

(19) World Intellectual Property Organization
International Bureau



(43) International Publication Date
8 January 2009 (08.01.2009)

PCT

(10) International Publication Number
WO 2009/004565 A2

(51) International Patent Classification:
C21C 7/064 (2006.01) **C04B 35/10** (2006.01)

(74) Agent: **D M KISCH INC**; P O Box 781218, 2146 Sandton (ZA).

(21) International Application Number:
PCT/IB2008/052619

(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, 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, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(22) International Filing Date: 30 June 2008 (30.06.2008)

(25) Filing Language: English

(26) Publication Language: English

(30) Priority Data:
2007/05373 2 July 2007 (02.07.2007) ZA
2008/01434 11 February 2008 (11.02.2008) ZA

(84) Designated States (*unless otherwise indicated, for every kind of regional protection available*): ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

(71) Applicant (*for all designated States except US*): **BUMAT-ECH (PTY) LIMITED** [ZA/ZA]; Suite 2, Waterstone Junction Main Road, 6573 Sedgfield (ZA).

(72) Inventors; and

(75) Inventors/Applicants (*for US only*): **FOUCHE, Pierre Mark** [ZA/ZA]; 72 Claude Urban Drive, Myoli Beach, 6573 Sedgfield (ZA). **HEWITT, Samuel** [ZA/ZA]; 72 Touleier Street, Wapadrand, 0002 Pretoria (ZA).

Published:

— *without international search report and to be republished upon receipt of that report*

(54) Title: FLUX AND METHOD OF MAKING SAME

(57) Abstract: The invention relates to a desulphurising flux comprising alumina dross formed into agglomerated particles of a size distribution of between 3 mm and 40 mm, preferably between 3 mm and 60 mm in maximum cross dimension by means of a suitable binder material. Also provided is a method of converting fine powdery alumina dross into such particles. Cement may be used as a binder material. The particles may be calcined.



WO 2009/004565 A2

FLUX AND METHOD OF MAKING SAME

FIELD OF THE INVENTION

5

This invention relates to a flux for use in steel making.

BACKGROUND TO THE INVENTION

10 The steel industry uses a desulphurising flux in secondary steel making. Different flux compositions are used for this purpose. Compositions comprising alumina (Al_2O_3), lime (CaO) and sometimes MgO and other minor components are examples of such flux compositions. The flux product needs to be of a particulate nature having a size distribution of larger than 3mm and
15 smaller than 40mm in cross dimension. This constraint is general because of the furnace designs and dynamics which precludes the use of a finer or powdery product.

This invention relates to the use of a waste product as a raw material for
20 producing fluxes of the type in issue. The waste product utilised for the purpose is powdery alumina dross, which is the final waste after all extractable aluminium has been removed from slag originating from an aluminium furnace. In the extraction of aluminium from its source material a milling process is used and consequently the dross is a fine powdery material.
25 Large tonnages ended up in waste dumps previously. Surprisingly, it does not seem to have been realised previously that this waste product contains alumina, or if it was realised it was not appreciated that it may be utilised as a source of alumina in a flux composition suitable for use as a desulphurising flux in the steel making industry. This is presumably so because of the fine
30 powdery state of the waste material in which form it is not suitable for such use.

OBJECT OF THE PRESENT INVENTION

It is accordingly an object of the present invention to provide a flux composition containing alumina dross and a method of making such a flux composition.

SUMMARY OF THE INVENTION

According to the present invention there is provided a desulphurising flux comprising alumina dross and a binder material, formed into an agglomerated product having a size distribution of between 3 mm and 60 mm in maximum cross dimension.

The agglomerated product may preferably have a size distribution of between 3 mm and 40 mm in maximum cross dimension.

The agglomerated product may further preferably be a pelletised product.

In one form of the invention cement is used as a binder material.

20

In this form of the invention it may be preferred to use a high alumina cement. Alternatively, a mixture of high alumina cement and ordinary Portland cement is used as a binder material. The mixture of high alumina cement and ordinary Portland cement may be in different ratios depending on the specifications of the end user of the product. It is however preferred to use a binder material composed of a mixture of high alumina cement and ordinary Portland cement in a ratio of 20:80 to 40:80 parts by weight but most preferably in a ratio of 30:70 parts by weight.

30 According to a further feature of the invention the flux incorporates additional compounds including lime (CaO) or MgO according to the requirements of the steel making process in which the flux is intended to be utilised.

According to yet a further feature of the invention the flux includes a suppressant material for suppressing the release of ammonia gas during the process of converting the powdery alumina dross into an agglomerated product. The suppressant material is selected from sodium carbonate, sodium bicarbonate and sodium sulphate.

According to a second aspect of the present invention there is provided a method of converting powdery alumina dross into an agglomerated product having a size distribution of between 3 mm and 60 mm in maximum cross dimension comprising the step of agglomerating a mixture of the alumina dross and a suitable binder material.

Again, the agglomerated product may preferably have a size distribution of between 3 mm and 40 mm in maximum cross dimension.

