METHOD OF CONTINUOUS PROCESSING OF SULFIDE ORES

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ABSTRACT

A continuous processing of sulfide ores in utilization of a combination of smelting, slagging, and blister furnaces, or of smelting and blister furnaces.

4 Claims, 4 Drawing Figures
METHOD OF CONTINUOUS PROCESSING OF SULFIDE ORES

BACKGROUND OF THE INVENTION

This invention relates to a method for continuous processing of sulfide ores, and more particularly to a method for extracting copper, nickel, cobalt, and other similar metals in large quantity and in an economical manner by treating sulfide ores of these metals through a series of furnaces that are mutually linked together and by exchange transfer of intermediate products in the molten state, all these operations being carried out continuously and successively.

SUMMARY OF THE INVENTION

It is a primary object of this invention to provide a method for attaining high thermal efficiency and high yield of metals by connecting in an uninterrupted succession the unit metallurgical stages that are fundamental to the sulfide ore processing i.e. smelting and oxidizing stages so that they may constitute an integral, continuous, sequential, and continuing whole; by simplifying and making durable the structure of individual unit furnaces which perform each fundamental unit stage as well as the structure of the means for transferring melts that link each of the unit furnaces; and by facilitating the construction, operation, and maintenance of the entire system as a direct consequence of the structural simplification and added endurance so that the metal extracting operation may be maintained constant and continuing over an indefinitely long period of time.

It is the secondary purpose of this invention to provide a method for increasing the sulfur dioxide concentration in the waste gas to a fixed high level so that it may be economically recovered for the manufacturing sulfuric acid as well as for effectively preventing air pollution.

The foregoing objects and other objects of the present invention will become more apparent from the following detailed description of the invention when read in conjunction with the accompanying drawings.

BRIEF EXPLANATION OF THE DRAWING

In the drawing:

FIG. 1 is a longitudinal section showing arrangement as well as connection of the fundamental unit furnaces according to the present invention;

FIG. 2 is an enlarged diagram showing the relative positions of product layers when matte is caused to flow by itself between the first furnace (smelting furnace) and the second furnace (slagging furnace);

FIG. 3 is an enlarged longitudinal section showing a structure to continuously transfer into the first furnace the slag produced in the second (slagging producing) furnace so as to maintain the state shown in FIG. 2; and

FIG. 4 is a longitudinal cross-section of a modified arrangement of the furnace, in which the method of the present invention is practiced with only the first furnace (smelting furnace) and the third furnace (blister furnace) shown in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

In discussing the method of this invention, examples will be taken of copper extraction, in which the metallic copper is obtained from the ore through four fundamental unit stages of: smelting the ore to be molten and separated into matte and slag (the formation of matte and slag), and recovering or stripping out the copper entrapped in a reverting slag formed at the second stage and transferred back to the first stage; forming the slag in second stage by removing the iron content in the matte produced at the first stage by oxidation (the formation of the white metal and the reverting slag); removing sulfur in the white metal produced at the second stage by further oxidation (the formation of blister copper); and refining the blister copper thus produced by adjusting or regulating the specific composition thereof (dry refining).

In the conventional copper extraction methods, it has been the usual practice to arrange either a reverberatory furnace or an autogenous flash smelting furnace for the first stage, and utilizing batch-operated converters for the second and third stages. These methods, however, are not for economical mass production, because the recovery of copper, sulfur, and other useful substances, the thermal economy, the operating efficiency, the easiness, constancy, and continuity of operation with these methods are not at all satisfactory for the purpose. This is due to various factors such that productivity of the furnaces of the smelting stage is low because, control of the furnace operations is inadequate, resulting in large fluctuations in the matte production. There has still not been developed a practical method suitable for continuous transportation by counterflow of the matte to the converter and of the reverting slag from the converter back to the smelter. Thus that the operation of the converter is fundamentally batchwise. The furnace, used is of an open structure which makes it difficult to capture waste gases; and erosion of the furnace lining, especially at the bottom portion and at the tuyere is rapid, which is detrimental to continuous furnace operations.

