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PROCESS FOR DEOXIDIZING IRON AND STEEL

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2 Claims. (Cl. 75—58)

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The invention relates to improvements in the manufacture of iron and steel and particularly to that part of the process known as blocking.

In the manufacture of killed steels, and where blocking of the heat in the furnace is required, it is customary to stop the action of the bath by the addition of 10% to 14% ferro-silicon. This addition of the 10% to 14% ferro-silicon sinks through the slag and into the molten metal below and goes into solution thus effecting deoxidation of the molten metal to a point where the reaction between the carbon content and the FeO content is stopped.

The amount of silicon added in this manner usually ranges from .06% to .20%, depending upon the degree of oxidation of the metal and the length of time it is desired to block the same.

During the period in which the heat is thus blocked considerable silica is formed as a result of the oxidation of the silicon, and this silica remains trapped, or in solution, in the molten metal resulting in objectionable inclusions in the finished steel.

Another method employed in blocking steel or iron in the furnace consists in adding powdered 50% ferro-silicon to the slag when the bath has reached the desired carbon content.

This method of deoxidation lowers the FeO content of the slag causing the FeO to flow from the metal to the slag which lowers the FeO in the bath below the point where it will react with the carbon in the metal.

There are certain disadvantages inherent in the use of both of the above methods of blocking the heat in an effort to prevent or retard further carbon loss during the final step of the melt.

Where the 10% to 14% ferro-silicon addition is made to the bath the formation of undesirable inclusions cannot be prevented and in the method where the powdered 50% ferro-silicon is added to the slag for deoxidizing the same, it is difficult to prevent a phosphorous reversion into the steel from the slag.

I have discovered that a much improved practice results, if instead of deoxidizing the steel, by making additions of 10% to 14% ferro-silicon thereto, or deoxidizing the slag by the addition of powdered 50% ferro-silicon to the slag, as above described, lumps of 30% to 60% ferro-silicon are added to the molten bath of slag and metal so as to go into solution immediately at the interface, thus effecting deoxidation at this point.

It is therefore an object of the invention to provide a much improved practice for deoxidizing or blocking iron or steel heats.

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Another object is to provide a more economical method of effectively blocking the heat.

A further object is to provide a method of blocking the heat which produces a cleaner steel.

Still another object is to provide a method of blocking iron or steel heats by the addition of lumps of dense 30% to 60% ferro-silicon.

A still further object of the invention is to provide such a method which includes the addition of lumps of 30% to 60% ferro-silicon which have been treated with a wetting agent.

The above objects together with others which will be apparent from the following description, or which may be later referred to, may be attained by carrying out the improved method in the manner hereinafter described in detail.

In carrying out the improved method, when the heat of metal has reached approximately the desired carbon content, there is added to the molten bath of slag and metal, lump 30% to 60% ferro-silicon which is preferably in the form of lumps of 50% ferro-silicon one inch in thickness and larger.

For this purpose I prefer to use dense ferro-silicon which is produced by casting in metal molds as described in U. S. Patent No. 2,197,660 of April 16, 1940, to H. V. Glunz. The 50% ferro-silicon as produced in the past has been cast in sand beds producing a rather porous product.

The dense lump 30% to 60% ferro-silicon sinks through the slag to the inter-face between slag and metal, and I have further discovered that if sand cast lump 30% to 60% ferro-silicon is coated with a wetting agent it will also readily sink through the slag to the inter-face.

Further I have found that by coating lumps of dense 30% to 60% ferro-silicon with a wetting agent, they will sink more readily through the slag.

A great variety of wetting agents are suitable for this purpose, such as the group or products known as oxidants which are compounds having available free oxygen such as sodium nitrate, sodium chlorate, peroxides, permanganates, etc. Another wetting agent suitable for the purpose is a group of products containing halogens such as sodium chloride, calcium fluoride, etc.

Still another group of suitable wetting agents are derived from the group of products consisting of reaction products of an acid with a metal, such as sulphates, chromates, borates, etc.

The lump 30% to 60% ferro-silicon, either dense or sand cast, may be either immersed in, or sprayed with, a solution of the wetting agent

so as to produce a film on the surface of the ferro-silicon.

This film allows the ferro-silicon lumps to become wet by the slag immediately on addition to the furnace, and to sink through the slag to the inter-face between slag and metal. Due to its specific gravity, and low melting point, the lump 30% to 60% ferro-silicon goes in the solution immediately at the inter-face, thus effecting deoxidation at this point.

Since the deoxidation thus takes place at the upper layer of the metal and the lower layer of the slag, transfer of FeO from the slag to the metal is retarded to a greater extent than if the deoxidation took place entirely in the slag or entirely in the metal.

The improved method of effecting deoxidation at the inter-face thus overcomes the objections inherent in the method of blocking the heat by the use of 10% to 14% ferro-silicon, or powdered 50% ferro-silicon in the slag.

The silicates formed by reducing the iron oxides are formed close to the inter-face and are therefore absorbed by the slag producing a metal free from objectionable silicates.

Further, since the deoxidation is mainly at the inter-face and not in the slag, there is no danger of phosphorous reversion from the slag to the metal.

Shortly after the lump 30% to 60% ferro-silicon is added to the inter-face between the slag and metal of the bath the final additions of alloying elements or other deoxidizers may be made, and when these additions are melted the heat may be tapped.

Although in using the lump dense 30% to 60% ferro-silicon for arresting the action of the iron oxide on the carbon in the metal, the wetting agent may be eliminated, and the invention can be successfully carried out without first coating the ferro-silicon lumps with a wetting agent, I have found that the use of a wetting agent has certain advantages and that when it is eliminated there is more deoxidation of the slag than when it is used and therefore more possibility of a phosphorous reversion.

The proper amount of lump 30% to 60% ferro-silicon required for effectively blocking the heat can be readily and accurately determined by a few trial heats. For example, I have found that when a heat of 250,000 pounds had reached a carbon content of .20 and an addition of .12% of contained silicon in the form of lump 50% ferro-silicon was added to the furnace in 300 pounds lots through the second and fourth doors of the furnace, that in two or three minutes after the addition of the ferro-silicon the bath was effectively blocked and there were only a few occasional bubbles at the end of the bath. The heat remained blocked for a total of twenty-seven minutes before it was tapped.

From the above it will be evident that this method of deoxidation overcomes the disadvantages of prior practice and since the cheapest form of silicon available is that contained in 50% ferro-silicon, the process is more economical than prior practice.

I claim

1. In the manufacture of iron and steel, the method of blocking the heat when it has reached the desired carbon content, which consists in coating one inch and larger lump dense 50% ferro-silicon with the film of a wetting agent which will allow the lump ferro-silicon to become wet by molten slag, and adding the coated lump ferro-silicon to the furnace bath, whereby the lump ferro-silicon immediately becomes wet by the slag and sinks through the slag and immediately goes into solution at the inter-face between slag and metal, in an amount sufficient to effectively deoxidize the upper layer of the metal and the lower layer of the slag in the region of the inter-face.

2. In the manufacture of iron and steel, the method of blocking the heat when it has reached the desired carbon content, which consists in coating one inch and larger lump dense 50% ferro-silicon with a film of sodium nitrate which will allow the lump ferro-silicon to become wet by molten slag, and adding the coated lump ferro-silicon to the furnace bath, whereby the lump ferro-silicon immediately becomes wet by the slag and sinks through the slag and immediately goes into solution at the inter-face between slag and metal, in an amount sufficient to effectively deoxidize the upper layer of the metal and the lower layer of the slag in the region of the inter-face.

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