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PROCESS OF SUCCESSIVELY DESULPHURIZING AND DESILICONIZING A BATH OF PIG IRON

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This invention relates to a process of successively desulphurizing and desiliconizing a bath of pig iron.

A process is known for desulphurizing a bath of pig iron which consists in injecting into it finely powdered lime entrained in a non-oxidizing gas such as nitrogen, argon or hydrogen. It is essential that the gas be non-oxidizing with respect to silicon since otherwise a part of the silicon, manganese and iron is converted into oxides and the oxides impregnate the lime and render the removal of sulphur ineffective. In the course of the operation, the lime remains solid and absorbs most of the sulphur of the pig iron. However, this process does not remove silicon from the pig iron. It is desirable to provide a process which removes both sulphur and silicon since pig iron containing both high sulphur and high silicon can be made economically in blast furnaces operated under acid conditions.

It is known that pig iron can be desiliconized by blowing it with oxygen. However, difficulties arise when it is attempted to combine the two processes of blowing the bath with a non-oxidizing gas carrying entrained lime to remove sulphur with the process of blowing the bath with an oxidizing gas to remove silicon. If oxygen is first blown into the bath to remove silicon before the sulphur is removed, a slag of manganese and iron silicates is formed during the blowing with oxygen and it is difficult to fully remove these silicates from the bath. If they are not fully removed, they hinder the desulphurization of the bath in the next step in which lime entrained in a non-oxidizing gas is blown into the bath. On the other hand, if the bath is desulphurized first with lime in a neutral gas followed by blowing the bath with an oxidizing gas under such conditions that there is a strong stirring of the bath, the slag resulting from the oxidation of silicon, manganese and iron reacts with the sulphur-containing lime which has not been fully removed from the bath and reintroduces sulphur into the bath.

These difficulties are overcome according to the present invention in which in a first step the bath of pig iron is blown laterally (side blowing) or through the bottom of the apparatus containing the pig iron with a gas which is non-oxidizing with respect to silicon at the temperature of the bath and carries entrained lime, thus forming a layer of sulphur-containing lime on the surface of the bath. The bath is then blown laterally (side blowing) or through the bottom of the apparatus containing the pig iron with a gas which is oxidizing with respect to silicon at the temperature of the bath, thereby forming globules of manganese and iron silicates which rise in the bath and form a layer of slag below the layer of lime. The blowing of the bath with oxidizing gas in the second step is carefully controlled, the oxidizing gas employed being limited to such an amount and being fed at such a rate that there is no violent stirring of the bath and the gas is substantially entirely absorbed by

the bath so that substantially no gas bubbles reach the surface of the bath. In the absence of any violent stirring of the bath, there is no appreciable reaction between the manganese and iron silicate globules formed by oxidation of the manganese, iron and silicon of the bath and the sulphur-containing lime resulting from the first step. Thus, there is no appreciable reintroduction of sulphur into the bath. These results could not be obtained if in the second step oxidizing gas mixed with large quantities of nitrogen or other non-oxidizing gas were blown into the bath at uncontrolled rates such as to cause violent stirring of the bath. Under these conditions, the violent stirring would cause reaction between the globules of manganese and iron silicates and the sulphur-containing lime distributed throughout the bath because of the violent stirring and there would be a reintroduction of sulphur into the bath.

The non-oxidizing gas employed in the first step of my process can be nitrogen, argon or hydrogen. The oxidizing gas used in the second step of my process can be substantially pure oxygen or oxygen mixed with air. It can be carbon dioxide gas or a mixture of carbon dioxide and carbon monoxide. The weight of oxidizing gas blown into the bath is such as to remove the desired quantity of silicon.

If the oxidizing gas used in the second step of my process is rich in carbon dioxide and/or carbon monoxide, the heat evolved at the apertures of the nozzles used for supplying the gas is not excessive and will not tend to wear the nozzles excessively. Thus, the desiliconizing of the bath can be readily obtained by employing carbon dioxide gas supplied from bottles of liquid carbon dioxide. When oxygen or gas rich in oxygen is blown into the bath, the heat evolved at the apertures of the nozzles by the oxidation of silicon in the bath is considerable and the nozzles tend to wear rapidly. Under such conditions, it is advantageous to employ in the second step of my process a heat absorbing material which is entrained with the oxidizing gas. Any suitable heat absorbing material can be employed. These materials should not contain too high a sulphur content nor should they have acidic properties. It is possible, for example, to employ coal dust as the heat absorbing material which is entrained with the oxidizing gas. Such use does not cause the liberation of carbon monoxide gas because this is prevented due to the silicon present in the pig iron bath. However, the cooling action of carbon is relatively slight owing to its low specific heat.

Lime is suitable as a heat absorbing material which can be entrained in the oxidizing gas. Other heat absorbing materials are oxides of iron and/or manganese, and iron and/or manganese ores in the form of dust or finely ground particles. In such cases, the volume of oxidizing gas required to be introduced into the bath in order to remove a given quantity of silicon will be less than if the oxides were not employed. The use of oxides entrained in the oxidizing gas offers the advantage that it involves a lower loss of manganese and iron from the bath and even, on some occasions, produces a recovery of iron and manganese due to the reduction of the oxides of iron and manganese by the silicon in the bath. The loss or recovery of iron or manganese will depend upon the relative proportions of free oxygen and the oxides of iron and manganese suspended in the gases employed.

The desiliconizing step of our process is exothermic and compensates very largely for the cooling of the bath in the desulphurizing step.

The following example further illustrates my invention.

Example

2,000 kgs. of pig iron of the following composition were poured into a converter of standard type:

	Percent
C	3.56
Si	0.78
Mn	0.46
S	0.06
P	1.82

The bath was blown for a period of 2½ minutes with a total volume of 1 cubic meter (measured at the surrounding temperature) of pure nitrogen gas (less than 0.5% oxygen) containing in suspension 36 kgs. of very finely powdered quicklime of a good commercial quality (about 93% CaO). Thereafter, the bath was blown during a period of 4½ minutes with a total volume of 1.8 cubic meters (measured at the surrounding temperature) of commercially pure oxygen containing in suspension Fe_3O_4 in an amount of approximately 30 kgs. of the oxide per cubic meter of the gas.

During the first blowing, a layer of pulverulent lime containing some clots of small size was formed on the top of the bath. During the second blowing, a layer of slag of almost pure iron silicate was formed between the bath and the layer of lime without, apparently, any appreciable intermingling of these layers.

The blown pig iron contained 0.39% silicon and 0.003% sulphur, the other elements having varied but little during the operation.

The invention is not limited to the preferred embodiment but may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. A process of successively desulphurizing and desiliconizing a bath of pig iron, which comprises blowing the bath by means of side blowing or through the bottom of the apparatus containing the pig iron with a gas which is non-oxidizing with respect to silicon at the temperature of the bath and carries entrained lime, thereby forming a layer of sulphur-containing lime on the surface of the bath, and thereafter, without removing the layer of sulphur-containing lime, blowing the bath by means of side blowing or through the bottom of the apparatus containing the pig iron with a gas which is oxidizing with respect to silicon at the temperature of the bath, thereby forming globules of manganese and iron silicates which rise in the bath and form a layer of slag below the layer of lime, the oxidizing gas employed being limited to such an amount and being fed at such a rate that there is no violent stirring of the bath and the gas is substantially entirely absorbed by the bath so that substantially no gas bubbles reach the surface of the bath.

2. A process according to claim 1, wherein the gas which is oxidizing with respect to silicon is substantially pure oxygen and carries entrained heat absorbing material.

3. A process according to claim 2, wherein the entrained heat absorbing material is iron oxide.

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