Attempts to overcome these shortcomings have been made by attempting the continuous operations of the converter stage. For example, a method has been proposed, in which blister copper is obtained from either ore or matte in a single furnace and in one process. In this method, however, as the slag is taken out of the furnace in a state of coexisting with blister copper, the content of the copper in the slag is too high to justify mere disposal, hence it requires to be retreated after removal. In another proposal, a furnace of a special design is used. Though apparently a single entity, the furnace has in itself three substantially independent reaction zones, i.e., the smelting zone, the blister making zone, and the slag settling zone, or three furnaces, each having such an individual discrete zone is formally combined into one whereby the slag and the matte are made to move through these reaction zones, interacting with each other, either in counter- or in parallel-flow. In order, however, that the respective reaction zones sufficiently exhibit their own function, various reaction conditions such as the position or level of melt surface, the composition of the melt and its temperature have to be controlled independently from one to the other. However, with a single furnace as in this prior art method, such control is extremely difficult because the zones cannot be made entirely independent of each other in one and the same furnace, having one and the same hearth in common. Further, such a
furnace should be provided with an inclined hearth in the slag settling zone so as to effect a satisfactory recovery of copper from the slag. Moreover, in order to ensure a smooth counter- or parallel-flow of the matte and slag, the furnace shape and the hearth design become very complicated. All these conditions necessitate constant surveillance, repairing, and maintenance, which constitute a great obstacle for the continuity and constancy of the furnace operations.

In contrast to this, the present invention has succeeded in overcoming all these shortcomings inherent in the conventional methods by a distinctly different method, in which a plurality of furnaces, each having a different function as required at each stage of the metal processing operations, and a simple construction for easy operation, are combined integrally and sequentially, whereby it becomes possible to transfer intermediate products in the form of melts of slag, matte, revert slag, white metal, and blister metal between the respective furnaces in a continuous, constant, and functional manner. Thus, the present invention establishes a novel method for continuous mass production of an exceptionally high metallic yield, as well as effecting an extraordinarily high degree of recovery of sulfur dioxide, resulting in an admirably high productivity.

Here, the term "substantially continuous transfer" designates a transfer system wherein, even if the transfer is done batchwise, the quantity transported in a single batch is so small in comparison with the quantity held in the furnace that any fluctuation of metallurgical reaction condition due to the batchwise transportation can be neglected.

More specifically, this invention appropriately describes as its initial installation a furnace unit whose major function is to melt sulfide ores, namely the smelting furnace unit, furnace a second whose major function is to initially oxidize all the iron in the matte to produce white metal, namely the slagging furnace, and a third furnace unit whose major function is to further oxidize the sulfur in the white metal to produce blister copper, namely the oxidizing or blister furnace. These three furnaces are disposed in such a manner that the exchange of heat between the respective furnaces is limited substantially to that caused by transfer of the melts, and each furnace is designed so as to enable the composition, temperature, and levels of free surface and interface of the melts in the furnace to be controlled independently of the other furnaces and to maintain them at predetermined figures. Both oxidizing furnaces may be combined to perform the entire oxidation operation in a single unit as set forth below.

The operations in each of the furnaces as well as between the respective furnaces according to this invention are as follows. A first stage, in which a melting stock (or simply "raw material") consisting of sulfide ore and flux, as its principal components is suitably combined with fuel and air in an appropriate proportion to meet predetermined reaction conditions i.e. to yield a predetermined composition of slag and matte and is fed directly and continuously into the melt in the smelting furnace at a predetermined quantity per unit time (raw material feeding rate), while smelting and separating the fed material into matte and slag without delay, and, at the same time, the revert slag produced in the smelting furnace is transferred to the smelting furnace substantially continuously to cause any of the metal component still contained in the revert slag to be absorbed into the matte which is thereafter discharged continuously from the smelting furnace to the slagging furnace. This transfer operation between the smelting furnace and the slagging furnace can be done one of two ways, i.e., a natural transfer which causes the matte to flow by means of gravity or under its own weight by taking advantage of the head between the melt in the smelting furnace and that in the slagging furnace, or secondly a forced transfer which causes the matte to flow by means of externally applied force. Either of these two ways may be chosen.

