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METHOD FOR PRODUCING LOW SILICON FERROMANGANESE ALLOYS

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This invention in general relates to the manufacture of ferroalloys and in particular to the manufacture of low silicon ferromanganese.

For various metallurgical and operating reasons, steel-making plants require that standard high carbon ferromanganese used as an alloying or deoxidizing agent in steel should contain not more than 0.25% silicon.

Ferromanganese alloying agents are commercially manufactured in either a blast furnace or in an electric furnace. The blast furnace product is usually high in carbon and usually high in silicon, i.e. over 0.50% by weight. In order to produce a low silicon ferromanganese alloy in the blast furnace, it is necessary to carefully select raw materials to make up the charge. Usually a very low ash coke is used in the charge. Although carefully selected raw materials are used to manufacture the low silicon ferromanganese alloys, the operation of the blast furnace is erratic, resulting in many missed heats, that is, ferromanganese alloys having over 0.25% silicon by weight. It is therefore erratic and expensive to manufacture low silicon ferromanganese alloys by this process.

Electric furnace melting offers a greater control of the final product than does the blast furnace melting. However, electric furnace manufacture of the low silicon ferromanganese alloys requires the use of excessive quantities of flux materials to prevent the loss of large amounts of manganese to the slag and to prevent a high silicon content in the final product. The two-step methods in which high silicon slag or ferromanganese made in one furnace is subjected to a second, desiliconization step in a second furnace require specialized equipment such as two electric furnaces to carry out such methods.

It is evident from the foregoing that prior methods of manufacturing low silicon ferromanganese alloys are both erratic and expensive.

It is, therefore, the object of this invention to provide an improved economical process for manufacturing ferromanganese alloys which have a silicon content of about 0.25% or less.

Broadly, the improved process for producing a low silicon ferromanganese alloy includes continuously treating a substantially horizontally flowing molten stream of ferromanganese alloy high in silicon with a gaseous oxidizing agent in a refining vessel to remove a portion of the silicon contained therein.

In a more detailed description of the invention, molten ferromanganese is melted in any suitable furnace such as a blast furnace and is transferred by any convenient method such as a ladle to a generally elongated substantially horizontal refractory-lined covered trough. The molten ferromanganese is fed into one end of the trough at a rate sufficient to maintain a substantially horizontal flowing stream which may be about 2 inches to about 8 inches in depth. Gaseous oxygen is blown onto the surface of the molten flowing stream through a lance extending downwardly through the roof of the trough in a plane vertical to the longitudinal axis of the said trough. The lance is disposed at an angle of about 15° to about 45° to the vertical to effect a concurrent or a counter-current flow of oxygen with respect to the molten stream. The lance height is adjusted so that its nozzle is about 2 inches to about 8 inches above the surface of the molten

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stream. We have found that by blowing oxygen in a volume of about 60 cubic feet per minute to about 75 cubic feet per minute and at a velocity of about 700 feet per second to about 1000 feet per second, a reduction of about 0.07% by weight to about 0.083% by weight of silicon may be removed per lance from the molten ferromanganese. Accordingly, the number of lances to be used for desiliconizing a given batch of ferromanganese will depend on the initial silicon content of the batch and the desired final content.

At no time during the process is a flux added to the vessel. The formation of the siliceous manganese-bearing slag formed during the desiliconization process provides an unexpected result in our process in that the siliceous manganese bearing slag forms a glassy, pebbly protective film on the surface of the refractory lining prolonging the life thereof.

In a specific example of the method of this invention, 92.5 tons of a ferromanganese alloy having a chemical composition of carbon 6.9%, manganese 77.6% and silicon 0.41% were tapped from the blast furnace and were fed at an average rate of 1.03 tons per minute to the refining vessel in a stream which was 6¾ inches deep. The molten stream was blown with oxygen supplied through three water cooled lances extending downwardly through the roof of the vessel at an angle of +30° to the vertical to effect a flow of oxygen countercurrent to the stream of molten metal. The lance tips were three inches above the surface of the stream. Oxygen at a velocity of 745 feet per second and a volume of 65 cubic feet per minute per lance was blown onto the stream of flowing metal to effect a removal of approximately 0.083% silicon per lance. The ferromanganese flowing out of the refining vessel was found to have a chemical composition of carbon 6.90%, manganese 77.3% and silicon 0.16%, the remainder iron and incidental impurities.

In another example of the invention, 76.3 tons of a ferromanganese alloy having a chemical composition of carbon 6.8%, manganese 76.8%, silicon 0.31%, and the remainder iron and incidental impurities were tapped from a blast furnace and were fed to the refining vessel at the rate of one ton per minute in a stream 6¾ inches deep. Oxygen was blown onto the stream at a velocity of 760 feet per second and a volume of 6 cubic feet per minute per lance through two lances depending downwardly through the roof of the vessel at an angle of +30° to the vertical to effect a flow countercurrent to the stream. The lance nozzles were three inches above the surface of the stream. Each lance removed approximately 0.080% silicon from the stream. The chemical composition of the refined ferromanganese was carbon 6.9%, manganese 76.5%, silicon 0.15%, the remainder substantially iron and incidental impurities. The oxygen treatment effectively removed 0.16% silicon from the molten blast furnace ferromanganese alloy.

Although we have shown the preferred embodiment of the invention and have described it in a clear and concise manner, it will be understood that other adaptations and modifications may be made without departing from the scope of the invention.

We claim:

1. A method of reducing the silicon content of a continuously flowing substantially horizontal molten stream of ferromanganese flowing through a trough, said stream being about 2 inches to about 8 inches deep, comprising blowing about 60 cubic feet to about 75 cubic feet per minute of a commercially pure oxygen onto the surface of the flowing stream of molten ferromanganese at a velocity of 700 feet per second to about 1000 feet per second through a lance, said lance being located in a vertical plane passing through the longitudinal axis of the trough

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and being disposed at an angle to the vertical of about 15° to about 45° and having its nozzle about 2 inches to about 8 inches above the surface of the stream.

2. A method as claimed in claim 1, said lance being at an angle of about +30° to the surface of the molten metal and having a nozzle 3 inches above the surface of the molten ferromanganese, the depth of the stream being

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about 6¾ inches, said oxygen being blown at a velocity of about 760 feet per second in a volume of 65 cubic cubic feet per minute.

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No references cited.

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