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ADDITION AGENT AND METHOD FOR TREATING CAST IRON

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6 Claims. (Cl. 75—130)

The present invention relates to an agent and method for introducing into molten metal, such as molten cast iron, an addition material, such as magnesium, wherein only non-strategic ingredients are employed and wherein satisfactory addition characteristics are achieved.

It is well known to introduce metals having a comparatively low melting point, such as magnesium, into metals having relatively high melting points, such as cast iron, for the purpose of improving the properties of castings produced from the thus-treated melt. It is known that magnesium is highly reactive at the temperature of molten cast iron. Hence, it has been proposed heretofore to introduce magnesium into molten cast iron in the form of a stable alloy with other metals, for example, nickel, copper, silicon, and the like. However, in many parts of the world such magnesium alloys are not available or else their cost is so high that the use of such alloys is prohibitive on a commercial basis. It is known that metallic magnesium itself is a comparatively cheap and readily available material. In certain parts of the world economics have dictated the use of magnesium in ingot form as an addition agent for the purpose of introducing magnesium in the cast iron. Although this practice is associated with considerable hazard due to the highly reactive nature of magnesium at the temperature of molten cast iron, it nevertheless may be employed quite successfully provided proper safeguards, including covered ladles, stacks for leading away the magnesium vapor, etc., are used. It is to be pointed out that when an ingot of magnesium is introduced in molten cast iron, the metal vaporizes and produces a large bubble which tends to float rapidly to the surface without reacting with the molten metal. On the other hand, if magnesium is added to molten cast iron in the form of powder, small bubbles are obtained which do not float out of the iron as rapidly as large bubbles. However, magnesium powder has such a small heat capacity that it reacts too rapidly with molten cast iron and hence it is not practical to use this material for the purpose of introducing magnesium into molten cast iron. Again, powdered materials such as calcium carbide desirably may be introduced into molten cast iron for purposes of desulfurization, etc. However, calcium carbide powder by itself has a very low rate of reaction when used either in the form of a briquette or as a powder added to the surface of molten cast iron.

It has now been discovered that magnesium may be introduced into the molten cast iron in the form of a special briquette made from magnesium powder.

It is an object of the present invention to provide a special magnesium-containing agent adapted for the purpose of introducing magnesium into molten cast iron.

Another object of the invention is to provide a relatively inexpensive magnesium-containing agent which is practical for the purpose of introducing magnesium into molten cast iron.

The invention also contemplates providing a process for producing magnesium-containing cast iron utilizing a commercially satisfactory magnesium-containing addition agent which is devoid of strategic elements.

Other objects and advantages will become apparent from the following description.

Generally speaking, the present invention contemplates a briquetted agent for the introduction of magnesium into molten cast iron which comprises magnesium or magnesium alloy powder bonded together with about 20% to about 35% of a synthetic resin binder. In accordance with the invention, magnesium powder having a fineness up to about 48 mesh may be employed although preferably the particle size of the magnesium powder does not exceed about 32 mesh. The binders which may be employed in accordance with the invention comprise synthetic resins which may be either of the thermosetting or thermoplastic type. As examples of satisfactory resins urea-formaldehyde resin, phenolformaldehyde resin and acrylic resin may be mentioned. It is important that the resin content of the magnesium powder-resin briquette be maintained in the aforementioned range in order to achieve efficient introduction of magnesium into molten cast iron therewith. A smaller content of resin binder is insufficient to develop complete spheroidization of graphite in magnesium-containing cast iron treated with the special agent and a greater content of resin binder does not offer additional improvement in reduced reaction time.

The briquette size employed in accordance with the invention may be varied considerably depending upon the size of the melt to be treated therewith, etc. Thus, the size of the briquettes may be ¾ of an inch (2 cm.) to about 2 inches (5 cm.) in average diameter. As an example, briquettes having an average diameter of about 2.3 cm. have been found to produce satisfactory results.

A series of briquettes was made which contained a mixture of powdered magnesium and phenolic resin. In the series, the resin content was varied to provide respective amounts of about 8%, 11%, 17% and 33% resin in the briquettes. To separate portions of molten cast iron suitable for the production of spheroidal graphite cast iron, sufficient of each of the briquetted mixtures was added while the iron was at a temperature of about 1400° C. (2550° F.) to provide an addition of 0.15% magnesium. Metal from each portion was then cast to provide graphitic castings. It was found that the briquette containing only 8% resin was undesirably reactive and that the grapite in the casting made from the portion of molten cast iron treated therewith was only about 20% spheroidal. All of the other briquettes were found to have improved and satisfactory reaction characteristics and the graphite in the castings produced using them was substantially all spheroidal, i. e., at least about 60% and even 100% spheroidal.

For the purpose of giving those skilled in the art a better understanding of the invention, the following illustrative examples are given:

Example I

A bath of molten cast iron containing about 3.7% carbon, about 1.5% silicon, about 0.35% manganese, about

0.08% phosphorus and about 0.035% sulfur was prepared. To various portions of the cast iron melt, additions of a magnesium-resin briquette contemplated in accordance with the invention were made. These briquettes contained about 70% magnesium having a particle size of about 35 mesh and about 30% of phenol resin. These briquettes were about 2 cm. in average diameter. Metal from each thus-treated portion was cast and analyzed for sulfur and magnesium with the following results:

Addition of Magnesium, Percent	Sulfur, Percent	Magnesium Retained in Casting, Percent	Spheroidal Graphite in Casting, Percent
0.06	0.013	0.029	10
0.08	0.013	0.040	95
0.10	0.006	0.068	100
0.15	0.009	0.072	100
0.20	0.007	0.078	100

In contrast to the foregoing, it was found that an addition of 0.40% magnesium in ingot form to the same bath yielded a recovery of only 0.85% magnesium in the final castings.