A second stage, in which air, flux, and coolant are suitably combined in a proportion to yield a predetermined composition of white metal and slag to be determined by the aforesaid raw material feeding rate at the first stage, and then fed directly and continuously into the melt in the slagging furnace to produce and separate without delay white metal and the revert slag, simultaneously allowing the revert slag to overflow from the slagging furnace to be substantially continuously to the smelting furnace, while causing the white metal to flow from the slagging furnace under its gravity to be charged into the blister furnace.

A third stage, in which only air, or a combination of air and a coolant, which does not form slag, in a quantity determined by the reaction conditions in the smelting furnace and in the slagging furnace are fed directly and continuously into the melt in the blister furnace to produce blister metal; simultaneously allowing the blister metal to overflow continuously from the blister furnace so as to be sent to a further refining process.

The abovementioned three stages are characteristically combined in particular relationship so that the rates of production of slag, matte, white metal, and blister metal in the respective furnaces as well as the rate of transfer of the melt between the respective furnaces are adjusted by the feeding rate of the raw material and coolant and maintain constant equilibrium among them, and, at the same time, the composition, temperature, and levels of free surface and interface of the melts in the respective furnaces are controlled independently in each furnace to constant values, thereby obtaining metal from ore in a continuous and highly economical manner.

In the following, a case of copper production according to the present invention is explained with reference to the accompanying drawing. Referring to FIGS. 1 to 3, the apparatus for continuous processing of sulfide ores comprises a smelting furnace 1, a slagging furnace 2, and a blister furnace 3. The smelting furnace 1 is provided with lances 6, a slag overflow port 7, a matte tapping port 8, a matte siphon 9, a siphon overflow weir 9a which is provided at a predetermined level, and a revert slag charging port 15. Slag 4 and matte 5 are within the smelting furnace. The slagging furnace 2 is provided with a matte charging port 10, lances 13, an overflow port 14 for revert slag, a white metal tapping port 16, a white metal siphon 17, and a white metal siphon overflow weir 17a. White metal 11 and revert slag 12 are contained within the slagging furnace. The blister furnace 3 is provided with a white metal charging port 18, lances 21, a blister siphon 22, and a blister
overflow weir 22a. White metal 19 and blister copper 20 are contained within the blister furnace in layers.

FIG. 3 indicates a connection means between the smelting furnace and the slagging, which is constituted by a bubble pump 23 having a U-shaped conduit and a bubbling nozzle 24. FIG. 4 shows a connection means between the smelting furnace and the blister furnace, which is constituted by the matte tapping port 25 in the smelting furnace, a matte charging port in the blister furnace, a path 27 for forced transfer connecting the tapping and charging ports, a blister furnace slag overflow 29, a blister furnace slag conduit 30, and a blister furnace slag charging port 31. The blister furnace slag 28 is on the top surface in a layer over the white metal 19. Flue ducts 32 may be made common to all the furnaces for SO₂ removal.

Referring to FIG. 1, raw material mainly containing sulfide ore and a flux such as silicate ore is appropriately combined with fuel and air at a rate suitable for a predetermined reaction conditions to yield a predetermined composition of slag and matte, and is fed directly and continuously at a pre-determined feeding rate into the melt bath 4 and 5, or both. Although any feeding method may be adopted, when pulverized or granulated raw material is blasted together with an air stream into the melt through the lance pipes 6, a large quantity of the raw material can be melted rapidly and efficiently, and, at the same time, generation of dust can be avoided. However, excess care should be exercised not to cause agitation due to the air blast in the entire portion of the melt bath, but to restrict such agitation only to the extent of causing the lanced air to effectively agitate the melt in the vicinity of its feeding portion and to bring about a turbulent flow of the melt.

The mixing ratio of the air to the raw material should be adjusted to be barely sufficient to burn the excess sulfur in the raw material, which possibly minimizes the premature oxidation of iron in the raw material and also makes it possible to maintain the grade of the matte produced low enough to cause a more complete stripping of copper contained in the revert slag. The fuel, be it gaseous, liquid, or solid, should be in such quantity to replenish any insufficiency of heat in the smelting furnace. For this purpose, either preliminary heating of air and/or raw material, use of oxygen or oxygen-enriched air, or combined use of these two expedients is considered effective. Although the fuel need not be fed to the same site as the raw material, when it is blown directly into the melt bath in the same manner as the raw material, an extremely large heat transfer efficiency is obtained. Thus the waste gas temperature can be lowered to a substantially same level as that of the melt, the capturing and treatment of the waste gas is greatly facilitated, and the life of the furnace wall is much more prolonged.

