FORM 1

SPRUSON & FERGUSON

606670

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COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

APPLICATION FOR A STANDARD PATENT

LODGED AT SUB-OFFICE
- 6 APR 1988
Sydney

Vsesojuzny Nauchno-Issledovatelsky Gorno-Metallurgichesky Institut Tsvetnykh Metallov, of USSR, Ust-Kamenogorsk, ulitsa Promyshlennaya, 1, UNION SOVIET SOC. REPUBLICS, hereby apply for the grant of a standard patent for an invention entitled:

Method of Processing Sulphide Lead or Sulphide Lead-Zinc Ores and/or Concentrates

which is described in the accompanying complete specification.

Details of basic application(s):-

Basic Applic. No:	Country:	Application Date:
4225983	SU	7 April 1987

The address for service is:-

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DATED this SIXTH day of APRIL 1988

Vsesojuzny Nauchno-Issledovatelsky Gorno-Metallurgichesky
Institut Tsvetnykh Metallov

By:

Registered Patent Attorney

TO: THE COMMISSIONER OF PATENTS
OUR REF: 53065
S&F CODE: 63320

5845/2

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PATENT OFFICE 100 ONE HUNDRED DOLLARS

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PATENT OFFICE 60 AUSTRALIA SIXTY DOLLARS

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Form 8

AUSTRALIA

PATENTS ACT 1952-1973

DECLARATION IN SUPPORT OF A CONVENTION APPLICATION FOR A PATENT OR PATENT OF ADDITION

In support of the Convention Application for a patent ~~patent of addition~~ for an invention entitled:
Method of Processing Sulphide Lead or Sulphide Lead-Zinc Ores and/or Concentrates

I, Anatoly Petrovich Sychev

of USSR, Ust-Kamenogorsk, prospekt Lenina, 60,kv.16

do solemnly and sincerely declare as follows:-

~~1. I am the applicant for the~~ patent ~~patent of addition.~~

1. I am authorised by Vsesojuzny Nauchno-Issledovatelsky Gorno-Metallurgichesky Institut Tsvetnykh Metallov the applicant for the patent ~~patent of addition~~ to make this declaration on its behalf.

2. The basic application as defined by Section 141 of the Act was made in Soviet Union on the 7 day of April 1987 by Vsesojuzny Nauchno-issledovatelsky gorno-metallurgichesky institut tsvetnykh metallov

~~3. I am the actual inventor of the invention referred to in the basic application.~~

3. ANATOLY PETROVICH SYCHEV of USSR, Ust-Kamenogorsk, prospekt Lenina,60,kv.16; JURY IVANOVICH SANNIKOV of USSR, Ust-Kamenogorsk, prospekt Lenina, 58/1, kv. 22; IVAN PETROVICH POLYAKOV of USSR, Ust-Kamenogorsk, prospekt Lenina, 58/1, kv.12; JURY ALEXANDROVICH GRININ of USSR, Ust-Kamenogorsk, ulitsa Solnechnaya, 34, kv. 74; JURY MASGUNTOVICH ABDEEV of USSR, Ust-Kamenogorsk, ulitsa Ushanova, 116, kv. 37; GULNAR ASYLBEKOVNA SABITOVA of USSR Ust-Kamenogorsk, ulitsa Burova,47,kv.80; MAREK YAKOVLEVICH KESLER of USSR Ust-Kamenogorsk, prospekt Lenina, 30, kv. 58; FELIX NIKOLAEVICH LISIN of USSR, Sverdlovsk, ulitsa Uktusskaya, 46,kv.73; VALERY VLADIMIROVICH TEREKHIN of USSR, Ust-Kamenogorsk, ulitsa Krasnooktyabrskaya, 11, kv.8; VLADIMIR ALEXEEVICH IVANOV of USSR, Ust-Kamenogorsk, prospekt Lenina, 58/1,kv.13; MARIA ALEXEEVNA LYAMINA of USSR, Ust-Kamenogorsk, Naberezhnaya Irtysha, 20, kv. 61; ELENA PETROVNA SEMASHKO of USSR, Ust-Kamenogorsk, prospekt Lenina,3/1,kv.1 and VYACHESLAV PETROVICH KUUR of USSR, Ust-Kamenogorsk, ulitsa Stakhanovskaya, 59/1, kv.18

are the actual inventors of the invention and the facts upon

which the applicant is entitled to make the application are as follows: The said applicant is the assignee of the actual inventors.

4. The basic application referred to in paragraph 2 of this Declaration was the first application made in a Convention country in respect of the invention the subject of the application.

Declared at Ust-Kamenogorsk this 1st day of December 19 87

VSESOJUZNY NAUCHNO-ISSLEDOVATELSKY
GORNO-METALLURGICHESKY INSTITUT
TSVETNYKH METALLOV

Signature of Declarant
Anatoly Petrovich Sychev - Director

To:
The Commissioner of Patents,

(12) PATENT ABRIDGMENT (11) Document No. AU-B-14308/88
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(54) Title
PROCESSING LEAD & LEAD-ZINC SULPHIDE ORES

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(56) Prior Art Documents
US 4519836
AU 548838 88412/82 C22B 13/02 19/36

(57) Claim

1. A method of processing sulphide lead or sulphide lead-zinc ores and/or concentrates containing compounds of metals, including iron and copper compounds, silicon dioxide, aluminium, calcium and magnesium oxides, comprising delivery of a charge consisting of the above sulphide materials and flux for smelting together with oxidized return dusts through a burner, smelting of said charge together with the oxidized return dusts in a vertical flame in the atmosphere of an oxygen-containing gas with the formation of an oxidized melt containing predominantly

.../2

oxides of metals and a mixture of the oxidized return dusts with ~~from the~~ smelting gases, separation of said oxidized return dusts from the ~~with~~ smelting gases, and return of the dusts for smelting, reduction of metal oxides, predominantly lead oxide, to metals by filtrating the oxidized melt through a layer of a solid carbon-containing material with the formation of crude lead and lead-depleted zinc-containing slag, sedimentation of the slag with the formation of lead-containing zinc vapours, oxidation of said lead-containing zinc vapours with an oxygen-containing gas with the formation of coarsely and finely dispersed sublimates; the method residing in that as a flux use is made of a mixture of limestone or lime with an iron-containing material at a calcium oxide/iron mass ratio in the mixture varying from 0,43 to 0,76, the above mixture being used in amount from 5 to 22 % of the mass of the initial ore and/or concentrate as calculated for the sum of calcium oxide and iron in the mixture.

S & F Ref: 53065

FORM 10

COMMONWEALTH OF AUSTRALIA

PATENTS ACT 1952

COMPLETE SPECIFICATION 606670

(ORIGINAL)

FOR OFFICE USE:

Class Int Class

Complete Specification Lodged:
Accepted:
Published:

Priority:

Related Art:

[illegible]

Name and Address
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Complete Specification for the invention entitled:

Method of Processing Sulphide Lead or Sulphide Lead-Zinc Ores and/or Concentrates

The following statement is a full description of this invention, including the best method of performing it known to me/us

METHOD OF PROCESSING SULPHIDE LEAD OR SULPHIDE LEAD-ZINC ORES AND/OR CONCENTRATES

The present invention relates to non-ferrous metallurgy and, more particularly, to methods of precessing sulphide lead or sulphide lead-zinc ores and/or concentrates.

The main trend in improving pyrometallurgical production of heavy non-ferrous metals consists in the development of the processes for extraction said metals from sulphide raw material with the use of autogenous techniques. Autogenous processes have the following common advantages: high specific capacity, sharp reduction of volume of technological gases, the use of heating capacity of sulphide ores and concentrates (the latter ensures a great decrease of the use of external heat sources), the possibility of the effective processing of raw material relatively deficient in non-ferrous metals. Various versions of autogenous processes are known. The use of a highly developed surface of sulphide material for ensuring the autogenous nature of the smelting processes is the common feature of all versions of the autogenous processes.

Known in the art is a method of processing sulphide lead or sulphide lead-zinc ores and/or concentrates containing compounds of metals, including iron and copper compounds, silicon dioxide, aluminium, calcium and magnesium oxides, wherein the charge consisting of said sulphide materials and flux together with oxidized return dusts is delivered through a burner to smelting. As a flux use is made of quartz sand with limestone or lime. The smelting of said charge together with oxidized return dusts is performed in a vertical flame in the atmosphere of an oxygen-containing gas with the formation of an oxidized melt,containing predominantly oxides of metals, and a mixture of oxidized return dusts with smelting gases. Said oxidized return dusts are separated from the smelting gases and returned for smelting. Metal oxides, predominantly lead oxide, are reduced to metals by filtration of the oxidized melt through a layer of a solid carbon-containing material with the formation of crude lead and lead-depleted zinc-containing slag. Said slag is subjected to sedimentation with the formation of lead-containing zinc vapours, said vapours are oxidized with an oxygen-containing gas with the formation of coarsely and finely dispersed oxidized sublimates (US, A, 4519836).

Because of the use of a refractory component, namely quartz sand in the flux, the method is characterized by an enhanced amount of lead in oxidized return dusts as a result of sublimation of lead sulphide. Besides, the presence of quartz sand in the flux decreases the reduction degree of lead oxide on a solid carbon-containing reducer and, hence, increases the losses of lead with zinc-containing slag.

The main object of the invention is to change the conditions of smelting in the method of processing sulphide lead or sulphide lead-zinc ores and/or concentrates in order to ensure a maximum possible extraction of lead.

