METHOD AND COMPOSITION FOR THE TREATMENT OF FERROUS MELTS AND PROCESS FOR MAKING THE TREATING COMPOSITION

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ABSTRACT

A composition for the desulfurization of a ferrous melt comprises particles of calcium carbide coated with metallic magnesium to protect them against moisture-laden air. The coated particles can be blown by a lance into the melt.

10 Claims, 2 Drawing Figures
Method and Composition for the Treatment of Ferrous Melts and Process for Making the Treating Composition

Field of the Invention

The present invention relates to a process for or method of desulfurizing a ferrous melt, to a composition for this purpose and to a method of making the composition. More particularly, the invention relates to desulfurization of a ferrous melt using a calcium-carbide based composition.

Background of the Invention

It has been proposed heretofore to desulfurize ferrous-metal melts, such as baths of crude or pig iron, steel and ferroalloys by introducing calcium carbide into the bath and carrying out a solid-liquid interphasic reaction therein.

The desulfurizing property of calcium carbide with respect to sulfur-containing iron melts is well known. However, because the softening point of calcium carbide lies above 1,800°C and the treatment of the melt generally takes place at temperatures between 1,250°C and 1,600°C, the reaction is seldom quantitative and unsatisfactorily large proportions of the relatively expensive calcium carbide pass unscathed into the desulfurization slag.

It has been proposed heretofore to incorporate inorganic compounds such as lime or feldspar with the carbide to lower the softening or melting point thereof by a fluxing-type action. It is also known to process a mixture of magnesium particles or magnesium alloy particles and calcium carbide into bodies which are used for desulfurization.

However, all of the prior art systems for effecting desulfurization with calcium carbide have the common disadvantage that the calcium carbide must be protected against contact with moist atmospheric air since it is highly reactive therewith to form acetylene. Furthermore, not only is there a problem with the storage and handling of the calcium carbide because of safety, health and economic reasons, but the earlier systems have been found to be generally unsatisfactory for most desulfurization processes.

Objects of the Invention

It is the principal object of the present invention to provide a composition, substance or material for the desulfurization of a ferrous melt whereby the aforementioned disadvantages will be obviated and which can be readily handled and stored for long periods without appreciable danger, even in the presence of moist atmospheric air.

Still another object of the invention is to provide a process for the treatment of ferrous melt whereby desulfurization can be carried out more economically and efficiently and without the danger incident upon earlier use of calcium carbide.

Still another object of the invention is to provide a method of making the improved desulfurizing agent.

It is, further, an object of the invention, to provide an improved method of treating a steel melt and an improved treatment system which is more effective and efficient for desulfurization than calcium carbide alone or earlier materials based thereon.

Summary of the Invention

These objects and others which will become apparent hereinafter are attained, in accordance with the present invention, by encasing a granulate of calcium carbide in a sheath or coating of a metal resistant to atmospheric deterioration and present in an amount of at least 2% by weight of the particles, the metal preferably being magnesium.

The metal may be present in an amount up to about 50% by weight of the granulate which may consist of particles with a particle size of 0.3 to 5 mm. For the desulfurization of pig iron, between 5 and 25% of the weight of each particle should be constituted by the metal sheath.

Since the metal sheath forms a hermetic seal for the carbide-containing core, the storage, displacement, handling and use of the granulate is greatly simplified. Of course, the system is also safer, there is no danger of explosion or flashing and a spontaneous decomposition with all of the negative results thereof need not be feared.

Surprisingly, the particles of the present invention are more effective in terms of the amount of carbide per unit weight of the melt treated than the uncoated carbide itself, in spite of the fact that one would ordinarily believe that the coating would reduce the activity of the carbide. Firstly, because the magnesium coating serves as a deoxidation medium for the melt, the oxygen potential or concentration is reduced and hence desulfurization effectiveness, which increases with decreasing oxygen potential, tends to rise. Secondly, the deoxidation reaction is highly exothermic and a portion of the heat generated in the coating is available to melt or soften the calcium carbide far more rapidly than would be the case if the heat were merely picked up by contact with the melt, especially since the latter is generally at a lower temperature than the normal softening point of calcium carbide. Because of the accelerated melting or flowing of the calcium carbide core, there is greater contact between the calcium carbide and the iron melt and hence an increased efficiency.

The coated desulfurizing agent according to the invention is fed to the melt in an amount of 0.05 to 0.5 percent by weight thereof, depending of course upon the ultimate sulfur content which is tolerable in the product. The particles may be injected by means of a lance deep into the bath so that a particularly intimate and long contact between the particles of the metal of the bath is ensured so that there is no noticeable magnesium loss through the surface of the bath.

The gas for displacement of the particles can be nitrogen, argon or carbon dioxide and, of course, serves to mix the bath and further ensure the intimate contact mentioned above.

According to a feature of the invention, the desulfurizing agent of the present invention is made by treating a mixture of calcium oxide and magnesium oxide in a carbide-producing electrothermal furnace of the closed type in the presence of carbon, the melt being granulated and treated with vapors of magnesium generated in the furnace.