The slag 4 is caused to flow continuously out of the smelting furnace 1 through the slag overflow port 7, while the matte 5 is continuously transferred to and charged into the slagging furnace 2. FIG. 1 shows a case wherein the transfer of the matte is done by the natural transfer method, which can be attained easily by installation of a siphon 9 having the matte tapping port 8 opened at the lower part of the furnace at a position close to the furnace hearth. The levels of the melt free surface and the interface between the matte and slag in the furnace, i.e., the quantities of the matte and slag, are maintained constant by adjusting the levels of the slag overflow port 7 and the siphon overflow weir 9a of the siphon 9 to attain equilibration between the rates of transferring slag and matte in accordance with the given feeding rate of raw material. FIG. 2 is an enlarged view of the siphon 9 and the relative positions of the melts in its vicinity.

The matte 5 is subsequently continuously charged into the slagging furnace 2 through the matte charging port 10 and becomes rapidly molten in the white metal bath 11 which is coexistent overlaid with the revert slag 12 in the slagging furnace. Into this bath 11 or 12, or both, air or a mixture of air and flux are directly fed. Taking advantage of the excess heat generated thereby, a quantity of coolant consisting mainly of the raw material and scrap metal is charged and molten to further increase the ore processing capability of the system as a whole. The feeding of the coolant to the slagging furnace may be carried in the same manner as in the smelting furnace, namely through lances 13. The oxidation of iron to iron oxide proceeds until the white metal 11 is formed which contains substantially no iron. As the oxidation rate of iron is very rapid, the iron content in the white metal can be controlled to any low level by varying the proportion of the air with respect to the matte and coolant. The white metal is continuously tapped from the furnace through the siphon 17 and charged continuously to the blister furnace 3, while the revert slag 12 is caused to overflow continuously out of the slagging furnace through the revert slag overflow port 15 by natural or the forced transfer methods and the manner in which the transfer or revert is to be carried out is arbitrary as long as it is done at least substantially continuously; for example, it can be done by means of a continuously moving mechanism having any number of small buckets, and it is also possible to attain the purpose in an easy, steady and perfect manner by using the bubble pump as shown in FIG. 3. That is, as indicated in the drawing, when the revert slag 12 overflowed from the slagging furnace 2 into the smelting furnace 1 through the slag overflow port 14 is led into the U-shaped bubble pump 23, and then air or inert gas is blown into the slag through the nozzle at a position near the bottom part of the pump and within one of two limbs of the U-shaped pump to the side of the smelting furnace 1, the apparent specific gravity of the slag is considerably reduced and the free surface of the slag within the aforesaid limb becomes higher than that of the slag 4 in the smelting furnace 1 with the consequence that the slag 12 flows continuously into the smelting furnace through the revert slag charging port 15.

In other aspect, by adjusting the respective levels of the overflow weir 17a of the siphon 17, the revert slag overflow port 14, the slag charging port 15, the levels of the free surface of the melt as well as the interface between the slag and white metal, hence the quantities of slag and white metal held in the furnace, can be maintained constant. Whereby the rate of transferring revert slag and white metal are equilibrated to the rate of transferring matte to the slagging furnace, hence equilibrated to the feeding rate of the raw materials at the smelting furnace.
All the metallurgical operations such as charging of various materials, regulation of the melt surfaces, and disposal of the waste gas are the same as in the foregoing example shown in FIG. 1.

According to the method of this invention, as the raw material, the fuel, and other materials are fed directly into the melt, the materials are melted very rapidly due to the direct conduction of heat from the surrounding melt, while the fuel which is burnt in the melt performs transfer of heat at very high efficiency due to its very large heat load. This results in a great improvement in the volumetric efficiency of the furnace in comparison with the known smelting furnaces, wherein the melting is done by the combustion of the fuel within the interior of the furnace and the heat conduction between the atmosphere in the furnace and the solid raw material charged thereinto. On account of this, it becomes possible to treat a large quantity of ores by a furnace of reduced size, whereby the heat loss, or the fuel consumption, is greatly reduced, the concentration of sulfur dioxide in the waste gas from the smelting furnace becomes stabilized to such a degree that an economical manufacture of sulfuric acid becomes possible, and recovery of sulfur can also be done at a very high rate. Also, as the melting of the raw material and supply of heat are carried out at an extremely high efficiency, the rate of the matte formation can be easily maintained at a constant value by adjusting the feeding rate of the raw material, whereby the rate of charging the matte into the further furnaces becomes stable and the continuous and constant operations throughout the entire process stages are secured.