Said object is accomplished by the provision of a method of processing sulphide lead or sulphide lead-zinc ores and/or concentrates containing compounds of metals, including iron and copper compounds, silicon dioxide, aluminium, calcium,and magnesium oxides, comprising delivery of a charge consisting of the above sulphide materials and a flux for smelting together with oxidized return dusts through a burner, smelting of said charge together with the oxidized return dusts in a vertical flame in the atmosphere of an oxygen-containing gas with the formation of an oxidized melt containing predominantly oxides of metals and a mixture of the oxidized return dusts with smelting gases, separation of said oxidized return dusts from the smelting gases and return of the dusts for smelting, reduction of metal oxides, predominantly lead oxide, to metals by filtrating the oxidized melt through a layer of a solid carbon-containing material with the formation of crude lead and lead-depleted zinc containing slag, sedimentation of the slag with the formation of lead-containing vapours of zinc, oxidation of said lead-containing zinc vapours with an oxygen-containing gas with the formation of coarsely and finely dispersed sublimates; according to the invention, in the proposed method use is made of the flux representing a mixture of limestone or lime with an iron-containing material at a calcium oxide/iron mass ratio in the mixture varying from 0.43 to 0.76, the above mixture baing used in amount from 5 to 22 % of the mass of the initial ore and/or concentrate as calculated for the sum of calcium oxide and iron in the mixture.

Due to the use in the proposed method of the flux containing a low-melting component, namely, an iron-containing material, the content of lead in oxidized return dusts is lowered greatly because of a decrease in the sublimation degree of lead sulphide. This occurs since in the course of smelting the iron-containing component of the flux forms a low-melting eutectic dissolving lead sulphide. Besides, since in the oxidized melt being formed silicon dioxide is substituted with iron oxides passing from the flux used in the proposed invention, this melt readily dissolves the ash formed of the surface of a solid carbon-containing material during the reduction process. As a result, the conditions of the contact between the oxidized melt and carbon of the reducer become better and, hence, the reduction degree of lead oxide increases and the losses thereof with zinc-containing slag decrease.

As was mentioned above, the flux components (limestone or lime, iron-containing material) are used in amounts ensuring the calcium oxide/iron mass ratio from 0.43 to 0.76, the amount of flux being equal to 5 - 22 % of the mass of the initial ore and/or concentrate as calculated for the sum of calcium oxide and iron in the flux.

The use of the flux with the above calcium oxide/iron ratio and in said amounts ensures the most favourable conditions for the formation of a low-melting eutectic "iron (II) oxide - calcium oxide - iron sulphide" (m.p. 880 °C), as a result of which lead sulphide passes into the melt being formed at a temperature below the initial temperature of lead intense sublimation (T = 1 000 °C).

The proposed method increases the efficiency of lead and zinc separation at the stage of reduction on the solid carbon-containing material, decreases the lead content in oxidized return dusts and thereby enhances lead extraction by 0.9 - 1.1 % as compared with the known method.

In the case when copper concentration in the initial sulphide materials exceeds 1 mass %, it is recommended to improve the quality of obtained crude lead, i.e. to decrease the copper content therein, to perform the smelting of the charge together with oxidized return dusts at a flow rate of the oxygen-containing gas, as calculated for oxygen, less than the stoichiometric amount required for a complete oxidation of metals and sulphide sulphur in the charge, with the formation, in addition to crude lead, of copper-enriched matte.

In the case when copper concentration in the initial sulphide materials does not exceed 1 mass %, it is expedient to carry out the smelting of the charge together with oxidized return dusts at a flow rate of the oxygen-containing gas determined from the following relationship:

$$P = A \cdot B \cdot K, \qquad /1/$$

where P is the flow rate of the oxygen-containing gas as calculated for oxygen, Nm^3/t charge;

$$A = 1.542-3.299C_a-7.972C_b-4.285C_i+28.851C_aC_b+$$

$$+14.657C_aC_i+27.370C_bC_i-88.895C_bC_iC_a \qquad /2/$$

where $C_a+C_b+C_i=1$ is the sum of concentrations in the charge of acid oxides C_a (SiO_2 and Al_2O_3), basic oxides C_b (CaO and MgO), and iron C_i (as calculated for FeO), the concentrations being expressed in mass fractions;

B is the stoichiometric flow rate of oxygen of the oxygen-containing gas required for a complete oxidation of metals and sulphide sulphur in the charge, Nm^3/t charge;

$K = 1 + \frac{0,965}{H}$, where H is the height of the melting zone, m.

It is known that the specific reaction rate (or more particularly the reaction rate constant) of the gas-melt reaction depends on the composition of the melt, including the composition of such components which do not participate in the reaction. For instance, the effect of slag-forming components (CaO, MgO, Al_2O_3, SiO_2, FeO) on the rate of desulphurization reactions such as

$$PbS + 1.5\ O_2 \longrightarrow PbO + SO_2$$

$$ZnS + 1.5\ O_2 \longrightarrow ZnO + SO_2$$

is explained, firstly, by the dependence of solubility of lead and zinc sulphides in the melt and, secondly, by the dependence of structurally sensitive parameters of the rate constants of heterogeneous reactions of desulphurization on the concentration of said slag-forming components in the melt. Thus, the rate constants of desulphurization reactions have a complete dependence on the chemical composition of the initial charge. Besides, it is known that the desulphurization degree (the ratio of the amount of sulphur in the smelting gases to that in the charge) depends on the time of residence of the charge in the melting zone. This residence time is related to the height of the melting zone (on the basis of the known physical laws). Hence, the amount of oxygen really required for the attainment of the needed desulphurization degree depends on the content in the charge being processed of the above .... - slag-forming components and the height of the melting zone.

The really required amount of oxygen is that ensuring the desired result of the smelting process without the formation of matte and excess amount of iron (III) oxide.

The above dependence (formula /1/) cannot be calculated theoretically. We have found it experimentally.

The accomplishment of the smelting process at a flow rate of the oxygen-containing gas determined by formula /1/ ensures the required desulphurization degree, i.e. maximum possible heat liberation providing the best conditions of smelting and reduction processes which in the long run increases the extraction of lead by 0.5 - 0.9 %.

In the case when copper concentration in the initial sulphide materials exceeds 1 mass %, it is recommended to perform the smelting of the charge together with oxidized return dusts at the stoichiometric flow rate of oxygen-containing gas, as calculated for oxygen, required for a complete oxidation of lead, iron and zinc in the charge and at a flow rate of the oxygen-containing gas, as calculated for oxygen, per 1 kg of sulphide sulphur in the charge determined by the relationship:

$$Q = 0.70\ (1 - n \frac{C_{Cu}}{C_S}) \qquad /3/$$

where Q is the flow rate of the oxygen-containing gas, as calculated for oxygen, per 1 t of sulphide sulphur in the charge, Nm^3;

n is the mass ratio of sulphide sulphur to copper in the oxidized melt equal to 0.65 - 1.30;

C_{Cu} and C_S are the concentrations of copper and sulphide sulphur in the charge, mass %,

and to cool the bottom layer of crude lead to 330 - 900 °C with the formation, in addition to crude lead and lead-depleted zinc-containing slag, copper-enriched matte.

Such a flow rate of oxygen for the smelting and cooling of the bottom layer of crude lead to a temperature within the above range ensures the preparation of crude lead with minimum content of copper and sulphur (the main amount of copper and sulphur passes to matte).

When the sulphide sulphur/copper ratio in the oxidized melt is less than 0.65, the extraction of copper from crude lead to matte is incomplete. If this ratio exceeds 1.30, excess amount of sulphur appears in crude lead which gives rise to lead sulphides. This is undesirable since the removal of sulphur from crude lead requires a special purification.

Upon cooling the bottom layer of crude lead to the above temperatures the solubility of copper sulphide in crude lead decreases and, as the lead drops move downward, the copper content in lead becomes lower and the matte drops move upward to the slag-crude lead interface.

Since upon cooling the bottom layer of crude lead the lead being purified from copper and copper removed therefrom move in the opposite directions, a continuous refinement of crude lead from copper with the formation of matte is attained.

If the bottom layer of lead is cooled to a temperature above 900 °C, the quality of lead refinement from copper deteriorates sharply. If the bottom layer of crude lead is cooled to a temperature below 330 °C, the quality of lead refinement from copper does not improve since this is accompanied with a gradual decrease of the bath height of melted crude lead and a rise in energy consumption for maintaining the required slag temperature as well as with difficulties arising when removing lead purified from copper.

It is seen from the above that realization of the process at a flow rate of the oxygen-containing gas determined by relationship /3/ and upon cooling the bottom layer of crude lead improve the quality of crude lead and, in the long run, decrease the losses thereof in the course of subsequent refining.

To ensure the optimum degree of charge desulphurization, maximum possible heat liberation at the melting stage, better conditions of charge oxidation and oxidized melt reduction, and maximum lead extraction, it is recommended to deliver the charge together with oxidized return dusts for smelting through a burner with the effective cross-section diameter being determined from the following relationship:

$$d_e = \sqrt{\frac{0.01911 \cdot C_S \cdot \delta \cdot M \cdot \tau}{\rho \cdot H}} , \qquad /4/$$

where d_e is the effective cross-section diameter of the burner, m ;

δ is the desulphurization degree determined as a ratio of the amount of sulphur in the smelting gases to that in the charge;

M is the consumption of the charge, kg/s;

ρ is the density of the oxygen-containing gas, kg/m^3;

H is the height of the melting zone, m;

$$\tau = -0.0703 + 0.3031 \cdot \delta - 0.0157 \cdot \delta^2 - 8.17 \cdot 10^{-5} \cdot \delta \cdot C_{CaO} -$$
$$-3.64 \cdot 10^{-3} \cdot C_{SiO_2} + 1.83 \cdot 10^{-5} \cdot C^2_{SiO_2} + 8.899 \cdot 10^{-4} C_{CaO} +$$
$$+2.768 \cdot 10^{-3} \cdot C_{CaO, s} \qquad /5/$$

C_S, C_{CaO}, C_{SiO_2} are the concentrations of sulphide sulphur, calcium oxide and silicon dioxide in the charge, mass %.