Example II

Briquettes were made in accordance with the invention by mixing about 3 parts by weight of magnesium powder having a particle size in the range 38 to 48 mesh and about 1 part by weight of urea resin and then forming the mixture into briquettes having a diameter of about 2.3 cm. To separate portions of molten pig iron suitable for the production of spheroidal graphite cast iron, additions were made of megnesium of about 0.08%, 0.10% and 0.20% in the form of said briquettes. The briquettes were held beneath the molten iron surface by means of an inverted cup. It was found that satisfactory spheroidal graphite castings were produced when the magnesium addition was 0.10% and 0.20%, and that a high magnesium recovery in the resulting castings of the magnesium added was obtained. This is in great contrast to the practice using magnesium ingot as the addition agent in which it has been found that an addition of about 0.3% to 0.5% of magnesium is required to produce the same graphite spheroidizing effect. In general, an addition to molten cast iron of about 0.10% or more of magnesium in the form of the briquettes contemplated in accordance with this invention will produce spheroidal graphite.

It has been found that in the use of briquettes contemplated in accordance with the present invention, the reaction characteristics are satisfactory and it is unnecessary to use any special safeguards for the protection of foundry personnel.

It has also been found that desulfurization of pig iron with a briquette of calcium carbide bonded together with plastic resin in accordance with the invention is carried out much more effectively than is the case when powdered calcium carbide is employed as a desulfurizer. As an example, small briquettes of calcium carbide having a particle size of about 100 to 150 mesh were made up with urea resin in a mixing ratio of three parts calcium carbide to about 1 part of resin and were used to desulfurize molten pig iron in a manner comprising holding the briquette below the surface of the molten pig iron. It was found that a desulfurization rate of about 80% to 90% was obtained as compared to a desulfurization rate of only about 20% to 40% obtained when calcium carbide powder was added to the surface of the same molten pig iron.

The magnesium-containing briquette provided in accordance with the invention may be added to molten cast iron in a number of ways, not only for the production

of spheroidal graphite cast iron but also for the purpose of deoxidizing, desulfurizing and otherwise improving the cast iron. It is found, however, that improved results are obtained when the powdered magnesium-resin briquettes are held below the surface of the molten iron to be treated by means of mechanical devices which may, for example, comprise an inverted can or cup. In this manner, the binder appears gradually to be decomposed by combustion, thus permitting contact between the melt and additional magnesium powder with the result that the magnesium content of the briquette is in large part recovered in the molten cast iron. The special powdered magnesium-resin briquettes provided in accordance with the present invention enable the use of a much smaller magnesium addition to cast iron for the purpose of producing spheroidal graphite cast iron than was the case when magnesium ingot was used. Furthermore, the temperature drop in the ladle resulting from the magnesium addition is reduced and the amount of dross generated has also been reduced.

The magnesium powder employed in accordance with the invention may be substantially pure magnesium or it may be an alloy containing at least about 90% of magnesium with up to about 3% zinc and up to about 7% aluminum.

The method for preparing the briquette comprises mixing the magnesium powder with powdered resin (preferably phenolic or acrylic resin), shaping the briquette and then baking it as in the "C" or shell-molding process.

In the production of spheroidal graphite cast iron, it is generally necessary to employ a graphitizing inoculation, usually with silicon or a silicon-containing material, after the magnesium addition in accordance with the invention.

Although the present invention has been described in conjunction with preferred embodiments, it is to be understood that modifications and variations may be resorted to without departing from the spirit and scope of the invention as those skilled in the art will readily understand. Such modifications and variations are considered to be within the purview and scope of the invention and of the appended claims.

I claim:

1. The method for improving molten cast iron which comprises mixing a powdered material from the group consisting of magnesium, magnesium alloys and calcium carbide with about 20% to about 35% of a synthetic resin binder, briquetting the mixture and adding the resulting briquettes to molten cast iron.

2. In the method for producing spheroidal graphite cast iron wherein magnesium as the graphite-spheroidizing agent is introduced into molten cast iron, the improvement which comprises introducing magnesium in the form of a briquette containing magnesium powder with about 20% to about 35% of synthetic resin.

3. An addition agent adapted for the purpose of improving molten cast iron which comprises a briquetted mixture containing a powdered material from the group consisting of magnesium, magnesium alloys and calcium carbide with about 20% to about 35% of a synthetic resin binder.

4. An addition agent adapted for the purpose of introducing magnesium into molten cast iron which comprises a briquetted mixture of about 20% to about 35% of a synthetic resin with the balance essentially magnesium powder.

5. The method according to claim 1 wherein the briquette added to molten cast iron comprises a mixture containing powdered material from the group consisting of magnesium, magnesium alloys containing at least about 90% magnesium and calcium carbide, with the balance essentially a synthetic resin from the group consisting of urea-formaldehyde resin, phenol-formaldehyde resin and acrylic resin, said synthetic resin being at least about 20% to about 35% of said briquette.

6. An addition agent adapted for the purpose of in-

troducing magnesium into molten cast iron which comprises a briquetted mixture of about 20% to about 35% of a synthetic resin from the group consisting of urea-formaldehyde resin, phenol-formaldehyde resin and acrylic resin, with the balance essentially a powdered material from the group consisting of magnesium, magnesium alloys containing at least about 90% magnesium and calcium carbide.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

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It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 25, for "0.85% magnesium" read -- 0.085% magnesium --; line 36, for "megnesium" read -- magnesium --.

Signed and sealed this 28th day of October 1958.

(SEAL)

Attest:

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