METHOD OF PRODUCING MAGNESIUM FERROSILICON

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1 Claim. (Cl. 75—129)

ABSTRACT OF THE DISCLOSURE

Method of producing magnesium-containing ferrosilicon without excessive loss of magnesium by adding magnesium to molten ferrosilicon containing more than 53% silicon and then diluting the ferrosilicon with iron to obtain the desired ferrosilicon composition.

The present invention relates to the production of magnesium ferrosilicon. More particularly the present invention relates to a method of adding magnesium to ferrosilicon alloys whereby substantially improved recoveries of magnesium are obtained.

A common technique for producing magnesium-containing ferrosilicon is to provide a bath of molten ferrosilicon alloy in a ladle and adding magnesium by plunging magnesium ingots into the molten metal. Other techniques are also used, but the problem of magnesium recovery is common to all in view of the relatively low boiling point of magnesium (2030°F) with respect to molten ferro-alloy (2250—2400°F).

This problem of magnesium recovery is highly significant in view of the cost of the metal and also creates a safety hazard in that the portion of magnesium which is not dissolved in the alloy is subject to flaring.

It is therefore an object of the present invention to provide a process for adding magnesium to ferrosilicon alloys whereby a very high proportion of the magnesium is recovered in the alloy.

Other objects will be apparent from the following description and claims.

A process in accordance with the present invention comprises providing a molten bath of ferrosilicon containing at least 53 percent silicon; adding magnesium to the molten ferrosilicon by dissolving magnesium metal therein; and, after dissolution of magnesium, adding iron to the molten bath to increase the iron content of the magnesium-containing ferroalloy to the desired value.

The present invention is particularly directed to the production of magnesium-containing ferrosilicon having a silicon content of about 44—50%; an iron content of about 40 to 45% and a magnesium content of 5 to 15%.

In the past, the usual manner of preparing such an alloy, which is widely used in the manufacture of ductile iron, was to provide a bath containing 50% ferrosilicon (containing 44 to 50% Si) and adding magnesium metal, usually by plunging, to provide the desired magnesium content. Magnesium recoveries following this practice were usually on the order of 65%.

It has been discovered however, as part of the present invention, that if the silicon content of the ferrosilicon bath is at least 53% prior to the magnesium addition, with iron being subsequently added to adjust the final alloy composition to its desired value, magnesium recoveries can be increased to 80% and higher. The reason for this is believed to be that the higher silicon content in the starting ferrosilicon provides silicon available for the formation of Mg5Si, upon the addition of magnesium, whereby the vapor pressure of magnesium is lowered and losses reduced.

The following example will illustrate the method of the present invention.

Example I

Molten ferrosilicon alloy (56% Si, about 2% incidental impurities, balance iron) in the amount of 5000 pounds is provided in a ladle at a temperature of about 1400°F. At this temperature magnesium metal in the amount of 650 pounds is plunged into the ferrosilicon by attaching magnesium ingots to steel bars and holding the ingots beneath the surface of the steel bath until the magnesium ingots are dissolved; the temperature after the plunge is about 1200°F.

Steel scrap, in the form of cut up bars (1" or more in diameter and about 4" or more in length) weighing 593 pounds is added to increase the iron content, causing practically no temperature change. The alloy is then cast and analyzes about 9% Mg, 46% Si, 44% iron. The magnesium recovery is 85%.

To further illustrate the present invention, tests were conducted by making heats as shown in Table I.

Heat 1 was made in the conventional manner by plunging magnesium directly into ferrosilicon having the desired final silicon to iron ratio. Heat 2 was made by using a higher silicon ferrosilicon as the starting alloy and, after the magnesium addition, adding iron, to obtain a product of the desired composition.

In obtaining the data of Table I the heats were prepared by melting the charge in an Ajax induction furnace using a graphite crucible. For plunging the magnesium, a magnesium ingot was attached to steel bars and submerged in the melt so that the ingot was 2 or 3 inches beneath the surface and held in this position until they were dissolved.

The iron addition for Heat 2 was in the form of scrap steel bars 1" in diameter by 4" long.

<table>
<thead>
<tr>
<th>Heat No.</th>
<th>Furnace Charge, lbs.</th>
<th>Mg Addition, lbs.</th>
<th>Heat Addi-</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat No.</td>
<td>50% Refract.</td>
<td>45.8</td>
<td>2,450</td>
</tr>
<tr>
<td>1</td>
<td>174</td>
<td>8</td>
<td>22.95</td>
</tr>
<tr>
<td>2</td>
<td>143</td>
<td>23</td>
<td>22.90</td>
</tr>
</tbody>
</table>

TABLE I

<table>
<thead>
<tr>
<th>Heat No.</th>
<th>Cup Sample</th>
<th>After Meltdown, percent</th>
<th>Temp., °F.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Si</td>
<td>Fe</td>
<td>Mg</td>
</tr>
<tr>
<td>1</td>
<td>50.18</td>
<td>47.53</td>
<td>0.12</td>
</tr>
<tr>
<td>2</td>
<td>53.5</td>
<td>41.68</td>
<td>0.67</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Heat No.</th>
<th>Final Alloy Sample, percent</th>
<th>Recoveries, percent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mg</td>
<td>Fe</td>
</tr>
<tr>
<td>1</td>
<td>10.29</td>
<td>42.0</td>
</tr>
<tr>
<td>2</td>
<td>10.29</td>
<td>42.89</td>
</tr>
</tbody>
</table>

In the past, the usual manner of preparing such an alloy, which is widely used in the manufacture of ductile iron, was to provide a bath containing 50% ferrosilicon (containing 44 to 50% Si) and adding magnesium metal, usually by plunging, to provide the desired magnesium content. Magnesium recoveries following this practice were usually on the order of 65%.

As can be seen from the foregoing table, in making a magnesium-containing ferrosilicon wherein the iron and silicon contents are substantially in a 1 to 1 ratio, considerably higher magnesium recovery is obtained using the practice of the present invention.

In the practice of the present invention it is important to use heavy steel scrap, e.g., in the form of cut-up bars about 1" diameter by 1" long or larger, for the iron addition so that the scrap sinks immediately to the bottom.
Light scrap, such as punchings and turnings, is not suitable since this type of material tends to remain at the surface and leads to boiling and loss of magnesium.

What is claimed is:

1. A process for adding magnesium to ferrosilicon to produce an alloy containing substantially equal amounts of iron and silicon and from about 5 to about 15 percent magnesium whereby high recoveries of magnesium are obtained, said process comprising:
   (1) providing a molten bath of ferrosilicon containing at least 53 percent silicon
   (2) plunging magnesium metal below the surface of the molten ferrosilicon to cause magnesium to be dissolved therein

(3) and, after dissolution of the magnesium, adding iron to the molten bath in a form that sinks beneath the surface of the iron bath to provide, upon dissolution of the added iron, an alloy containing substantially equal amounts of iron and silicon.

References Cited

UNITED STATES PATENTS
3,177,071 4/1965 Ebert et al. 75—129
DAVID L. RECK, Primary Examiner.
RICHARD O. DEAN, Examiner.