If the effective cross-section diameter of the burner does not correspond to that calculated by formula /4/, the following undesirable effects are observed. If the effective cross-section diameter of the burner is smaller than the calculated one (a high rate of flowing of the sulphide material), the required desulphurization degree is not attained because of a short residence time of the material in the melting zone which enhances the amount of lead in matte and decreases lead extraction into crude metal, and, hence, increases the losses of lead. If the effective cross-section diameter of the burner exceeds the calculated one, the residence time of the material in the melting zone becomes greater than the required time (the flowing rate of the sulphide material exceeds the required one) as a result of which the reoxidation of the charge takes place, the conditions of lead oxide reduction deteriorate, and, hence, the losses of lead with zinc-containing slag increase.

It is expedient, prior to the delivery of the charge for smelting through the burner, to grind 4.5 - 13 % of the mass of the initial charge to a particle size 4 - 8 times smaller than the particle size of the initial charge after which to mix the ground part with the rest part of the charge.

We have shown that upon oxidation of sulphide ores and/or concentrates under the conditions of heating thereof by the heat releasing in the course of oxidation, an increase in the rate of the heterogeneous reaction after grinding proves to be by 50 - 80 % higher than it can be expected from the ratio of the particle sizes of the initial and ground fractions of the charge. Due to a considerable increase in the oxidation rate of the partially ground charge as compared to that of the initial charge, the partially ground charge is oxidized completely in the upper part of the melting zone and the heat liberated during oxidation thereof is used for heating and melting of the coarse fraction dominating in the charge as a result of which oxidation of larger particles of the sulphide material becomes more intense and a high-temperature region of the melting zone is extended. The extension of the high-temperature region of the melting zone enhances 2.1 - 3.6 times the residence time of the charge in this region, increases noticeably the rate of sulphide interaction with oxygen of the gaseous phase and the rate of interaction of higher iron oxides with sulphides.

As a result of increasing the residence time of the charge at high temperatures, the degree of using oxygen of the gaseous phase and especially oxygen bonded in higher iron oxides rises. A lowered content of higher iron oxides in the prepared oxidized melt results in that upon subsequent reduction of the melt the consumption of a solid carbon-containing material for the reduction of higher iron oxides decreases.

We have found that upon the addition of the ground fraction in amount less than 4.5 % of the mass of the initial charge, the amount of heat liberated in the reaction is insufficient for the temperature of intense oxidation of the charge in the upper part of the melting zone to be attained. Similarly, the addition of the material with grinding degree less than 4 does not ensure a sufficiently high oxidation rate needed for initiating the oxidation of the main coarse fraction of the charge.

If the ground fraction is added in amount more than 13 % of the mass of the initial charge or with a very high grinding degree of sulphide material (exceeding 8), the amount of oxidized return dusts grows sharply and the expenses for additional grinding the material become essential.

As is seen from the above, the grinding of the part of the charge increases the coefficient of using oxygen, i.e. transforms completely the metals from the sulphide form to the oxide one and as a result of which lead extraction at the reduction stage rises by 0.2 - 0.5 %. In addition, such a technique makes it possible to cut down the consumption of the solid carbon-containing material.

It is expedient to oxidize lead-containing zinc vapours formed in the course of sedimentation of lead-depleted zinc-containing slag with an oxygen-containing gas under a pressure of from -19.6 to +19.6 Pa with the formation of coarsely dispersed oxidized sublimates enriched with zinc oxide ~~with copper and finely dispersed oxidized sublimates~~

~~enriched with copper~~ and finely dispersed oxidized sublimates enriched with lead oxide and to supply said finely dispersed oxidized sublimates for smelting.

Upon sedimentation of zinc-containing slag, lead and zinc pass partially into a vapour state. In the course of oxidation of said vapours under a pressure of from -19.6 to +19.6 Pa an effective separation of lead and zinc takes place in the obtained oxidized sublimates: zinc concentrates in coarsely dispersed sublimates and lead in finely dispersed ones delivered for smelting.

A high content of lead in finely dispersed sublimates exceeding that in the charge makes it expedient to return the sublimates to the smelting stage which increases extraction of lead.

Oxidation of lead-containing zinc vapours under pressure beyond the above limits rules out the possibility of enriching coarsely dispersed oxidized sublimates with zinc and finely dispersed oxidized sublimates with lead and, hence, makes impossible the use of oxidized finely dispersed sublimates as a return material in the course of smelting.

Thus, due to oxidation of lead-containing zinc vapours under a pressure of -19.6 to +19.6 Pa, it becomes possible to enrich the fraction of finely dispersed sublimates with lead and to enhance lead extraction by 0.3 - 0.4 %.

The proposed method of processing sulphide lead and sulphide lead-zinc ores and/or concentrates containing the compounds of metals, including iron and copper compounds, silicon dioxide, aluminium, calcium and magnesium oxides is performed in the following way.

To realize the proposed method, a smelting aggregate is used ("Non-ferrous metals", No. 8, 1977. A.P.Sychev, "Oxygen-electrothermal processing of lead concentrates in KIVCRT-CS aggregate", pp.8-15).

A charge consisting of sulphide lead or sulphide lead-zinc ores and/or concentrates and a flux is dried to a moisture content no more than 1 mass % and delivered together with oxidized return dusts for smelting through a burner of the smelting aggregate. As a flux use is made of a mixture of lime or limestone with an iron-containing material at a calcium oxide/iron mass ratio in the mixture of from 0.43 to 0.76, the mixture being used in amount from 5 to 22 % of the mass of the initial ore and/or concentrate as calculated for the sum of calcium oxide and iron in the mixture. The smelting of the above charge together with oxidized return dusts is carried out in a vertical flame in the atmosphere of an oxygen-containing gas. As an oxygen-containing gas use can be made of commercial oxygen or oxygen-enriched air.

If concentration of copper in the initial sulphide materials exceeds 1 mass %, it is recommended to perform the smelting process at a flow rate of the oxygen-containing gas, as calculated for oxygen, less than the stoichiometric flow rate required for a complete oxidation of metals and sulphide sulphur in the charge (i.e. it is recommended to carry out the smelting with the formation copper-enriched matte). If concentration of copper in the initial sulphide materials is no more than 1 mass %, it is expedient to perform the smelting process without the formation of matte at a flow rate of the oxygen-containing gas, as calculated for oxygen, exceeding the stoichiometric amount required for a complete oxidation of metals and sulphide sulphur in the charge.

After smelting an oxidized melt is obtained containing, predominantly oxides of metals and a mixture of oxidized return dusts with the gases of smelting. Said mixture of oxidized return dusts with the gases of smelting are delivered through a gas-exhaust stand pipe of the smelting aggregate into a device for separating oxidized return dusts from the smelting gases, for instance, into an electrofilter. The oxidized return dusts are fed again for smelting into the smelting aggregate.

The obtained oxidized melt is filtered through a layer of a solid carbon-containing material (for instance, coke or coal). This is accompanied with a reduction of metal oxides, predominantly of lead oxide, to metals. As a result, crude lead and lead-depleted zinc-containing matte are obtained, or the same products and copper-enriched matte. Said melted products flow into an electrothermal zone of the smelting aggregate, a furnace bottom being common for the electrothermal and melting zones. In the electrothermal zone zinc-containing slag is sedimented and the following layers are formed: a bottom layer of crude lead and an upper layer of lead-depleted zinc-containing slag; if copper-enriched matte is present, it forms an intermediate layer between crude lead and slag. Upon sedimentation of the slag lead-containing zinc vapours are formed which are fed together with the gases of the electrothermal zone into a device (for instance, an afterburner) for oxidation of said vapours. An oxygen-containing gas (for instance, oxygen-enriched air) is also fed to the same device. As a result, oxidized coarsely and finely dispersed sublimates are obtained containing almost equal amounts of lead and zinc oxides. The coarsely dispersed sublimates are condensated in said device for oxidation of the vapours. The finely dispersed sublimates in a mixture with the gases of the electrothermal zone are delivered for separation, for instance, into a sleeve-like filter. The coarsely and finely dispersed sublimates are fed to a further processing for extraction zinc and lead therefrom.

As a result of the above-described processing of sulphide material, crude lead, lead-depleted zinc-containing slag, copper-enriched matte (if required), and gases of the smelting process are obtained. Crude lead is delivered for a finer purification from copper and other impurities, lead-depleted zinc-containing slag is fed for zinc extraction, copper-enriched matte for preparation of copper, and the smelting gases for preparation of sulphuric acid.

When copper concentration in the initial sulphide material is no more than 1 mass %, it is recommended to carry out the smelting process at a flow rate of the oxygen-containing gas determined from relationship /1/. For this purpose the stoichiometric flow rate (B) of oxygen is determined from the content of lead, zinc, iron, copper and sulphide sulphur in the initial charge. Then from concentrations in the charge of SiO_2, Al_2O_3, CaO, MgO and Fe (as calculated for FeO) (adopting that the sum of their concentrations is 1), the parameter A is determined from equation /2/. The height H of the melting zone being known, the parameter K is found. After determining the value of A, B and K from equation /1/, the required flow rate of the oxygen-containing gas (as calculated for oxygen) per ton of the charge can be found after which the smelting is performed at the flow rate thus calculated.

When concentration of copper in the initial sulphide material is more than 1 mass %, it is expedient to perform the smelting at a flow rate of the oxygen-containing gas determined by equation /3/ and simultaneously to cool (for instance, with air) the bottom layer of crude lead adjoining to the furnace bottom of the smelting aggregate to 330 - 900 °C.

As a result of processing sulphide materials at the above flow rate of the oxygen-containing gas and cooling the bottom layer of crude lead, in addition to crude lead and lead-depleted zinc-containing slag copper-enriched matte is also obtained.

To ensure the best conditions of the smelting process, the effective cross-section diameter of the burner is recommended to be determined from equation /4/.

