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B03D 103/04 (2006.01)
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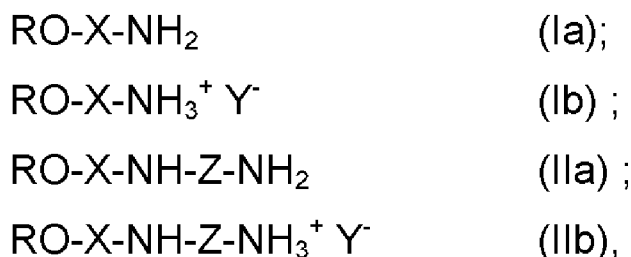
- (81) **Designated States (unless otherwise indicated, for every
kind of national protection available):** AE, AG, AL, AM,
AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ,
CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO,
DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN,
HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME,
MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ,
OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD,
SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR,
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UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU,
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- (88) **Date of publication of the international search report:**
17 January 2013

(54) **Title:** AMINE AND DIAMINE COMPOUNDS AND THEIR USE FOR INVERSE FROTH FLOTATION OF SILICATE FROM IRON ORE



(57) **Abstract:** Compounds of the formulae: RO-X-NH₂ (Ia); RO-X-NH₃⁺Y⁻ (Ib); RO-X-NH-Z-NH₂ (IIa); and RO-X-NH-Z-NH₃⁺Y⁻ (IIb), in which X is an aliphatic alkylene group containing 2 to 6 carbon atoms; Z is an aliphatic alkylene group containing 2 to 6 carbon atoms; Y⁻ is an anion; and R is an aliphatic iso C₁₃H₂₇- group with average branching degree ranging from 1.5 to 3.5. The compounds are particularly suitable as flotation collectors for enriching an iron mineral from a silicate-containing iron ore.

INTERNATIONAL SEARCH REPORT

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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 additional 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 an 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.:

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

International application No

PCT/EP2012/056396

A. CLASSIFICATION OF SUBJECT MATTER INV. B03D1/01 ADD. B03D103/04 B03D101/02											
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) B03D C08K											
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched											
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data											
C. DOCUMENTS CONSIDERED TO BE RELEVANT <table border="1"> <thead> <tr> <th>Category*</th> <th>Citation of document, with indication, where appropriate, of the relevant passages</th> <th>Relevant to claim No.</th> </tr> </thead> <tbody> <tr> <td>X</td> <td>US 4 652 273 A (MALDONADO PAUL [FR] ET AL) 24 March 1987 (1987-03-24) claim 6</td> <td>1-4</td> </tr> <tr> <td>X</td> <td> ----- "1-Propanamine, 3-(tridecyloxy)-, branched - Compound Summary", 12 May 2007 (2007-05-12), XP55033682, Retrieved from the Internet: URL: http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=22833357 [retrieved on 2012-07-24] PubChem compound CID 22833357 ----- -/-- </td> <td>1-4</td> </tr> </tbody> </table>			Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.	X	US 4 652 273 A (MALDONADO PAUL [FR] ET AL) 24 March 1987 (1987-03-24) claim 6	1-4	X	----- "1-Propanamine, 3-(tridecyloxy)-, branched - Compound Summary", 12 May 2007 (2007-05-12), XP55033682, Retrieved from the Internet: URL: http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=22833357 [retrieved on 2012-07-24] PubChem compound CID 22833357 ----- -/--	1-4
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.									
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X	----- "1-Propanamine, 3-(tridecyloxy)-, branched - Compound Summary", 12 May 2007 (2007-05-12), XP55033682, Retrieved from the Internet: URL: http://pubchem.ncbi.nlm.nih.gov/summary/summary.cgi?cid=22833357 [retrieved on 2012-07-24] PubChem compound CID 22833357 ----- -/--	1-4									
☒ 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 "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									
28 November 2012		06/12/2012									
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer									
		Roider, Josef									