Further, in view of the fact that the fuel burns in the melt interior, the furnace wall bricks are no longer exposed directly to the high temperature combustion gas, hence the service life of the bricks are markedly prolonged, and at the same time, as the furnace need be neither tilted nor stopped its operation for charging and discharging the intermediate products. Continuity of the furnace operation is secured over a very long period of time. Moreover, due to the agitation action caused by the blown gas the revert slag and the matte charged in the furnace are brought into an intimate contact, and as the copper concentration of the matte is kept at as low a level as desired, the magnetite in the slag is reduced quickly, while the copper therein is stripped into the matte rapidly and recovered at a high rate, whereby the copper content in the slag becomes as low as or even lower than 0.5 percent in spite of the fact that the average residence time of the slag in the furnace is remarkably shorter than that in the known methods.

Further advantage of the present invention is that, as the levels of the free surface and the interface of melts in each of the furnaces can be so controlled as to be most suited for the operations of the individual furnaces independently of the other, e.g., to minimize the slag loss of copper in the smelting furnace, or to reduce the thickness of the slag layer so as to improve the oxygen efficiency in the slagging furnace, the merits of the respective process stages can be completely utilized. The transfer of melts between each of the furnaces, in the case of the forced transfer, can be readily automated or mechanized, so that the cost of transfer is considerably reduced in comparison with that of any
known methods which almost always depended heavily on lagersized ladles. Undesirable recurring scraps such as the ladle skull is considerably decreased due to absence of the ladle with the result that the excess amount of heat after the slagging stage can be effectively utilized for the melting of coolants, an important factor for the greater productivity.

PREFERRED EXAMPLES

In order to induce one skilled in the art to the possible reduction into practice of the present invention, the following preferred examples are presented, although the invention is not limited to these examples alone.

EXAMPLE 1

40 kg of concentrated copper ore containing 25.6 percent copper, 31.3 percent iron and 32.2 percent sulfur, 9 kg of silicate sand, and 4.9 kg of lime were respectively lanced directly into the matte bath in the smelting furnace together with 20 Nm³ per minute of compressed air showing at a gauge pressure of 0.2 kg/cm². Concurrently therewith, 3.5 liter of fuel oil was lanced into the melt together with 37 Nm³ per minute of compressed air. The matte thus produced was tapped continuously out of the furnace through the siphon, and then transferred and charged into the slagging furnace at a rate of approximately 32.5 kg per minute by means of a continuously operating bucket mechanism. The composition of the matte was 35 percent copper, 36.8 percent iron, and 26 percent sulfur, while that of the slag was 0.3 – 0.5 percent copper, 35 – 38 % SiO₂, and 4 – 6 % CaO. The thickness of the slag layer was adjusted to be maintained at approximately 10 cm.

Concentrated copper ore of the same composition as that charged into the smelting furnace and silicate sand were charged into the white metal bath in the smelting furnace at a rate of 20 kg and 12 kg per minute, respectively, together with 57 Nm³ per minute of compressed air, thereby obtaining a white metal composed of 77.9 percent copper, 1.6 percent iron, and 20 percent sulfur, which was then tapped out of the furnace through a siphon and continuously charged into the blister furnace under its gravity at a rate of 19 kg per minute. As the matte was transferred by the forced transfer method, the revert slag was continuously taken out of the furnace and charged into the melting furnace under its gravity, namely, by the natural transfer method. The layer of the revert slag was maintained at approximately 5 cm thick. The copper in the revert slag was 2 – 4 percent.

Compressed air was blown into the white metal bath in the blister furnace at a rate of 10 Nm³ per minute together with a small quantity of silicate sand and lime, and scrap metal was charged thereinto at a mean rate of approximately 10 kg per minute so as to maintain the temperature in the furnace at 1,200° – 1,250°C. The blister copper thus obtained was tapped continuously out of the furnace by means of a siphon at a rate of approximately 23 kg per minute.