It is expedient, prior to the delivery of the charge for smelting through a burner, to grind the part of the charge in amount 4.5 - 13 % of the mass of the initial charge to a particle size 4 - 8 times smaller than the particle size of the initial charge and to mix the ground part of the charge with the rest part thereof.

It is recommended to oxidize lead-containing zinc vapours formed upon sedimentation of lead-depleted zinc-containing slag in, for instance, an afterburner with an oxygen-containing gas (commercial oxygen or oxygen-enriched air) under a pressure of from -19.6 to +19.6 Pa. As a result, coarsely dispersed oxidized sublimates enriched with zinc oxide are obtained and finely dispersed oxidized sublimates enriched with lead oxide. Said coarsely dispersed sublimates are condensated in the device where the vapours are oxidized and separated from finely dispersed sublimates after which coarsely dispersed sublimates can be used for a further extraction of zinc. Finely dispersed sublimates enriched with zinc are fed for smelting into the smelting aggregate.

For a better understanding of the present invention specific examples of realizing thereof are given hereinbelow by way of illustration.

Example 1

A sulphide lead-zinc concentrate containing (in mass%) 51.12 lead, 9.11 zinc, 0.73 copper, 3.61 iron, 16.31 sulphide sulphur, 4.48 silicon dioxide, 1.49 calcium oxide, 0.68 aluminium oxide,and 0.39 magnesium oxide is processed.

A charge is prepared by adding flux to the initial concentrate. As a flux use is made of a mixture of limestone (56 mass % of calcium oxide) with pyrite (42 mass % of iron) at a calcium oxide/iron mass ratio in the mixture equal to 0.60. Said flux is added in amount 5 % of the mass of the initial concentrate as calculated for the sum of calcium oxide and iron in the flux.

The charge composed from the sulphide concentrate and flux is dried to a moisture content of 1 mass % and fed for smelting into a smelting aggregate together with oxidized return dusts through a burner with an effective cross-section diameter equal to 0.095 m. The flow rate of the charge is 1 t/hr. Smelting is performed in a vertical flame in commercial oxygen (95 % O_2) delivered for smelting in an amount of 260 Nm^3 per ton of the charge. The height (H) of the melting zone in the aggregate is 2.0 m. As a result, an oxidized melt is obtained containing predominantly oxides of metals and a mixture of oxidized return dusts with the smelting gases. Said dusts are separated from the smelting gas in an electrofilter and the dusts are continuously returned for smelting. The amount of the dusts continuously returned for smelting is 16.4 mass % of the charge; the lead content in the dusts is 61.7 mass %.

The oxidized melt is filtered through a layer of coke used in amount 55 kg per ton of the charge. The oxides of metals, predominantly, lead oxide, are reduced to metals.

After the processing described above, crude lead is obtained containing 93.0 % lead of the total amount of lead in the initial concentrate and lead-depleted zinc-containing slag with the lead content equal to 0.79 % of the total amount of lead in the initial concentrate.

The above melted products flow into an electrothermal zone of the smelting aggregate where zinc-containing slag is subjected to sedimentation. Upon sedimentation of the slag, lead-containing zinc vapours are formed which, together with the gases of the electrothermal zone, are delivered to an afterburner for oxidation of said vapours. Air is also supplied to the afterburner.

As a result, oxidized coarsely and finely dispersed sublimates are obtained containing 45 mass % Zn and 35 mass % lead (6.1 % of the total mass of lead in the initial concentrate).

Example 2

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure similar to that given in Example 1. The flux is used representing a mixture of limestone (56 mass % of calcium oxide) and pyrite cinder (51 mass % of iron) at a calcium oxide/iron mass ratio in the mixture equal to 0.60. The flux is added in amount 22 % of the mass of the initial concentrate as calculated per sum of calcium oxide and iron in the flux. The smelting is performed in a vertical flame in oxygen-enriched air (70 % O_2) which is delivered for smelting in amount of 301 Nm^3 per ton of the charge. The amount of oxidized return dusts continuously returned for smelting is 14.1 mass % of the amount of the charge; the lead content in the dusts is 62.3 mass %.

As a result of the above-described processing, crude lead is obtained containing 93.1 % lead of the total amount of lead in the initial concentrate. In addition, lead-depleted zinc-bearing slag is obtaining 0.75 % lead of the mass of lead containing in the initial concentrate. Also formed are oxidized coarsely and finely dispersed sublimates containing 44.8 mass % of zinc and 32.7 mass % of lead (6.05 % of the mass of lead in the initial concentrate).

Example 3

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure given in Example 1. The flux is used representing a mixture of lime (70 mass % of calcium oxide) and pyrite (42 mass % of iron) at a calcium oxide/iron mass ratio in the mixture equal to 0.60. The flux is added in amount 15 % of the mass of the initial concentrate as calculated for the sum of calcium oxide and iron in the flux. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) which is delivered for smelting at a flow rate of 360 Nm^3 per ton of the charge. The amount of the oxidized return dusts continuously returned for smelting is 9.3 mass % of the amount of the charge; the lead content in the dusts is 62.7 mass %.

As a result of the above-described processing, crude lead is obtained containing 93.2 % lead of the total amount of lead in the initial concentrate and lead-depleted zinc-containing slag containing 0.81 % lead of the mass of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are obtained containing 45.1 mass % zinc and 33.8 mass % lead (5.9 % of the mass of lead in the initial concentrate).

Example 4

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure similar to that given in Example 1. The mass ratio of calcium oxide to iron in the flux is 0.43. The flux is added in amount 15 % of the mass of the initial concentrate as calculated for the sum of calcium oxide and iron in the flux. The smelting is carried out in a vertical flame in the atmosphere of commercial oxygen (85 % O_2) which is delivered for smelting at a flow rate of 370 Nm^3 per ton of the charge. The amount of oxidized return dusts continuously returned for smelting is 36.4 mass % of the amount of the charge; the lead content in the dusts is 62.3 mass %. The oxidized melt is filtered through a coal layer, the amount of coal being 71.5 kg per ton of the charge.

The described processing given rise to crude lead containing 93.0 % lead of the total amount of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.69 % lead of the amount of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 44.4 mass % zinc and 35.1 mass % lead (6.2 % of the mass of lead in the initial concentrate).

Example 5

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure similar to that given in Example 1. The mass ratio of calcium oxide to iron in the flux is 0.76. The flux is added in amount 15 %

of the mass of the initial concentrate as calculated for the sum of calcium oxide and iron in the flux. The smelting is carried out in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) which is delivered for smelting at a flow rate of 352 Nm^3 per ton of the charge. The amount of the oxidized return dusts continuously returned for smelting is 11.0 mass % of the amount of the charge; the lead content in the dusts is 61.9 mass %.

After the above-described processing crude lead is obtained containing 93.1 % lead of the total amount of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.72 % lead of the amount of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 45.1 mass % zinc and 35.1 mass % lead (6.1 % of the amount of lead in the initial concentrate).

Example 6 (for comparison)

Sulphide lead-zinc concentrate described in Example 1 is processed in accordance with the known method (US, A, 4519836) in a similar smelting aggregate under identical technological conditions. The flux is used representing a mixture of limestone (56 mass % of calcium oxide) and quartz sand (93 mass % of silicon dioxide). The mass ratio of $SiO_2+Al_2O_3$ to FeO in the charge is 0.8; the mass ratio of CaO+MgO to FeO in the charge is 0.51. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) which is delivered at a flow rate of 220 Nm^3 per ton of the charge. The amount of the oxidized return dusts continuously returned to smelting is 44.3 mass % of the amount of the charge; the lead content in the dusts is 62.1 mass %.

After the above-described processing crude lead is obtained containing 92.1 % lead of the amount of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.95 % lead of the amount of lead containing in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are obtained containing 45.1 mass % of zinc and 34.3 mass % of lead (6.8 % of the mass of lead in the initial concentrate).

As is seen from the above examples, realization of processing sulphide lead-containing materials by the proposed method (Examples 1 - 5) enhances the extraction of lead from the initial sulphide materials into crude lead by 0.9 - 1.1 % as compared with the known method (Example6) (as calculated for the mass of lead in the initial concentrate). Besides, the amount of lead returned to the smelting process with oxidized return dusts is cut down by 4.8 - 21.7 % (absolute) as calculated for the mass of lead in the initial concentrate.

Example 7

Sulphide lead-zinc concentrate containing (mass %) 52.3 lead, 9.6 zinc, 1.8 copper, 3.82 iron, 15.97 sulphide sulphur, 4.52 silicon dioxide, 1.28 calcium oxide, 0.65 aluminium oxide, and 0.26 magnesium oxide. The processing is carried out similarly to that described in Example 1. The mass ratio of calcium oxide to iron in the flux is 0.60. The flux is added in amount 15 % of the mass of the initial concentrate as calculated for the sum of calcium oxide and iron in the flux. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) which is delivered for smelting at a flow rate of 242 Nm^3 per ton of the charge. The amount of the oxidized return dusts continuously returned for smelting is 9.4 mass % of the amount of the charge; the lead content in the dusts is 61.6 mass %.

As a result of the above-described processing, crude lead is obtained containing 2.01 mass % of copper and 93.0 % lead of the mass of lead in the initial concentrate, lead-depleted zinc-containing slag with 0.81 % lead of the amount of lead in the initial concentrate, and matte containing 20.1 mass % of copper and 4.3 % of lead of the amount of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 43.9 mass % zinc and 32.4 mass % lead (1.8 % of the mass of lead in the initial concentrate).

Example 8

Sulphide lead-zinc concentrate containing (in mass %) 51.12 lead, 9.11 zinc, 0.73 copper, 3.61 iron, 16.31 sulphide sulphur, 4.48 silicon dioxide, 1.49 calcium oxide, 0.68 aluminium oxide and 0.39 magnesium oxide.

