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TITLE OF INVENTION					
54	THE PRODUCTION OF MATTES CONTAINING PLATINUM GROUP METALS AND GOLD				
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COMPLETE SPECIFICATION

(Section 30(1) - Regulation 28)

21	01	Official application No.	22	Lodging date	J&K Reference
		886670		8th September, 1988	P 10321 ZA/MVS
51	International classification				
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54	Title of Invention				
	THE PRODUCTION OF MATTES CONTAINING PLATINUM GROUP METALS AND GOLD				

BACKGROUND

- 2 -

"THE PRODUCTION OF MATTES CONTAINING
PLATINUM GROUP METALS AND GOLD"

FIELD OF THE INVENTION

THIS INVENTION relates to the production of mattes containing platinum group metals and gold from concentrates containing the same by way of the pyrometallurgical smelting of a concentrate to produce the platinum group metal and gold containing matte phase and a slag phase.

/BACKGROUND TO

BACKGROUND TO THE INVENTION

In the processing of naturally occurring ores containing PGMs (Platinum Group Metals), different types of concentrates are produced, generally by flotation, in which the PGMs are present and these concentrates are generally subjected to pyrometallurgical treatment in order to form a PGM containing matte and a slag which is depleted of PGMs, although sometimes a metallic collector phase is employed in place of the matte phase.

10 Usually such PGMs are accompanied by a chromium content in the form of chromite and certain ores such as that generally known in South Africa as Merensky reef, have a low chromium oxide content (of the order of 0,3% by mass of the flotation concentrate) whilst other ores, 15 such as that known in South Africa as the UG-2 reef, have a relatively high chromium oxide content (of the order of 3 - 3,5% by mass of the flotation concentrate). Other South African high chromium oxide-containing ores are those from the so-called LG-6 20 reef (3 - 6% chromium oxide by mass of the flotation concentrate) and those from the so-called MG-4 reef or

/similar chromite

similar chromite ores. Also of concern are mixtures or blends of such concentrates which may have a net chromium oxide content of down to almost that of the Merensky reef concentrate.

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5. In the pyrometallurgical smelting of the relatively high chromium containing concentrates, there is a tendency for the chromium to form a spinel in the smelting furnace which accumulates and, accordingly, leads, over a period of time to unacceptable dead volume of the furnace.

the

One effort to avoid this problem forms the subject matter of South African Patent No. 77/4202 to J.C.I. Company Limited entitled "Smelting Process". In this proposal for dealing with concentrates containing at least 2% by weight of chromium (equivalent to 2,9% Cr_2O_3 or 7,3% chromite), the smelting is generally carried out in the presence of sufficient carbonaceous reductant to result in the formation of three phases, namely, a slag phase, a matte phase and a ferro-nickel alloy phase, and in this case the PGMS are contained in the latter phase which acts as a collection phase, as

/opposed to

opposed to the matte phase, although in certain cases only a matte and a slag phase are apparently formed.

In a further proposal made by applicant in South African Patent No. 82/2966 it is proposed to avoid such a build-up of chromium spinel in a smelting furnace by employing extremely high power densities, of the order of 400kW/m^2 during smelting to achieve a substantial mixing between the slag and matte phases and thereby effect coalescence between the matte particles so that they may grow in size and settle more readily out of the slag.

It was believed that this turbulence would minimise the settling out of spinel on the hearth of the furnace.

This proposal operates effectively but has been found to suffer from the disadvantage that the furnace linings can, if conditions are not maintained correctly, or the linings are not designed for the purpose, be deleteriously affected.

It is the object of this invention to provide improvements and beneficial modifications to the

/process forming

process forming the subject matter of our said Patent
No. 8272966.

SUMMARY OF THE INVENTION

In accordance with this invention there is provided a
process for the treatment of a PGM containing
5 concentrate by a smelting operation carried out to
produce a matte phase and a slag phase, the smelting
operation being carried out at power densities of
between 150kW/m^2 and 750kW/m^2 and at a voltage of from
100 to 300 volts (after start-up is complete) the
10 process being characterised in that a reductant is
added in order to lower the partial pressure of oxygen
during the smelting operation the quantity of such
reductant being insufficient to cause the formation of
a metallic collection phase.

15 Further features of the invention provide for the
reductant to be a carbonaceous reductant; for the
smelting to be carried out in a preferred range of
power densities of between 150kW/m^2 and 350kW/m^2 and
most preferably at about 290kW/m^2 with the voltage
20 preferably being in the range of from 120 to 180 volts;

/for the

for the chromium oxide content of the PGM containing concentrate to be less than about 2,9% by mass of the concentrate and preferably, less than about 2,8% by mass; for the carbonaceous reductant (carbon) to be added in an amount of between 1% and 4% by mass based on the PGM containing concentrate; and for tapping of the furnace to be carried out without the step of allowing settling of the phases during a special quiescent time period as envisaged by our said Patent 10 No. 82/2966. The omission of the quiescent period avoids the possibility of spinel settling out during such period and also optimises operational time of the smelter.