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/056396

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3 363 758 A (CRONBERG ALVIN D ET AL) 16 January 1968 (1968-01-16) cited in the application	1-3, 5-12, 15, 16
Y	column 5, line 22 - line 23 column 6, line 4 - line 18 column 2, line 42 - line 62 column 3, line 57 - column 4, line 18 -----	13, 14
Y	US 6 076 682 A (GUSTAFSSON JAN OLOF [SE] ET AL) 20 June 2000 (2000-06-20) cited in the application column 3, lines 5-13 column 2, line 55 -----	1-3, 5-16
Y	FREYBERGER W L ET AL: "QUARTZ FLOTATION WITH BRANCHED CHAIN ETHER AMINES", INTERFACIAL PHENOMENA IN MINERAL PROCESSING: PROCEEDINGS OF THE ENGINEERING FOUNDATION CONFERENCE. RINDGE, NH, USA,, 1 January 1982 (1982-01-01), pages 255-270, XP009161399, page 255, last paragraph page 257 page 256, last paragraph -----	1-3, 5-16
Y	M Srdjan Bulatovic: "Ether Amines" In: "Handbook of Flotation Reagents", 1 January 2007 (2007-01-01), Elsevier, XP55033529, ISBN: 978-0-44-453029-5 page 36, paragraph [2.4.2] -----	13-16
Y	WO 2008/077849 A1 (AKZO NOBEL NV [NL]; GUSTAFSSON JAN OLOF [SE]; KLINGBERG ANDERS [SE]; L) 3 July 2008 (2008-07-03) cited in the application page 5 -----	1-16
A	ARAUJO A C ET AL: "Reagents in iron ores flotation", MINERALS ENGINEERING, PERGAMON PRESS , OXFORD, GB, vol. 18, no. 2, 1 February 2005 (2005-02-01), pages 219-224, XP027815644, ISSN: 0892-6875 [retrieved on 2005-02-01] ----- -/--	1-16

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International application No
PCT/EP2012/056396

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	PAPINI RM ET AL: "Cationic flotation of iron ores: amine characterization and performance", MINERALS AND METALLURGICAL PROCESSING, CO, vol. 18, no. 1, 1 January 2001 (2001-01-01), pages 5-9, XP009090087, ISSN: 0747-9182 -----	1-16
Y	LIMA R M F AND MAGALHÃES M P: "Influence of the degree of neutralization of amines in iron ore reverse flotation", INFORMACION TECNOLOGICA, CENTRO DE INFORMACION TECNOLOGICA, LA SERENA, ES, vol. 13, no. 5, 1 January 2002 (2002-01-01), pages 3-7, XP009128945, ISSN: 0716-8756 page 5 -----	4

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
US 4652273	A	24-03-1987	CA 1192519 A1	27-08-1985
			DE 3274368 D1	08-01-1987
			DK 337682 A	31-01-1983
			EP 0071513 A2	09-02-1983
			FI 822674 A	31-01-1983
			FR 2510598 A1	04-02-1983
			JP 1628686 C	20-12-1991
			JP 2051478 B	07-11-1990
			JP 58108297 A	28-06-1983
			NO 822591 A	31-01-1983
			US 4652273 A	24-03-1987

US 3363758	A	16-01-1968	DE 1558950 A1	23-04-1970
			FR 1553908 A	17-01-1969
			SE 326416 B	27-07-1970
			US 3363758 A	16-01-1968

US 6076682	A	20-06-2000	BR 9802339 A	03-08-1999
			CA 2249942 A1	27-05-1999
			SE 521949 C2	23-12-2003
			SE 9704365 A	28-05-1999
			US 6076682 A	20-06-2000

WO 2008077849	A1	03-07-2008	AU 2007338062 A1	03-07-2008
			WO 2008077849 A1	03-07-2008

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 13(completely); 1-3, 5-12(partially)

Compounds of the formula Ia, its preparation and its use for inverse iron flotation

2. claims: 4, 14(completely); 1-3, 5-12(partially)

Compounds of the formula Ib, its preparation and its use for inverse iron flotation

3. claims: 15(completely); 1-3, 5-12(partially)

Compounds of the formula IIa, its preparation and its use for inverse iron flotation

4. claims: 16(completely); 1-3, 5-12(partially)

Compounds of the formula IIb, its preparation and its use for inverse iron flotation