The charge is prepared by adding flux to the initial concentrate. As a flux use is made of a mixture of limestone (56 mass % calcium oxide) with pyrite (42 mass % iron) at a mass ratio of calcium oxide to iron in the mixture equal to 0.60. The flux is added in amount of 5 % of the mass of the initial concentrate as calculated for the sum of calcium oxide and iron in the flux. Thus prepared charge contains (in mass %) 47.68 lead, 8.39 zinc, 0.67 copper, 6.21 iron, 18.32 sulphide sulphur, 4.13 silicon dioxide, 3.09 calcium oxide, 0.63 aluminium oxide and 0.36 magnesium oxide.

The charge composed of the above sulphide concentrate and flux is dried to a moisture content of 1 mass % and delivered for smelting into a smelting aggregate together with oxidized return dusts through a burner with the effective cross-section diameter equal to 0.095 m. The flow rate of the charge is 1 t/hr. The smelting is performed in a vertical flame of the atmosphere of commercial oxygen (95 % O_2) which is fed in amount determined from the relationship /1/. Found: $C_i = 0.492$, $C_a = 0.294$, $C_b = 0.214$, $A = 0.823$, $K = 1.483$ (the height of the melting zone in the smelting aggregate, H, is 2.0 m), $B = 181$. From here the flow rate (P) of the oxygen-containing gas as calculated for oxygen is 221 Nm^3 per ton of the charge or, taking into account the concentration of oxygen in the oxygen-containing gas, 233 Nm^3 per ton of the charge.

As a result, an oxidized melt is obtained containing predominantly oxides of metals and a mixture of oxidized return dusts with the gases of smelting. The dusts are separated from the gases of smelting in an electrofilter and continuously returned for smelting. The amount of oxidized return dusts continuously returned for smelting is 15.6 mass % of the amount of the charge; the lead content in the dusts is 62.2 mass %.

The oxidized melt is filtered through a layer of coke taken in amount 50 kg per ton of the charge. Metal oxides, predominantly lead oxide, are reduced to metals.

As a result of the above-described processing, crude lead is obtained containing 93.8 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-bearing slag containing 0.43 % lead of the mass of lead in the initial concentrate.

The melted products flow into an electrothermal zone of the smelting aggregate where zinc-containing slag is subjected to sedimentation. In the course of sedimentation lead-containing zinc vapours are formed which, together with the gases of the electrothermal zone, are delivered to an afterburner for oxidation of said vapours. Air is supplied to the same device.

As a result, oxidized coarsely and finely dispersed sublimates containing 45,3 mass % of zinc and 35.1 mass % of lead (5.6 % of the mass of lead in the initial concentrate).

Example 9

Sulphide lead concentrate containing (in mass %) 67.43 lead, 2.71 zinc, 0.48 copper, 2.84 iron, 15.33 sulphide sulphur, 4.6 silicon dioxide, 1,45 calcium oxide, 0.07 magnesium oxide and 0.01 aluminium oxide is processed by following the procedure described in Example 8. The charge thus prepared contains 62.10 lead, 2.50 zinc, 0.44 copper, 5.5 iron, 17.42 sulphide sulphur, 4.24 silicon dioxide, 3.06 calcium oxide, 0.06 magnesium oxide, and 0.01 aluminium oxide (mass %). The smelting is carried out in a vertical flame of the oxygen-enriched air (80 % O_2) delivered in amount determined by the relationship /1/.

Found: $C_1 = 0.49$, $C_a = 0.294$, $C_b = 0.216$, $A = 0.824$, $K = 1.483$ ($H = 20$ m), $B = 164$. From here the flow rate P of the oxygen-containing gas, as calculated for oxygen, is 200 Nm^3 per ton of the charge or, taking into account oxygen concentration in the oxygen-containing gas, the flow rate is 250 Nm^3 per ton of the charge. The amount of oxidized return dusts continuously returned for smelting is 15.7 mass % of the amount of the charge; the lead content in the dusts is 62.4 mass %.

The oxidized melt is filtered through a layer of coke taken in amount 86 kg per ton of the charge.

As a result of the above-described processing, crude lead is obtained containing 93.9 % lead of the total amount of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.41 % lead of the total amount of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 44.2 mass % of zinc and 33.6 mass % of lead (5.6 % of the mass of lead containing in the initial concentrate).

It is seen from Examples 1 - 5, 8, 9 of realizing the proposed method of processing sulphide lead-containing materials that realization of the method as described in Examples 8 and 9 as compared with Examples 1 - 5 enhances the extraction of lead from the initial sulphide materials into crude lead by 0.5 - 0.9 % of the mass of lead in the initial concentrate. Besides, the consumption of a solid carbon-containing reducer decreases by 9.1 mass % and that of an oxygen-containing gas by 10.4 mass %.

Example 10

A mixture of sulphide lead-zinc concentrate and a sulphide lead ore containing (in mass %) 40.39 lead, 8.24 zinc, 1.99 copper, 6.24 iron, 17.96 sulphide sulphur, 6.15 silicon dioxide, 2.28 calcium oxide, 2.76 aluminium oxide and 2.05 magnesium oxide is processed.

The charge is prepared by adding a flux to the initial mixture of the concentrate and ore. As a flux use is made of a mixture of limestone (56 mass % of calcium oxide) and pyrite (42 mass % of iron) at a mass ratio of calcium oxide to iron in the mixture equal to 0.60. The flux is added in amount 5 % of the mass of the initial sulphide material (a mixture of concentrate with ore) as calculated for the sum of calcium oxide and iron in the flux. The charge contains (in mass %) 37.2 lead, 7.59 zinc, 1.83 copper, 8.63 iron, 19.84 sulphide sulphur, 5.66 silicon dioxide, 3.82 calcium oxide, 2.54 aluminium oxide and 1.89 magnesium oxide.

The charge is dried to a moisture content of 1 mass % and delivered for smelting into a smelting aggregate together with oxidized return dusts through a burner with the effective cross-section diameter equal to 0.06 m. The flow rate of the charge is 1 t/hr. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2). The smelting is performed at a stoichiometric flow rate of the oxygen-containing gas equal to 50.4 Nm^3 per ton of the charge as calculated for oxygen required for a complete oxidation of lead, iron and zinc in the charge. The flow rate (Q) of the oxygen-containing gas, as calculated for oxygen, per 1 ton of sulphide sulphur in the charge is determined from relationship /3/, where n = 1.30; Q proves to be 0.616 Nm^3. The flow rate of the oxygen-containing gas (as calculated for oxygen) for the whole amount of sulphide sulphur (198.4 kg) in a ton of the charge is 122.2 Nm^3. The total flow rate of the oxygen-containing gas as calculated for oxygen is 172.6 Nm^3 per ton of the charge or, taking into account oxygen concentration in the oxygen-containing gas, 182 Nm^3 per ton of the charge. The height of the melting zone in the smelting aggregate (H) is 2.0 m.

An oxidized melt is obtained containing predominantly oxides of metals and a mixture of oxidized return dusts with the gases of smelting. The dusts are separated from the gases of smelting in an electrofilter and continuously returned for smelting. The amount of the oxidized return dusts continuously returned for smelting is 16.5 mass % of the amount of the charge; the lead content in the dusts is 62.5 mass %.

The oxidized melt is filtered through a layer of coke taken in amount 52 kg per ton of the charge. The oxides of metals, predominantly lead oxide, are reduced to metals.

After the above-described processing, crude lead is obtained containing 0.55 mass % copper and 93.1 % lead of the mass of lead in the initial sulphide material (the mixture of the concentrate with the ore), lead-depleted zinc-containing slag with 0.66 % lead of the mass of lead in the initial sulphide material, and matte containing 25.4 mass % of copper and 3.5 % of lead of the mass of lead in the initial sulphide material.

The melted products flow into the electrothermal zone of the smelting aggregate where lead-depleted zinc-containing slag is sublected to sedimentation. The bottom layer of crude lead adjoining the furnace bottom is continuously cooled with air to 650 °C. Upon sedimentation of the slag lead-containing zinc vapours are formed which, together with the gases of the electrochemical zone, are fed into an afterburner for oxidation of said vapours. Air is fed into the same device.

As a result, oxidized coarsely and finely dispersed sublimates are formed containing 45.5 mass % of zinc and 35.0 mass % of lead (2.6 % of the mass of lead containing in the initial sulphide material).

Example 11

A mixture of sulphide lead-zinc ore and sulphide lead concentrate containing (in mass %) 46.04 lead, 10.04 zinc, 2.20 copper, 6.16 iron, 20.24 sulphide sulphur, 6.62 silicon dioxide, 2.18 calcium oxide, 2.39 aluminium oxide and 2.18 magnesium oxide is processed by following the procedure described in Example 10. The prepared charge contains (in mass %) 42.4 lead, 9.25 zinc, 2.03 copper, 8.56 iron, 21.94 sulphide sulphur, 6.1 silicon dioxide, 3.73 calcium oxide, 2.2 aluminium oxide and 2.01 magnesium oxide. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) at a stoichiometric flow rate of the oxygen-containing gas as calculated for oxygen required for a complete oxidation of lead, iron, and zinc in the charge equal to 55.8 Nm^3

per ton of the charge. The flow rate (Q) of the oxygen-containing gas, as calculated for oxygen, per 1 kg of the sulphide sulphur in the charge is determined by the equation /3/, where n = 1.05, is 0.632 Nm^3. The flow rate of the oxygen-containing gas, as calculated for oxygen, for the whole amount of sulphide sulphur (219.4 kg) in one ton of the charge is 138.7 Nm^3. The total flow rate of the oxygen-containing gas as calculated for oxygen is 194.5 Nm^3 per ton of the charge or, taking into account the oxygen concentration in the oxygen-containing gas, 204 Nm^3 per ton of the charge. The amount of the oxidized return dusts continuously returned for smelting is 16.5 mass % of the amount of the charge; the lead content in the dusts is 62.0 mass %.

