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7 August 2008

(54) Title: HEAVY METAL ADSORBENT MATERIAL, PROCESSES OF MAKING SAME, AND METHODS OF SEPARATING HEAVY METALS FROM FLUIDS

(57) Abstract: Disclosed herein are granulated heavy metal adsorbent materials such as granulated mercury adsorbent materials, processes of making the same, and methods for their use. Also disclosed herein are granulated heavy metal adsorbent materials including a sol-gel three-dimensional cross-linking network of oxides.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 07/71311

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - B01D 53/64 (2008.04)
USPC - 423/210; 502/412
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)
IPC(8) - B01D 53/64 (2008.04)
USPC - 423/210; 502/412

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC - 502/412; 95/34 (Keywords limited - See list for keywords)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); DialogPRO(Chemistry); Google Scholar
Search Terms: heavy, metal$2, adsorbent$2, granulated, diatomite, silane$2, mercury, alkoxy, mercapto, disulfide, acetoxy, diselenide

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 2005/0207955 A1 (Wang) 22 September 2005 (22.09.2005), especially, para [0005], [0054], [0059], [0068], [0074], [0075], [0091] and [0144].	1,3-4, 10-20 --- 2, 5-6, 7-9
Y	US 2005/0016418 A1 (Holbek) 27 January 2005 (27.01.2005), especially, para [0098], [0205] and [0206].	2
Y	US 2001/0018044 A1 (Nakanashi et al.) 30 August 2001 (30.08.2001), especially, para [0009]-[0011].	5, 6
Y	US 2005/0247635 A1 (Vo et al.) 10 November 2005 (10.11.2005), especially, para [0021].	7-9

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"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
20 May 2008 (20.05.2008)	05 JUN 2008
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. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (April 2007)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 07/71311

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:
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 examined, the appropriate additional examination fees must be paid.

Group 1: claims 1-20 are directed to a granulated heavy metal adsorbent material comprising a granulated diatomite and at least one surface treatment agent capable of separating heavy metals from a fluid.

Group 2: claims 21-91 are directed to a process for preparing a granulated heavy metal adsorbent material comprising:
(a) preparing a heavy metal adsorbent powder by treating a diatomite feed
material with at least one surface treatment agent capable of removing heavy metal in the presence of at least one first solvent and
(b) agglomerating said heavy metal adsorbent powder with at least one silicate
and at least one second solvent.

----------See Continuation 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.:
1-20

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.

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/US 07/71311

Box III: Observations where Unity of Invention is Lacking.

The inventions listed as groups 1-2 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 technical features for the following reasons:

Groups 1-2 share the technical feature of an adsorbent comprising a granulated diatomite and at least one surface treatment agent capable of separating heavy metals from a fluid. However, said adsorbents are well known in the art, e.g. US 2005/0207955 A1 (Wang) teaches a mercury adsorbent comprising a diatomite and at least one surface treatment agent capable of separating heavy metals, e.g. mercury, from a fluid. (see Abstract). Therefore, an adsorbent comprising a granulated diatomite and at least one surface treatment agent capable of separating heavy metals from a fluid is well known in the art and not a special technical feature common to both groups.

The special technical feature of Group 2 is agglomerating the heavy metal adsorbent powder with at least one silicate and at least one second solvent to form a sol-gel, which is not present in Group 1. Accordingly, unity of invention is lacking under PCT Rule 13.1 because the groups do not share a same or corresponding special technical feature.