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EXOTHERMIC ALLOYING COMPOSITION FOR ADDITION TO MOLTEN STEEL

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This invention relates to the production of steel.

In steel making practice it has become common in recent years to add any necessary alloying additions to the melt in the form of ferro alloys. These alloys are normally added either as the metal is running through the launder, in which case they are added as a steady trickle of coarse powder, or they are added to the ladle before it is filled with metal, and the molten metal poured onto them. In this case they may be either in the form of coarse powder or as tablets.

A disadvantage arising from the use of ferro alloys is that substantial amounts are normally required and, unless these additions are pre-heated, substantial chilling of the molten metal occurs. To prevent this chilling the practice is to employ ferro alloys which contain exothermic material so that, as the molten metal contacts the ferro alloy, an exothermic reaction is set up which gives out substantial amounts of heat and so counteracts or prevents the chilling effect of the addition. A further advantage of this type of material is that a higher recovery of alloy in the metal is obtained.

The exothermic material normally consists of a mixture of oxidizing agents, reducing agent and a ferro alloy, and these ingredients are present in amounts such as to produce sufficient heat to cause the ferro alloy to melt. The exothermic reaction also promotes stirring of the metal in the ladle and so helps to obtain uniform distribution of the alloy addition. It has also been the practice to include fluorspar in the exothermic mixture thus employed. This acts to increase the fluidity of the slag formed by the end products of the exothermic reaction and it also aids in increasing the rate of reaction and so the rate of dissolution of the alloy in the metal.

It is an object of this invention to provide means for improving the effectiveness of additions of the type set forth.

According to the present invention an alloying composition for addition to molten steel comprises a ferro alloy of the metal which is to be alloyed with the steel and an exothermic mixture comprising at least one reducing agent, at least one oxidizing agent and a small proportion of aluminium fluoride and/or magnesium fluoride.

More particularly the said composition may comprise a ferro alloy as aforesaid, and an exothermic mixture comprising a finely divided reducing agent selected from aluminium, magnesium, silicon, ferrosilicon and mixtures of any of these, an oxidizing agent therefor selected from alkali metal nitrates and chlorates, and a small proportion of aluminium fluoride and/or magnesium fluoride. Such nitrates and chlorates are for example, sodium and potassium nitrates and chlorates.

According to a further feature of the invention alloying compositions as aforesaid are in the form of granules which either contain all the ingredients of the composition or are separate granules of the ferro alloy and granules containing all the ingredients of the exothermic mixture.

It has been found that using the aluminium and/or magnesium fluorides, increased sensitivity is obtained and the reaction, therefore, commences at a lower temperature, thus affording an increase in the intimate admixture of the alloy with the metal. Only small amounts of these fluorides need therefore be added so that considerably less slag is produced. Suitable quantities of the said fluorides are usually in the range 0.1 to 20% of the weight of the total of exothermic mixture and ferro alloy. Fluorspar or any other slag-fluxing agent can be included in the compositions if desired but owing to the less amount of slag formed its presence is less necessary.

It has further been found that when the composition is in granular form and each of the granules contains some exothermic material and some alloying addition, each granule acts as a centre for the reaction and a more efficient additive is thus obtained. The ferro alloy or exothermic mixture may be granulated together or the exothermic materials and ferro alloys may be granulated separately and the granules mixed together in correct proportions. The composition may be packaged in cans, paper parcels, or other containers at set weights or the loose granules may be used as required.

The following examples will serve to illustrate the invention:

Example 1

The following materials are mixed together and the resulting composition granulated:

	Parts by weight
Aluminium	2 to 10
Oxidizing agents (e.g. nitrates)	5 to 20
Aluminium and/or magnesium fluoride	0.1 to 10
Ferro alloy	93 to 60

Example 2

An exothermic composition is prepared by mixing together and granulating the following:

	Parts by weight
Aluminium	2 to 10
Oxidizing agents (e.g. nitrates)	5 to 20
Aluminium and/or magnesium fluoride	0.1 to 10

The said granulated exothermic composition is mixed with granulated ferro alloy in the proportion of 5 to 25% by weight of the former to 95 to 75% by weight of the latter.