After the above-described processing, crude lead is obtained containing 0.88 mass % of copper and 93.0 % of lead of the mass of lead in the initial sulphide material (the mixture of the ore with the concentrate), lead-depleted zinc-containing slag with 0.68 % of lead of the mass of lead in the initial sulphide material, and matte containing 26.8 mass % of copper and 3.41 % of lead of the mass of lead in the initial sulphide material.

The bottom layer of crude lead adjoining the bottom furnace of the aggregate is constantly cooled with air to 900 °C.

In addition to the above products, oxidized coarsely and finely dispersed sublimates are formed containing 44.1 mass % of zinc and 35.6 mass % of lead (2.8 % of the mass of lead in the initial sulphide material).

Example 12

A mixture of sulphide lead-zinc ore and lead concentrate containing (in mass %) 46.04 lead, 10.04 zinc, 2.20 copper, 6.16 iron, 20.24 sulphide sulphur, 6.62 silicon dioxide, 2.18 calcium oxide, 2.39 aluminium oxide and 2.18 magnesium oxide is processed by following the procedure described in Example 10. The charge prepared contains (in mass %) 42.4 lead, 9.25 zinc, 2.03 copper, 8.56 iron, 21.94 sulphide sulphur, 6.1 silicon dioxide, 3.73 calcium oxide, 2.2 aluminium oxide and 2.01 magnesium oxide. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) at a stoichiometric flow rate of the oxygen-containing gas, as calculated for oxygen, required for a complete oxidation of lead, iron, zinc in the charge and equal to 55.8 Nm^3 per ton of the charge. The flow rate (Q) of the oxygen-containing gas, as calculated for oxygen, per 1 kg of sulphide sulphur in the charge is determined from equation /3/, wnere n = 1.05, and equals to 0.632 Nm^3. The flow rate of the oxygen-containing gas, as calculated for oxygen, for the total amount of sulphide sulphur (219.4 kg) in one ton of the charge is 138.7 Nm^3. The total flow rate of the oxygen-containing gas, as calculated for oxygen, is 194.5 Nm^3 per ton of the charge or, taling into account the concentration of oxygen in the oxygen-containing gas, 204 Nm^3 per ton of the charge. The amount of oxidized return dust continuously returned for smelting is 16.4 mass % of the amount of the charge; the lead content in the dusts is 62.1 mass %.

The above-described processing gives rise to crude lead containing 0.56 % copper and 93.2 % lead of the mass of lead in the initial sulphide material (the mixture of ore with concentrate), lead-depleted zinc-containing slag with 0.73 % lead of the mass of lead in the initial concentrate, and matte containing 25.9 mass % of copper and 3.55 % lead of the mass of lead in the initial sulphide material.

The bottom layer of crude lead adjoining the bottom furnace of the smelting aggregate is cooled with air to 650 °C.

In addition to the above products oxidized coarsely and finely dispersed sublimates are formed containing 44.9 mass % zinc and 35.1 mass % lead (2.4 % of the mass of lead in the initial sulphide material).

Example 13

A mixture of sulphide lead-zinc ore and lead concentrate containing (in mass %) 46.04 lead, 10.04 zinc, 2.20 copper, 6.16 iron, 20.24 sulphide sulphur, 6.62 silicon dioxide, 2.18 calcium oxide, 2.39 aluminium oxide and 2.18 magnesium oxide is processed by following the procedure described in Example 10. The prepared charge contains (in mass %) 42.4 lead, 9.25 zinc, 2.03 copper, 8.56 iron, 21.94 sulphide sulphur, 6.1 silicon dioxide, 3.73 calcium oxide, 2.2 aluminium oxide and 2.01 magnesium oxide. The smelting is performed in a vertical flame in an oxygen-enriched air atmosphere (70 % O_2) at a stoichiometric flow rate of the oxygen-containing gas, as calculated for oxygen, required for a complete oxidation of lead, iron, zinc in the charge equal to 55.8 Nm^3 per ton of the charge. The flow rate (Q) of the oxygen-containing gas, as calculated for oxygen, per 1 kg of sulphide sulphur in the charge is determined from equation /3/, where $n = 0.65$, and equals to 0.658 Nm^3. The flow rate of the oxygen-containing gas, as calculated for oxygen, for the total amount of sulphide sulphur (219.4 kg) in one ton of the charge is 144.3 Nm^3. The total flow rate of the oxygen-containing gas, as calculated for oxygen, is 200.1 Nm^3 per ton of the charge or, taking into account the concentration of oxygen-containing gas, 286 Nm^3 per ton of the charge. The amount of oxidized return dusts continuously returned for smelting is 17.2 mass % of the amount of the charge; the lead content in the dusts is 61.7 mass %.

The described processing gives rise to crude lead containing 0.62 mass % copper and 93.1 % lead of the mass of lead in the initial sulphide material (the mixture of ore with concentrate), lead-depleted zinc-containing slag with 0.75 % lead of the mass of lead in the initial sulphide material, and matte containing 25.5 mass % copper and 3.72 % lead of the mass of lead in the initial sulphide material.

The bottom layer of crude lead adjoining the bottom furnace of the smelting aggregate is cooled with air to 650 °C.

In addition to the above products oxidized coarsely and finely dispersed sublimates are formed containing 45.0 mass % zinc and 35.0 mass % lead (2.3 % of the mass of lead in the initial sulphide material).

Example 14

A mixture of sulphide lead-zinc ore and lead concentrate containing (in mass %) 46.04 lead, 10.04 zinc, 2.20 copper, 6.16 iron, 20.24 sulphide sulphur, 6.62 silicon dioxide, 2.18 calcium oxide, 2.39 aluminium oxide and 2.18 magnesium oxide is processed by following the procedure described in Example 10. The prepared charge contains (in mass %) 42.4 lead, 9.25 zinc, 2.03 copper, 8.56 iron, 21.94 sulphide sulphur, 6.1 silicon dioxide, 3.73 calcium oxide, 2.2 aluminium oxide and 2.01 magnesium oxide. The smelting is performed in a vertical flame in the atmosphere of commercial oxygen (95 % O_2) at a stoichiometric flow rate of the oxygen-containing gas, as calculated for oxygen, required for a complete oxidation of lead, iron,and zinc in the charge and equal to 55.8 Nm^3 per ton of the charge. The flow rate (Q) of the oxygen-containing gas, as calculated for oxygen, for 1 kg of sulphide sulphur in the charge is determined from equation /3/, where n = 1.05, and equals to 0.632 Nm^3. The flow rate of the oxygen-containing gas, as calculated for oxygen, for the total amount of sulphide sulphur (219.4 kg) in one ton of the charge is 138.7 Nm^3. The total flow rate of the oxygen-containing gas, as calculated for oxygen, is 194.5 Nm^3 per ton of the charge or, taking into account the concentration of oxygen in the oxygen-containing gas, 204 Nm^3 per ton of the charge. The amount of return dusts continuously returned for smelting is 15.5 mass % of the amount of the charge; the lead content in the dusts is 61.9 mass %.

As a result of the above-described processing, crude lead is obtained containing 0.33 mass % copper and 93.3 % lead of the mass of lead in the initial sulphide material (the mixture of ore with concentrate), lead-depleted zinc-containing slag with 0.70 % lead of the mass of lead in the initial sulphide material, and matte containing 24.1 mass % copper and 3.88 % lead of the mass of lead in the initial sulphide material.

The bottom layer of crude lead adjoining the bottom furnace of the smelting aggregate is constantly cooled with air to 330 °C.

In addition to the above products, oxidized coarsely and finely dispersed sublimates are formed containing 44.7 mass % zinc and 35.1 mass % lead (2.0 % of the mass of lead contained in the initial sulphide material).

From Examples 7, 10 - 11 of realizing the proposed method of processing sulphide lead-containing materials it is seen that realization of the method according to Examples 10 - 14 essentially improves the quality of lead and matte as compared with Example 7. The stage of the refinement of crude lead from copper is not required in this case.

Example 15

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure given in Example 1. The prepared charge contains (im mass %) 47.08 lead, 8.39 zinc, 0.67 copper, 6.21 iron, 18.32 sulphide sulphur, 4.13 silicon dioxide, 3.09 calcium oxide, 0.63 aluminium oxide, 0.36 magnesium oxide. The charge is delivered for smelting into a smelting aggregate together with oxidized return dusts through a burner with the effective cross-section diameter (d_e) determined from equation /4/, where the density (ρ) of commercial oxygen is 1.42 kg/m^3, the flow rate (M) of the charge is 0.278 kg/s, desulphurization degree (δ) 1.0, parameter τ equals to 0.2176 s (τ is calculated by equation /5/). The effective cross-section diameter (d_e) of the burner is 0.089 m. The amount of oxidized return dusts continuously returned for smelting is 16.4 mass % of the amount of the charge; the lead content in the dusts is 59.18 mass %.

The above-described processing gives rise to crude lead containing 93.4 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.41 % lead of the mass of lead in the initial concentrate. Besides, oxidized coarsely and finely dispersed sublimates are formed containing 46.1 mass % zinc and 33.4 mass % lead (6.1 % of the mass of lead in the initial concentrate).

Example 16

Sulphide lead-zinc concentrate described in Example 8 is processed by following the procedure given in Example 8. The prepared charge is delivered for smelting into a smelting aggregate together with oxidized return dusts through a burner with the effective cross-section diameter (d_e) determined by equation /4/, where the density (ρ) of commercial oxygen is 1.42 kg/m^3, the flow rate of the charge (M) is 0.278 kg/s, desulphurization degree (δ) is 1.0, parameter τ is 0.2176 s (τ is calculated by equation /5/). The effective cross-section diameter (d_e) of the burner is 0.089 m. The amount of oxidized return dusts continuously returned for smelting is 15.1 mass % of the amount of the charge; the lead content in the dusts is 60.87 mass %.