The concentration of sulfur dioxide in the waste gas was 6 – 7 percent in the smelting furnace, 11 – 13 percent in the slagging furnace, and 16 – 18 percent in the blister furnace, respectively, and the capturing rate thereof was approximately 99 percent of the total quantity. The generation of dust was less than 1 percent of the raw material charged.

EXAMPLE 2

Copper ore concentrate consisting of 25.4 percent copper, 27.7 percent iron, and 33.3 percent sulfur, granular silicate ore containing 85% SiO₂, and pulverized lime stone containing 53 % CaO, were mixed at a ratio of 100 : 15 : 8, and the mixture material was lanced directly into the matte in the smelting furnace at a rate of 50 kg per minute on a stream of 20 Nm³ per minute of compressed air showing at gauge pressure of 5 kg/cm². Also, fuel oil was lanced directly into the matte at rate of 3 liter on 30 Nm³ of compressed air per minute. An example of the analysis of the matte in the furnace was 32.5 percent copper, 33.5 percent iron, and 26.4 percent sulfur. The matte was tamped by means of a siphon out of the furnace and as per FIG. 4 was continuously charged into the blister furnace under its gravity. The slag layer in the smelting furnace was maintained at approximately 20 cm thick.

Granular silicate ore and compressed air were lanced into the melt in the blister furnace at a rate of 8 kg and 40 Nm³ per minute, respectively. The melt temperature was maintained at 1,250° – 1,300°C by adding scrap metal at a mean rate of approximately 15 kg per minute. The slag layer was adjusted to be maintained at approximately 5 cm thick, and the white metal at 15 cm thick. The blister copper thereby obtained was continuously tapped by means of a siphon out of the furnace, while the slag was caused to overflow out of the blister furnace and was continuously transferred back to the smelting furnace by means of a bubble pump. The rate of production of the blister copper was 20 – 23 kg per minute. The composition of the blister copper was 97.8 – 98.9 percent copper, and 0.8 – 1.7 percent sulfur. Also the composition of the blister furnace slag was 3.5 – 6.1 percent copper, and 25 – 28 % SiO₂. The composition of the white metal as sampled from the furnace was 79.0 percent copper, and 20.1 percent sulfur.

On the other hand, slag composed of 0.3 – 0.5 percent copper, about 37 % SiO₂, and about 5 % CaO was produced in the smelting furnace at a rate of approximately 37 kg per minute, which was caused to overflow from the furnace. The concentration of the sulfur dioxide in the waste gas was 6 – 7 percent in the smelting furnace, and 13 – 14 percent in the blister furnace. Approximately 99 percent of sulfur dioxide to its total quantity was captured. The dust generated was less than 1 percent of the total raw material charged.

In the foregoing, two preferred embodiments of the present invention have been presented. However, various modifications are possible without departing from the principles of this invention. For example, known reverberatory furnace or electric furnace may be used in place of the smelting furnace of this invention, in which case, although there exist disadvantages such as decrease in volumetric efficiency and low recovery of sulfur, existing installations can be effectively utilized. Also a known type of smelting furnace such as flash smelting furnace, and a known type of settling furnace may be used in combination with or in place of the smelting furnace of this invention. In this case, the matte tapped out of the known smelting furnace and the settling furnace should all be charged directly.
either into the slagging furnace or the blister furnace of this invention, while the slag either from the slagging furnace or the blister furnace of this invention is simultaneously charged into the settling furnace.

Further, the smelting furnace of this invention may be used in conjunction with a known type of smelting furnace. In this case, the slag tapped out of either the slagging furnace or the blister furnace of this invention is charged into the smelting furnace of this invention, or, if the known type of smelting furnace used is either the reverberatory furnace or the electric furnace, the slag may be charged into any one of these furnaces.

In describing the principles and applications of this invention, examples have been taken from the copper processing only. It is, however, evident that this invention is applicable to extraction of other metals of the same or similar reaction system, such as, for example, nickel or cobalt.