The coated calcium carbide can be drawn from the system in a steady state material flow balance, i.e. the
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calcium carbide withdrawn together with the magnesium vapor and carbon oxides being precisely equal to the calcium oxide, magnesium oxide and carbon input. Of course, the calcium carbide can be partly or fully withdrawn from a conventional calcium carbide synthesis or a portion of the calcium carbide produced in accordance with the invention may be diverted to other markets for use of calcium carbide. The magnesium may be coated onto CaC₂ granules otherwise produced. The calcium carbide particles, which are to be coated by magnesium, may contain other compounds which are soluble or chemically nonreactive with the carbide. These substances include lime, bauxite, feldspar and coke breeze. The cores to be coated may have a particle size of 0.2 to 5 mm.

Most advantageously, the raw materials for the electro-smelting furnace consist of burned dolomite or mixtures of dolomite and magnesite in any desired proportion or as additives to burned lime. The magnesium vapor produced by the reaction system electrical furnace is condensed upon the calcium carbide products for a period sufficient to obtain the desired coating thickness. Of course, the carbide can be coated with metal vapors from other sources and we may generate magnesium vapors by other means for this purpose. Other coating metals can include baryum and aluminium and their alloys. Of course, instead of vapor deposition, coating of the cores may be carried out using a melt of the metal. Because of the fact that mixtures of dolomite and magnesite may be used as raw materials the process has been found to be highly economical and we may operate with high concentrations of magnesium oxide because the reduction of the magnesium oxide is highly effective.

BRIEF DESCRIPTION OF THE DRAWING

The above and other objects, features and advantages of the present invention will become more readily apparent from the following description in which:

FIG. 1 is a flow diagram of a system illustrating the invention; and

FIG. 2 is a section through a particle of the type used in the present process.

SPECIFIC DESCRIPTION

In the drawing, we show a system for the desulfurizing of a metal melt 10 in a ladle 11 consisting of a steel shell 12 lined at 13 with refractory material and in which a lance 14 is immersed. The lance 14 receives the desulfurizing particles or granules from a hopper 15 via a duct 16, the particles being entrained in an argon stream displaced to the lance as represented by the pump 17.

As will be apparent from FIG. 2, the particles 18 within the hopper may consist of cores 19 of calcium carbide and sheaths 20 of magnesium.

FIG. 1 also shows the production of the coated particles.

Carbon 1 (line 21), magnesium oxide (line 22), and calcium oxide (line 23), either individually or in the form of dolomite/magnesite mixture to which carbon has been added, are combined so that the mixture of the reactants is passed at 24 into a calcium carbide producing electro-smelting furnace 25 from which the calcium carbide is discharged at 26, is cooled at 27 and is granulated at 28 by conventional means. The granules are then placed upon a coating surface 29 of a vapor-deposition chamber 30 which may be evacuated at 31. Magnesium vapor, conducted via line 32 from the electro-smelting furnace, is supplied to the vapor deposition chamber 30 and coats the cooled particles, carbon oxides being evacuated at 31. The coated particles are led at 33 to the hopper 18.

EXAMPLE

In a ladle as illustrated in FIG. 1, 100 tons of a pig iron melt containing 0.5 percent sulfur is desulfurized using particles as shown in FIG. 2. The particles consist of cores of calcium carbide having a particle size of about 2 mm and carry a magnesium coating such that the magnesium content of each particle represents 10 percent by weight thereof. The product is supplied to the charge in the furnace by blowing with argon through a lance. 400 kg of the particles are added and the ultimate sulfur content is found to be less than 0.01 percent by weight.

We claim:

1. A method of desulfurizing a ferrous melt comprising the steps of introducing into said melt particles of a size between 0.3 and 5 mm and having a core of calcium carbide coated with a metal sheath of magnesium constituting 5 to 25 percent by weight of the particles.

2. The method defined in claim 1 wherein said particles are charged into said melt in an amount ranging between 0.05 and 0.5 percent by weight thereof.

3. The method defined in claim 2 wherein said particles are entrained into said melt close to the bottom thereof in a gas stream.

4. A desulfurizing agent consisting of a mass of calcium carbide particles individually coated with a metal sheath of magnesium constituting 5 to 25 percent by weight of said particles, said particles having a particle size between 0.3 and 5 mm.

5. The desulfurizing agent defined in claim 4 wherein said calcium carbide contains a soluble or chemically nonreactive inorganic substance incorporated therewith in the cores of said particles.

6. A method of making a desulfurizing agent for a ferrous melt comprising the steps of smelting a calcium oxide/magnesium oxide mixture and carbon in an electro-smelting calcium-carbide-producing furnace to form magnesium vapor and calcium carbide; granulating calcium carbide as produced in said furnace; and coating the granules of calcium carbide thus produced with magnesium condensed from said vapor.

7. The method defined in claim 6 wherein said magnesium oxide is formed at least in part by burned dolomite.

8. The method defined in claim 6 wherein said mixture is in part by dolomite- or magnesite-enriched burned lime.

9. The method defined in claim 6 wherein an excess of magnesium vapor is produced by said furnace beyond which is required to coat granules of calcium carbide produced from said furnace, the excess magnesium vapor being used to coat calcium carbide granules derived from another source.

10. The method defined in claim 6, further comprising the step of entraining the particles coated with magnesium into a ferrous melt by a gas stream through a lance reaching to the bottom of the melt.

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