The above-described processing gives rise to crude lead containing 94.0 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.44 % lead of the mass of lead in the initial concentrate. Besides, oxidized coarsely and finely dispersed sublimates are obtained containing 45.3 mass % zinc and 34.1 mass % lead (5.5 % of the mass of lead containing in the initial concentrate).

Example 17

A mixture of sulphide ore and sulphide lead-zinc concentrate described in Example 10 is processed by following the procedure given in Example 10. The prepared charge is delivered for smelting into a smelting aggregate together with oxidized return dusts through a burner with the effective cross-section diameter (d_e) determined by equation /4/ where the density (ρ) of commercial oxygen is 1.42 kg/m^3, the flow rate of the charge is 0.278 kg/s, desulphurization degree (δ) is 0.5, the parameter τ is 0.101 s (τ is calculated by equation /5/). The effective cross-section (d_e) of the burner is 0.043 m. The amount of oxidized return dusts continuously returned for smelting is 16.4 mass % of the amount of the charge; the lead content in the dusts is 62.6 mass %.

As a result of the above-described processing, crude lead is obtained containing 0.5 mass % copper and 93.3 % lead of the mass of lead in the initial sulphide material (the mixture of ore with concentrate) and lead-depleted zinc-containing slag with 0.61 % lead of the mass of lead in the initial sulphide material as well as matte containing 26.6 mass % copper and 3.1 % lead of the mass of lead in the initial sulphide material. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 45.5 mass % zinc and 35.1 mass % lead (2.9 % of the mass of lead in the initial sulphide material).

Example 18

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure given in Example 1. Prior to delivering the charge for smelting through a burner, the part of the charge in amount 8.8 % of the mass of the initial charge is ground to a particle size four times smaller than the particle size of the initial charge after which the ground part is mixed with the rest part of the charge and fed for smelting. The amount of oxidized return dusts continuously returned for smelting is 13.3 mass % of the amount of the charge; the lead content in the dusts is 62.3 mass %.

The oxidized melt is filtered through a layer of coke taken in amount 48 kg per ton of the charge.

The above-described processing gives rise to crude lead containing 93.5 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.7 % lead of the mass of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are obtained containing 45.6 mass % zinc and 34.7 mass % lead (5.8 % of the mass of lead in the initial concentrate).

Example 19

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure given in Example 1. Prior to delivering the charge through a burner for smelting, the part of the charge (8.8 %) of the mass of the initial charge is ground to a particle size eight times smaller than the size of the initial charge after which the ground fraction is mixed with the rest part of the charge and fed for smelting. The amount of oxidized return dusts continuously returned for smelting is 15.3 mass % of the amount of the charge; the lead content in the dusts is 59.9 mass %.

The oxidized melt is filtered through a layer of coke taken in amount 49 kg per ton of the charge.

The above-described processing gives rise to crude lead containing 98.6 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.7 % lead of the mass of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 45.5 mass % zinc and 34.8 % lead (5.6 % of the mass of lead in the initial concentrate).

Example 20

Sulphide lead-zinc concentrate described in Example 2 is processed by following the procedure given in

Example 8. Prior to delivering the charge for smelting through a burner, the part of the charge (8.8 % of the mass of the initial charge) is ground to a particle size six times smaller than the particle size of the initial charge and fed for smelting. The amount of oxidized return dusts continuously returned for smelting is 16.0 mass % of the amount of the charge; the lead content in the dusts is 61.3 mass %.

The oxidized melt is filtered through a layer of coke used in amount 43 kg per ton of the charge.

As a result of the above-described processing, crude lead is obtained containing 94.1 % of lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag containing 0.44 % lead of the mass of lead in the initial concentrate. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 45.5 mass % zinc and 34.3 mass % lead (5.4 % of the mass of lead in the initial concentrate).

Example 21

Sulphide lead-zinc concentrate described in Example 8 is processed by following the procedure given in Example 8. Prior to delivering the charge through a burner for smelting, the part of the charge (13 % of the mass of the initial charge) is ground to a particle size six times smaller than the size of the initial charge after which the ground fraction is mixed with the rest part of the charge and fed for smelting. The amount of oxidized return dusts continuously returned for smelting is 16.3 mass % of the amount of the charge; the lead content in the dusts is 61.0 mass %.

The oxidized melt is filtered through a layer of coke used in amount 44 kg per ton of the charge.

The above-described processing gives rise to crude lead containing 94.1 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.46 % lead of the mass of lead in the initial concentrate. Besides, oxidized coarsely and finely dispersed sublimates are formed containing 45.5 mass % zinc and 34.5 mass % lead (5.4 % of the mass of lead in the initial concentrate).

Example 22

A mixture of sulphide lead ore and sulphide lead-zinc concentrate described in Example 10 was processed by following the procedure given in Example 10. Prior to delivering the charge through a burner for smelting, the part of the charge in amount 4.5 % of the mass of the initial charge is ground to a particle size six times smaller than that of the initial charge and then mixed with the rest part of the charge and fed for smelting. The amount of oxidized return dusts continuously returned for smelting is 16.6 mass % of the amount of the charge; the lead content in the dusts is 62.2 mass %.

The oxidized melt is filtered through a layer of coke used in amount 48 kg per ton of the charge.

The described processing gives rise to crude lead containing 0.56 mass % copper and 93.4 % lead of the mass of lead in the initial sulphide material (the mixture of ore with concentrate) and lead-depleted zinc-containing slag with 0.6 % lead of the mass of lead in the initial concentrate; also obtained is matte containing 3.2 % lead of the mass of lead in the initial sulphide material. In addition, oxidized coarsely and finely dispersed sublimates are formed containing 45.3 mass % zinc and 34.4 mass % lead (2.7 % of the mass of lead in the initial sulphide material).

From Examples 1, 8, 10, 18 - 22 of realizing the proposed method of processing sulphide lead-containing materials it is seen that realization of the method according to Examples 18 - 22 enhances the extraction of lead from the initial sulphide materials into crude lead by 0.2 - 0.5 % as compared with Examples 1, 8, 10 (as calculated for the mass of lead in the initial sulphide material). Besides, the consumption of a solid carbon-containing reducer decreases by 8 - 14 mass %.

Example 23

Sulphide lead-zinc concentrate described in Example 1 is processed by following the procedure given in Example 1. The amount of oxidized return dusts continuously returned for smelting is 16.4 mass % of the amount of the charge; the lead content in the dusts is 61.7 mass %.

The above-described processing results in the formation of crude containing 93.2 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.59 % lead of the mass of lead in the initial concentrate.

The pressure in the afterburner upon oxidation of lead-containing zinc vapours formed upon sedimentation of zinc-bearing slag is -19.6 Pa.

As a result, oxidized coarsely dispersed sublimates are formed containing 8.13 mass % lead and 48.2 mass % zinc (1.2 % lead of the mass of lead in the initial concentrate). The oxidized coarsely dispersed sublimates are subjected to sedimentation in the afterburner. In addition, oxidized finely dispersed sublimates are obtained containing 61.2 mass % lead and 10.75 mass % zinc (4.9 % lead of the mass of lead in the initial concentrate). The finely dispersed sublimates are separated on sleeve-like filters and fed for smelting into the smelting aggregate.

Example 24

Sulphide lead-zinc concentrate described in Example 8 is processed by following the procedure described in Example 8. The amount of oxidized return dusts continuously returned for smelting is 15.6 mass % of the amount of the charge; the lead content in the dusts is 62.2 mass %. The processing results in the formation of crude lead containing 93.9 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-containing slag with 0.38 % lead of the mass of lead in the initial concentrate.

The pressure in the afterburner upon oxidation with air of lead-containing zinc vapours formed during sedimentation of zinc-containing slag is -0.1 Pa.

As a result, oxidized coarsely dispersed sublimates are formed containing 8.0 mass % lead and 34.3 mass % zinc (1.2 % lead of the mass of lead in the initial concentrate). Said oxidized coarsely dispersed sublimates are condensed in the afterburner. In addition, oxidized finely dispersed sublimates are formed containing 61.1 mass % of the mass of lead in the initial concentrate. Said oxidized finely dispersed sublimates are separated on the sleeve-like filters and directed for smelting into the smelting aggregate.

Example 25

A mixture of sulphide lead ore and sulphide lead-zinc concentrate described in Example 10 is processed by following the procedure given in Example 10. The amount of oxidized return dusts continuously returned for smelting is 16.5 mass % of the amount of the charge; the lead content in the dusts is 62.5 mass %.

The processing results in the formation of crude lead containing 0.55 mass % copper and 93.3 % lead of the mass of lead in the initial sulphide material (the mixture of concentrate with ore) and lead-depleted zinc-containing slag with 0.46 % lead of the mass of lead in the initial concentrate: also obtained is matte containing 25.4 mass % copper and 3.5 % lead of the mass of lead in the initial sulphide material.

The pressure in the afterburner upon oxidation with air of lead-containing zinc vapours formed during sedimentation of zinc-containing slag is +19.6 Pa.

As a result, oxidized coarsely dispersed sublimates are formed containing 9.8 mass % lead and 56.5 mass % zinc (0.5 % lead of the mass of lead in the initial sulphide material). Said oxidized finely dispersed sublimates are condensed in an afterburner. Besides, oxidized finely dispersed sublimates are also formed containing

59.3 mass % lead and 12.1 mass % zinc (2.1 % lead of the mass of lead in the initial sulphide material). Said oxidized finely dispersed sublimates are separated on the sleeve-like filters and directed for smelting into the smelting aggregate.

From Examples 1, 8, 10, 23 - 25 of realizing the proposed method of processing sulphide lead-containing materials it is seen that realization of the method according to Examples 23 - 25 favours the enrichment of the oxidized finely dispersed sublimates with lead (compare with Examples 1, 8, 10). This makes it possible to direct said sublimates for smelting into the smelting aggregate, thereby increasing the extraction of lead from the initial sulphide materials into crude lead by 0.1 - 0.2 % of the mass of lead in the initial sulphide material.