The agglomerated product may again further preferably be a pelletised product.

The method of converting the powdery alumina dross into an agglomerated product comprises any suitable method to achieve that objective. Preferably the process comprises a pelletising process utilizing a pelletising pan and includes the addition of water.

It is a further feature of the invention to include the step of incorporating into the mixture of the powdery alumina dross and binder material, a suitable suppressant material for suppressing the release of ammonia gas during the process of converting the powdery alumina dross into an agglomerated product.

The suppressant material is selected from sodium carbonate, sodium bicarbonate and sodium sulphate. The suppressant material may be dissolved or suspended in the water used in the method of converting the powdery alumina dross into an agglomerated product.

A mixture of high alumina cement and ordinary Portland cement may be used as a binder material. The mixture may again contain alumina and ordinary Portland cement in a ratio dependant on end user requirements but may preferably be in the ratio of 20:80 to 40:60 parts by weight, but most
5 preferably in a ratio of 30:70.

The mixture of alumina dross and this form of binder material is furthermore preferably spread open to atmosphere after the mixture is agglomerated. The time for which the mixture of alumina dross and such binder material is left
10 spread open to atmosphere will depend on the nature of the alumina dross and ambient climatic conditions but is generally between a few hours to about two days.

Smoke generation during the use of the agglomerated product of the invention, may result from the presence of either carbon or aluminium metal or both in the agglomerated product. The method of the present invention may include the further step of reducing either or both of the carbon or aluminium metal content of the agglomerated product beforehand by calcining or decarburising the agglomerated product in a kiln in a manner as
15 conventionally used for calcining various products.
20

Alternatively, it has been found that the agglomerated product is combustible by the self-sustaining combustion thereof. It is accordingly a further feature of the present invention to convert the agglomerated product into a substantially
25 non-smoke generating product with a low mass loss on ignition by setting the agglomerated product alight and burning the agglomerated product. This step is preferably carried out in a vertical stack, chimney or column structure.

By virtue of the fact that the oxidation of the aluminium in the agglomerated
30 product provides the heat for the combustion, the aluminium is converted to aluminium oxide.

According to a third aspect of the invention there is provided for the use of powdery alumina dross as a source of alumina in a desulphurising flux by

combining it with a suitable binder material to form an agglomerated product of size distribution of between 3 mm and 60 mm in maximum cross dimension.

- 5 Again, the agglomerated product may preferably have a size distribution of between 3 mm and 40 mm in maximum cross dimension.

The agglomerated product may again further preferably be a pelletised product.

10

EXAMPLE OF THE INVENTION

An example of the present invention will now be described below without thereby limiting the scope of the invention to the illustrative embodiment.

15

950Kg of fine powdery alumina dross received in bulk bags was weighed out. 50Kg of Ordinary Portland Cement as binder material was weighed out and was added to the weighed out alumina dross, and was thoroughly mixed therewith. The mixture was added to a circulating pelletising pan. Water containing 10% by weight of sodium carbonate (or of sodium bicarbonate or of sodium sulphate) was added to the pan by means of a dosing pump and spray bar. The water addition was adjusted by means of a valve until pellets were formed in the pan. The formed pellets discharged automatically into a wheelbarrow or conveying system.

20

25

The use of high alumina cement would in particular be preferred if the steel making process in which the flux according to the invention is to be used is sensitive to the silica content of the flux. High alumina cement is known to contain very little silica.

30

It has been found that alumina dross often contains metal nitrides, which hydrolyse when water is added thereto and that such hydrolysis leads to the formation of ammonia gas.

It has been found that the release of ammonia may also be suppressed, or at least be made less noticeable, by utilising a mixture of high alumina cement and ordinary Portland cement as binder material.

- 5 The mixture of alumina dross and this form of binder material was spread open to atmosphere after the mixture was pelletised. The time for which the mixture is left spread open to atmosphere will depend on the nature of the dross and ambient climatic conditions but may generally be between a few hours to about two days.

10

- The pellets were loosely packed into a vertical chimney or other tubular column or stack structure providing a lower end with a steel grid or mesh and an open upper end. The pellets at the lower end of the stack were then set alight or heated at the lower end of the stack. The heat source was applied only initially until self-sustaining combustion took place. As the self-sustaining combustion of the product, which is postulated to be energised by the presence of aluminium metal in the dross powder incorporated in the pellets, progressed upwardly through the stack the pellets were converted into a pelletised product with a much lower mass loss on ignition than the pellets before the combustion or calcining.
- 15
- 20

By virtue of the fact that the oxidation of the aluminium in the pellets provides the heat for the combustion, the aluminium is converted to aluminium oxide. This further reduces smoke generation from the pellets during use.