It is not essential to this invention that the compositions be granulated. They can be employed as free powders or in compacted form, e.g. as tablets. In this latter case the compositions will usually contain a binding agent, e.g. core gum.

The invention includes not only the novel compositions set forth herewith but also the method of producing steel in which said compositions, preferably granulated as aforesaid, are added to the molten metal in the launder or in the ladle. The invention further includes steel manufactured by the aid of such alloying additions as aforesaid.

I claim as my invention:

1. An alloying composition for addition to molten steel consisting essentially of a ferro alloy and an exothermic mixture consisting essentially of a reducing agent selected from the group consisting of aluminum, magnesium, silicon, ferrosilicon and mixtures thereof, an oxidizing agent selected from the group consisting of alkali metal nitrates and alkali metal chlorates and mixtures thereof, and a fluoride selected from the group consisting of aluminum fluoride and magnesium fluoride and mixtures thereof, the proportion of said fluoride being 0.1 to 20% of the said composition.

2. An alloying composition for addition to molten steel consisting essentially of a ferro alloy and an exothermic mixture consisting essentially of a reducing agent selected from the group consisting of aluminum, magnesium, silicon, ferrosilicon and mixtures thereof, an oxidizing agent

selected from the group consisting of alkali metal nitrates and alkali metal chlorates and mixtures thereof, and a fluoride selected from the group consisting of aluminum fluoride and magnesium fluoride and mixtures thereof, the proportion of said fluoride being 0.1 to 20% of the said composition and the composition being granulated so that each granule contains all the said constituents of the composition.

3. An alloying composition for addition to molten steel consisting essentially of a ferro alloy and an exothermic mixture consisting essentially of a reducing agent selected from the group consisting of aluminum, magnesium, silicon, ferrosilicon and mixtures thereof, an oxidizing agent selected from the group consisting of alkali metal nitrates and alkali metal chlorates and mixtures thereof, and a fluoride selected from the group consisting of aluminum fluoride and magnesium fluoride and mixtures thereof, the proportion of said fluoride being 0.1 to 20% of the said composition and the composition being granulated as a mixture of granules of the ferro alloy with granules of the exothermic mixture.

4. An alloying composition for addition to molten steel consisting essentially of 2 to 10 parts by weight of aluminum, 5 to 20 parts by weight of an oxidizing agent selected from the group consisting of alkali metal nitrates and alkali metal chlorates, 0.1 to 10 parts by weight of aluminum fluoride, and 93–60 parts by weight of a ferro alloy.

5. An alloying composition for addition to molten steel

consisting essentially of 95–75% of a granulated ferro alloy and 5 to 25% of a granulated exothermic composition consisting essentially of 2 to 10 parts by weight of aluminum, 5 to 20 parts by weight of an oxidizing agent selected from the group consisting of alkali metal nitrates and alkali metal chlorates, and 0.1 to 10 parts by weight of aluminum fluoride.

6. An alloying composition for addition to molten steel consisting essentially of 2 to 10 parts by weight of aluminum, 5 to 20 parts by weight of an oxidizing agent selected from the group consisting of alkali metal nitrates and alkali metal chlorates, 0.1 to 10 parts by weight of magnesium fluoride and 93–60 parts by weight of a ferro alloy.

7. An alloying composition for addition to molten steel consisting essentially of 95–75% of a granulated ferro alloy and 5 to 25% of a granulated exothermic composition consisting essentially of 2 to 10 parts by weight of aluminum, 5 to 20 parts by weight of an oxidizing agent selected from the group consisting of alkali metal nitrates and alkali metal chlorates, and 0.1 to 10 parts by weight of magnesium fluoride.

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