What we claim is:

1. A method for continuous production of blister copper from sulfide copper ores in a smelting unit and an oxidizing unit, each controllable in operation independently of the other unit as to compositions of melts therein, temperatures, levels of free surfaces of corresponding slags, and the thickness of the layers of the individual melts therein including the corresponding slag therein, and wherein the rates of production of slag, matte and blister copper and the rate of transfer of matte from the smelting unit to the oxidizing unit and the rates of transfer of blister copper and slag out of the oxidizing unit are maintained in constant equilibrium with the rate of feeding inputs into the smelting unit; the method comprising the steps of:
   a. continuously smelting in a smelting unit inputs of sulfide copper ores, flux and oxygen-containing gas to yield a slag and matte;
   b. simultaneously, while smelting said inputs, continuously transferring matte from said smelting unit to an oxidizing unit at a rate of transfer balancing the rate of production of matte and continuously transferring slag out of said smelting unit at a rate balancing the rate of production of slag, and both rates of transferring matte and slag being equilibrated to the rate of feeding said inputs to said smelting unit by retaining in said smelting unit a fixed amount of slag and a fixed amount of matte, whereby a measured amount of matte is continuously transferred to said oxidizing unit;
   c. introducing into said oxidizing unit flux and oxygen containing gas to convert said matte to blister copper and slag while continuously transferring matte into said oxidizing unit; and
   d. simultaneously, while oxidizing said matte in said oxidizing unit, continuously transferring blister copper out of said oxidizing unit at a rate of transfer balancing the rate of production of blister copper and simultaneously transferring slag out of said oxidizing unit at a rate balancing the rate of production of slag in said oxidizing unit, both rates of transferring blister copper and slag produced in said oxidizing unit being equilibrated to the rate of feeding matte, flux and oxygen-containing gas to said oxidizing unit by retaining in said oxidizing unit a fixed amount of slag and a fixed amount of blister copper, and the rates of transferring said blister copper and said slag out of said oxidizing unit being equilibrated to the rate of feeding said inputs to said smelting unit;

2. The method according to claim 1 wherein said slag produced in said oxidizing unit is introduced into said smelting unit.

3. A method for continuous extraction and production of an incompletely refined metal from sulfide ores in a smelting unit and an oxidizing unit each controllable in operation independently of the other unit as to compositions of melts therein, temperatures, levels of free surfaces of corresponding slags, and the thickness of the layers of the individual melts therein including the corresponding slag therein, and wherein the rates of production of slag and partly refined metal and the rates of transfer of partly refined metal from the smelting unit to the oxidizing unit and the rate of transfer of further refined metal out of the oxidizing unit is maintained in constant equilibrium with the rate of feeding inputs into the smelting unit; the method comprising the steps of:
   a. continuously smelting in a smelting unit inputs of sulfide ores, flux and oxygen-containing gas to yield a slag and a partly refined metal;
   b. simultaneously, while smelting said inputs, continuously transferring partly refined metal from said smelting unit to an oxidizing unit at a rate of transfer balancing the rate of production of partly refined metal and continuously transferring slag out of said smelting unit at a rate balancing the rate of production of slag, and both rates of transferring partly refined metal and slag being equilibrated to the rate of feeding said inputs to said smelting unit by retaining in said smelting unit a fixed amount of slag and a fixed amount of partly refined metal, whereby a measured amount of partly refined metal is continuously transferred to said oxidizing unit;
   c. introducing into said oxidizing unit flux and oxygen-containing gas to oxidize said partly refined metal and slag while continuously transferring partly refined metal into said oxidizing unit; and
   d. simultaneously, while oxidizing said partly refined metal in said oxidizing unit, continuously transferring further refined metal out of said oxidizing unit at a rate of transfer balancing the rate of production of further refined metal and simultaneously transferring slag out from said oxidizing unit, both rates of transferring further refined metal and slag produced in said oxidizing unit being equilibrated to the rate of feeding partly refined metal, flux and oxygen-containing gas to said oxidizing unit, by retaining a fixed amount of slag and a fixed amount of further refined metal and the rates of transferring said further refined metal and said slag out of said oxidizing unit thereby being equilibrated to the rate of feeding said inputs to said smelting unit.

4. The method according to claim 2 wherein said slag produced in said oxidizing unit is introduced into said smelting unit.

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