary supports include metal oxides...the support may include...alumina).

As the shared technical features were known in the art at the time of the invention, they cannot be considered special technical features that would otherwise unify the groups. Therefore, Groups I-II lack unity under PCT Rule 13.