Example 26

Sulphide lead-zinc concentrate described in Example 8 is processed by following the procedure given in Example 8. Prior to delivering the charge through a burner for smelting, the part of the charge in amount 8.8 % of the mass of the initial charge is ground to a particle size six times smaller than that of the initial charge. Then the ground fraction of the charge is mixed with the rest part and fed for smelting to a smelting aggregate together with oxidized return dusts through a burner. The effective cross section (d_e) of the burner is determined by equation /4/ where the density (ρ) of commercial oxygen is 1.42 kg/m^3, the flow rate of the charge (M) is 0.278 kg/s, the desulphurization degree (δ) is 1.0, the parameter τ is calculated by equation /5/. The effective cross-section diameter (d_e) of the burner is 0.089 m. The amount of the oxidized return dusts continuously returned for smelting is 15.6 mass % of the amount of the charge; the lead content in the dusts is 62.20 mass %.

The above-described processing results in the formation of crude lead containing 94.4 % lead of the mass of lead in the initial concentrate and lead-depleted zinc-bearing slag containing 0.38 % lead of the mass of lead in the initial concentrate.

The pressure in the afterburner upon oxidation with air of lead-containing zinc vapours formed during sedimentation of zinc-containing slag is -0.1 Pa.

As a result, oxidized coarsely dispersed sublimates are formed containing 8.0 mass % lead and 35.6 mass % zinc (1.2 % lead of the mass of lead in the initial concentrate). Said oxidized coarsely dispersed sublimates are condensed in an afterburner. In addition, oxidized finely dispersed sublimates are formed containing 61.1 mass % lead and 28.9 mass % zinc (4.0 % lead of the mass of lead in the initial concentrate). Said oxidized finely dispersed sublimates are separated on sleeve-like filters and fed for smelting into a smelting aggregate.

From the above Examples 8 and 26 of realizing the proposed method of processing sulphide lead-containing materials it is seen that realization of the method in accordance with Example 26 enhances the extraction of lead from the initial sulphide material into crude lead by 0.6 % of the mass of lead in the initial sulphide material as compared with Example 8.

Example 27

A mixture of sulphide lead ore and sulphide lead-zinc concentrate described in Example 10 is processed by following the procedure given in Example 10. Prior to delivering the charge through a burner for smelting, the part of the charge in amount 4.5 % of the mass of the initial charge is ground to a particle size six times smaller than that of the initial charge, mixed with the rest part of the charge, and then directed for smelting into a smelting aggregate together with oxidized return dusts through the burner. The effective cross section (d_e) of the burner is determined by equation /4/, where the density of commercial oxygen (ρ) is 1.42 kg/m^3, the flow rate of the charge (M) is 0.278 kg/s, the desulphurization degree (δ) is 0.5, the parameter τ is 0.101 s (τ is calculated by equation /5/). The effective cross section (d_e) of the burner is 0.043 m. The amount of the oxidized return dusts continuously returned for smelting is 16.5 mass % of the amount of the charge; the lead content in the dusts is 62.5 mass %.

The described processing results in the formation of crude lead containing 0.45 mass % copper and 93.8 % lead of the mass of lead in the initial sulphide material (the mixture of concentrate with ore), lead-depleted zinc-containing slag with 0.45 % lead of the mass of lead in the initial sulphide material, and matte containing 3.1 % lead of the mass of lead in the initial sulphide material.

The pressure in the afterburner upon oxidation with air of lead-containing zinc vapours formed during precipitation of zinc-containing slag is +19.6 Pa.

As a result, oxidized coarsely dispersed sublimates are obtained containing 9.8 mass % lead and 56.5 mass % zinc (0.5 % lead of the mass of lead in the initial sulphide material). Said oxidized coarsely dispersed sublimates are condensed in the afterburner. In addition, oxidized finely dispersed sublimates are formed containing 59.3 mass % lead and 12.1 mass % zinc (2.1 % lead of the mass of lead in the initial sulphide material). The oxidized finely dispersed sublimates are separated on the sleeve-like filters and directed for smelting into a smelting aggregate.

From Examples 10 and 27 of realizing the proposed method of processing sulphide lead-containing materials it is seen that realization of the method in accordance with Example 27 enhances the extraction of lead from the initial sulphide materials into crude lead by 0.7 % of the mass of lead in the initial sulphide material as compared with Example 10.

Thus, the proposed method of processing sulphide lead and sulphide lead-zinc ores and/or concentrates makes it possible to extract lead efficiently from said sulphide materials, namely, to enhance the extraction of lead into crude lead by 0.9 - 2.3 % of the mass of lead in the initial sulphide material as compared with the known method. Besides, the method ensures the extraction of sulphur from said sulphide materials into smelting gases with a high sulphur content (30 - 50 mass %) suitable for the production of sulphuric acid, the transfer of zinc into lead-depleted zinc-containing slag and into coarsely dispersed sublimates, and the transfer of copper (when the content thereof in the initial sulphide materials exceeds 1 mass %) into conditional matte.

~~CLAIMS~~

The claims defining the invention are as follows:

1. A method of processing sulphide lead or sulphide lead-zinc ores and/or concentrates containing compounds of metals, including iron and copper compounds, silicon dioxide, aluminium, calcium and magnesium oxides, comprising delivery of a charge consisting of the above sulphide materials and flux for smelting together with oxidized return dusts through a burner, smelting of said charge together with the oxidized return dusts in a vertical flame in the atmosphere of an oxygen-containing gas with the formation of an oxidized melt containing predominantly oxides of metals and a mixture of the oxidized return dusts, ~~from the~~ with smelting gases, separation of said oxidized return dusts, ~~with~~ from the smelting gases, and return of the dusts for smelting, reduction of metal oxides, predominantly lead oxide, to metals by filtrating the oxidized melt through a layer of a solid carbon-containing material with the formation of crude lead and lead-depleted zinc-containing slag, sedimentation of the slag with the formation of lead-containing zinc vapours, oxidation of said lead-containing zinc vapours with an oxygen-containing gas with the formation of coarsely and finely dispersed sublimates; the method residing in that as a flux use is made of a mixture of limestone or lime with an iron-containing material at a calcium oxide/iron mass ratio in the mixture varying from 0,43 to 0,76, the above mixture being used in amount from 5 to 22 % of the mass of the initial ore and/or concentrate as calculated for the sum of calcium oxide and iron in the mixture.

2. The method of claim 1, wherein when the sulphide lead or sulphide lead-zinc ores and/or concentrates contain a copper concentration of greater than 1 mass %, the copper-concentration is decreased and smelting of the charge with oxidized return dusts is carried out at a flow rate of the oxygen-containing gas, as calculated for oxygen, less than the stoichiometric amount required for a complete oxidation of metals and sulphide sulphur in the charge with the formation, in addition to crude lead and lead-depleted zinc-containing slag, matte enriched with copper.

3. The method claim 1, wherein when the sulphide lead or sulphide lead-zinc ores contain a copper concentration of not greater than 1 mass %, smelting of the charge together with the oxidized return dusts is carried out at a flow rate of the oxygen-containing gas determined from the relationship:

$$P = A \cdot B \cdot K ,$$

where P is the flow rate of the oxygen-containing gas as calculated for oxygen. Nm^3/t charge;

$$A = 1.542-3.299C_a-7.972C_b-4.285C_i+28.851C_aC_b+$$
$$+14.657C_aC_i+27.370C_bC_i-88.895C_bC_iC_a,$$ where

$C_a+C_b+C_i=1$ is the sum of concentrations of acid oxides C_a (SiO_2 and Al_2O_3), basic oxides C_b (CaO and MgO) and iron C_i (as calculated for FeO) in the charge, the concentrations being expressed in mass fractions;

B is the stoichiometric oxygen flow rate of the oxygen-containing gas required for a complete oxidation of metals and sulphide sulphur in the charge, Nm^3/t charge;

$K = 1 + \frac{0.965}{H}$, where H is the height of the smelting zone, m.

4. A method as claimed in Claim 1, wherein the smelting of the charge together with the oxidized return dusts is carried out at the stoichiometric flow rate of the oxygen-containing gas, as calculated for oxygen, required for a complete oxidation of lead, iron and zinc in the charge and at the consumption of the oxygen-containing gas, as calculated for oxygen, per kg of sulphide in the charge determined from the relationship:

$$Q = 0.70 \left(1 - n \frac{C_{Cu}}{C_S}\right) ,$$

where Q is the flow rate of the oxygen-containing gas, as calculated for oxygen, per kg of sulphide sulphur in the charge, Nm_3;

n is the mass ratio of sulphide sulphur to copper in the oxidized melt equal to 0.65-1.30;

C_{Cu} and C_S are concentrations of copper and sulphide sulphur in the charge, mass %,

and the bottom layer of crude lead is continuously cooled to 330-900°C with the formation, in addition to crude lead and lead-depleted zinc-containing slag, matte enriched with copper.

5. A method as claimed in any one of Claims 1 to 4, wherein prior to delivering the charge through a burner, the part of the charge in the amount 4.5-13% of the mass of the initial charge is ground to a particle size 4-8 times smaller than the particle size of the initial charge after which the ground portion of the charge is mixed with the rest of the charge.

6. A method as claimed in any one of Claims 1 to 5, wherein oxidation of lead-containing zinc vapours with the oxygen-containing gas is performed under a pressure, with respect to 1 atmosphere/760mm of a column of mercury, of from minus 19.6 to plus 19.6 Pa with the formation of coarsely dispersed oxidized sublimates enriched with zinc oxide, and finely dispersed oxidized sublimates enriched with lead oxide, said finely dispersed sublimates being fed for smelting.

7. A method of processing sulphide lead or sulphide lead-zinc ores and/or concentrates containing compounds of metals, which method is substantially as hereinbefore described with reference to any one of Examples 1 to 5 or 7 to 27.

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