25

- It has also been found that when a large vertical chimney or other tubular column or stack structure is used with a discharge mechanism the pellets at the bottom of the structure, which has already been calcined, can be discharged allowing the reaction zone in the structure to drop. New uncalcined pellets can then be added into the top of the structure allowing the reaction to progress upwards into the new pellets. This allows for a continuous operation in one structure.
- 30

It has also been found that another stack could be placed on top of the stack that was initially set alight or heated and that the heat generated by the self-sustaining combustion of the first stack or column provided sufficient heat to start the self-sustaining combustion of the pellets at the bottom of the upper
5 stack or column. An upward progression of the self-sustaining combustion in the second (upper) stack or column without applying heat from an external heat-source was achieved. The aforementioned process can be repeated continuously and allows the process to continue without applying any heat from an external heat-source.

10

It has been found that the preparation of the pellets, before the combustion or calcining process, had a significant influence on the ability for the self-sustaining combustion to take place. The pellets have to be left in open air for, preferably, two days and thereafter bagged for another two days before
15 starting the calcining or decarburisation process.

In addition it has been found that the design of the stack had a further effect on the temperature reached in the stack. Thus a stack, which is insulated by means of a refractory material, prevents heat losses and allows a higher
20 temperature to be reached within the stack and further improves on the efficiency of the calcining or decarburising.

It has also been found that a permeable bottom part of the structure being used for calcining allows for improved airflow into the structure to provide the
25 necessary oxygen for the oxidation reactions.

It has also been found that pellets containing high alumina cement only as binder material could be used at a lower percentage of the mix for pelletising without thereby compromising on binding strength of the pellets, and that such
30 pellets combusted more readily than pellets comprising ordinary Portland cement in combination with high alumina cement. It is postulated that the fact that more dross is used in this mix, more aluminium metal is available for combustion.

The pellets were left to cure. The cured pellets were then ready for use. Satisfactory results were obtained when these pellets were used as a desulphurising flux in a steel making process.

CLAIMS

1. A desulphurising flux comprising powdery alumina dross and a binder material, formed into an agglomerated product of a size distribution of between 3 mm and 60 mm in maximum cross dimension.
5
2. A method of converting powdery alumina dross into an agglomerated product having a size distribution of between 3 mm and 60 mm in maximum cross dimension comprising the step of agglomerating a mixture of the alumina dross and a binder material.
10
3. The use of powdery alumina dross as a source of alumina in a desulphurising flux by combining the powdery alumina dross with a binder to form an agglomerated product of size distribution of between 3 mm and 60 mm in maximum cross dimension.
15
4. The desulphurising flux according to claim 1, the method of converting powdery alumina dross into an agglomerated product according to claim 2, or the use of powdery alumina dross according to claim 3, wherein the agglomerated product is in a pelletised form.
20
5. The desulphurising flux according to claim 1, the method of converting powdery alumina dross into an agglomerated product according to claim 2, or the use of powdery alumina dross according to claim 3, wherein the agglomerated product has a size distribution of between 3 mm and 40 mm in maximum cross dimension.
25
6. The desulphurising flux according to claim 1, the method of converting powdery alumina dross into an agglomerated product according to claim 2, or the use of powdery alumina dross according to claim 3, wherein the binder material is cement.
30

- 5 7. The desulphurising flux, the method of converting powdery alumina dross into an agglomerated product, or the use of powdery alumina dross according to claim 6, wherein the binder material is a high alumina cement.
- 10 8. The desulphurising flux, the method of converting powdery alumina dross into an agglomerated product, or the use of powdery alumina dross according to claim 6, wherein the binder material is a mixture of high alumina cement and ordinary Portland cement.
- 15 9. The desulphurising flux, the method of converting powdery alumina dross into an agglomerated product, or the use of powdery alumina dross according to claim 8, wherein the mixture of high alumina cement and ordinary Portland cement is in a ratio of between 20:80 to 40:80 parts by weight.
- 20 10. The desulphurising flux, the method of converting powdery alumina dross into an agglomerated product, or the use of powdery alumina dross according to claim 9, wherein the mixture of high alumina cement and ordinary Portland cement is in a ratio of 30:70 parts by weight.
- 25 11. The desulphurising flux, the method of converting powdery alumina dross into an agglomerated product, or the use of powdery alumina dross according to any one of the preceding claims, wherein the flux incorporates at least one additional compound selected from the group consisting of CaO and MgO.
- 30 12. The method of converting powdery alumina dross into an agglomerated product, according to claim 2, wherein the method includes the step of including a suppressant material for suppressing the release of ammonia gas during the process of

converting the powdery alumina dross into mixture before forming it into an agglomerated product.

5 13. The method of converting powdery alumina dross into an agglomerated product according to claim 12, wherein the suppressant material is selected from sodium carbonate, sodium bicarbonate and sodium sulphate.

10 14. The method according to any one of claims 2 to 13, wherein the agglomerated product is spread open to atmosphere for a period of between two and 48 hours.

15 15. The method according to any one of claims 2 to 14, wherein the method includes the further step of reducing the mass percentage of either or both of any carbon or aluminium metal content of the agglomerated product by calcining or decarburising the agglomerated product in a kiln.

20 16. The method according to claim 15, wherein the agglomerated product is burned.

25 17. The method according to claim 16, wherein the agglomerated product is burned in a column structure by means of a self-fuelling and self-sustaining reaction.