Still further the invention provides for the PGM containing concentrate together with the carbon and any other additives to be intimately mixed and agglomerated, for example pelletised or briquetted, prior to smelting and for additional sulphides, such as pyrite from various sources including pyrite containing gold, copper sulphide or nickel sulphide to be added in order to increase the sulphide content of the concentrate in cases where insufficient sulphides are present for the formation of a satisfactory matte

/under the

under the particular prevailing conditions, or where the presence of, for example, a high iron oxide content of the concentrate results in the formation of mattes with too high an iron-to-sulphur ratio, especially when
5 reaction of iron oxide with carbon, either added or coming from the electrodes, occurs. Such iron rich mattes are difficult to break and would have to be transferred in the molten state to a converter process as is commonly used, or granulated, which can be
10 hazardous. It would be a disadvantage if a converting process requiring the use of oxygen instead of air were to be used and in which a quantity of cold, crushed matte would be required to be added to the converter as a coolant.

15 Laboratory studies have shown that the inclusion of carbon in the fluxed concentrate-containing charge causes a reduction of Fe_2O_3 in the slag to FeO . This destabilises the spinel structure and the formation of secondary magnetite around small grains of chromite
20 spinels contained in the matte is inhibited. FeO then becomes a component of the matte, and upon solidification, it exsolves as a separate phase.

/The inclusion

The inclusion of carbon also causes the reduction of FeO to Fe which dissolves in the matte phase. The lowering of the FeO content of the slag causes a decreased solubility of sulphur in the slag phase with
5 a resultant increase in the mass of matte that is formed.

Also noted has been an increased partitioning of chromium to the matte and a decreased concentration and, presumably, activity of Cr_2O_3 in the slag, thereby
10 minimising the precipitation of spinels in the slag.

It is to be noted that insufficient carbon should be added to result in the formation of three phases as the object of this particular invention is to provide a matte containing the PGMs as opposed to a metallic
15 collection phase which would form a third phase in the system.

The smelting temperature is in the range of $1450^{\circ}C$ to $1600^{\circ}C$ and preferably, in the range of $1475^{\circ}C$ to $1550^{\circ}C$.

It is to be noted that the addition of reductant to
20 lower the partial pressure of oxygen affects the

/partitioning of

partitioning of chromium in the matte phase relative to the slag phase with a decrease in chromium in the slag phase with increasing oxygen partial pressure. Thus the addition of reductant has the effect of increasing the chromium content of the matte phase thereby conveying it out of smelter.

Clearly any required fluxes such as lime, ferric oxide, hematite ore or mixtures thereof can be added as may be required.

WHAT IS CLAIMED IS :-

1. A process for the treatment of a PGM containing concentrate by a smelting operation carried out to produce a matte phase and a slag phase, the smelting operation being carried out at power densities of between 150kW/m^2 and 750kW/m^2 and at a voltage of from 100 to 300 volts (after start-up is complete) the process being characterised in that a reductant is added in order to lower the partial pressure of oxygen during the smelting operation the quantity of such reductant being insufficient to cause the formation of a metallic collection phase.
2. A process as claimed in claim 1 in which the reductant is a carbonaceous reductant.

/3. A process

3. A process as claimed in either of claims 1 or 2 in which the reductant is added in an amount of from 1 to 4% by mass of the PGM containing concentrate.
4. A process as claimed in any one of the preceding claims in which the smelting is carried out at a power density of from 150kW/m² to 350kW/m².
5. A process as claimed in claim 4 in which the smelting is carried out at a power density of about 290kW/m².
106. A process as claimed in any one of the preceding claims in which the furnace is operated at a voltage of from 120 to 180 volts.
7. A process as claimed in any one of the preceding claims in which the chromium oxide content of the PGM containing concentrate is less than about 2,9% by mass of concentrate.
15. A process as claimed in any one of the preceding claims in which the furnace is tapped without any special quiescent period as described.

/9. A process

9. A process as claimed in any one of the preceding claims in which the temperature at which smelting is effected is from 1450°C to 1600°C.

10. A process as claimed in claim 9 in which the temperature is from 1475°C to 1550°C.

11. A process as claimed in any one of the preceding claims in which the concentrate, reductant and any other ingredients are mixed and agglomerated prior to smelting.

12. A process as claimed in any one of the preceding claims in which additional sulphides are added to provide for the formation of a satisfactory matte phase.

13. A process as claimed in claim 12 in which the additional sulphide is a pyrite optionally containing gold.

14. A process according to claim 1 and substantially as herein described.

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G. K. JOE

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For the Applicant