

UNITED STATES PATENT OFFICE

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TREATING AGENT

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This invention relates to a method and agent for deoxidizing molten ferrous metal and is more particularly characterized by the solubility and exothermicity of the agent.

A primary function of addition agents is fluxing refractory inclusions from molten metal. The addition of exothermic agents to molten metal for this purpose is known, but such treatment has resulted in the introduction of slag products which are not readily eliminated from the molten metal.

It is an object of this invention to provide a method and agent for fluxing refractory inclusions, which agent effects the elimination of pre-existing inclusions from molten ferrous metal.

Another object is to provide an agent by which a molten ferrous metal bath may be subjected to a mild turbulence and the associated fluxing action of a rising fluid slag thereby effecting a coalescence of inclusions into relatively large particles readily separable from the molten bath.

A further object is to provide an exothermic agent that may be used as a ladle addition to a molten ferrous metal bath without substantially altering the temperature of the bath but providing sufficient heat of reaction to effect ready solubility of the addition agent.

A still further object is to provide an agent for deoxidizing ferrous metal characterized by its ready solubility in molten iron or steel.

These objectives are achieved by adding to molten ferrous metal an exothermic mixture comprising a silicon-containing alloy of at least 40% silicon content, manganese ore (MnO_2), and a suitable sodium compound. Ferrosilicon is a preferred form of silicon-containing alloy although other silicon alloys, containing at least 40% silicon, may be used when the metal constituent of such alloys other than silicon, is desired in the treatment of molten ferrous metal. Calcium, preferably as calcium-silicon alloy, may be advantageously employed as a constituent of the agent to increase exothermicity. A balance between calcium and silicon should be maintained. This may be effected by replacing a portion of ferrosilicon alloy, by calcium-silicon alloy. The manganese ore promotes fluidity in the flux, increases the exothermicity of the agent and provides a minimum change in the manganese content of the treated metal. It is desirable, particularly in the fluxing of silicate inclusions, that the flux formed by the agent be alkaline in character. Alkalinity is accomplished in the agent by the addition thereto of a sodium compound having a weak acid radical. Suitable compounds comprise

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sodium carbonate (soda ash), sodium hydroxide (caustic soda) or sodium silicate (water glass). Sodium carbonate is a preferred compound providing, in addition to basicity, a mild turbulence to the molten metal bath. A maximum of about 20 per cent of a sodium compound, as described, is sufficient to effect the desired result.

The limits within which the several materials may be incorporated in the mixture of the invention are shown below.

Material	Grade	Percent of Material in Mixture
		Percent
Ferrosilicon.....	40 to 90% Si.....	50 to 85
Calcium-Silicon.....	25 to 35% Ca.....	5 to 20
Manganese Ore.....	80 to 90% MnO_2	5 to 30
Alkaline sodium compound.....		2 to 20

It is desirable to secure a well blended mixture to assure quick and even ignition. To this end the ferrosilicon and calcium-silicon alloys preferably may be comminuted to pass through a 20 mesh screen (0.0328 in. openings) and blended with the manganese ore and sodium compound. The mixture may be bagged and used directly or briquettes may be formed, for example, by binding the other materials with a water paste of sodium carbonate or with sodium silicate followed by pressing and drying or by any other suitable means.

In general, not more than one per cent of an addition mixture, as described, is necessary to provide the desired action to molten ferrous metal. The condition of the molten metal, particularly in relation to the oxide, sulphur and phosphorus content, is a determining factor on the composition of the mixture within the indicated limits as well as the amount of the mixture required for final purification.

By way of example, the special mixtures were used in 650 pound arc furnace heats to observe their effects in fine-grained steels as found in commercial practice. The special mixtures, after comminution and blending were placed in paper bags and added to ladles in amounts calculated to introduce approximately 0.25 per cent silicon. One preferred mixture comprised by weight: 73 parts of 75% ferrosilicon, 7 parts of calcium-silicon, 10 parts of manganese ore (MnO_2), and 10 parts of sodium carbonate. This special mixture was added to the ladle during pouring and was observed to dissolve readily in the steel with a uniform mild turbulence but without evidence of any violent reaction or agitation that might

be objectionable or hazardous. The special addition was completed when the ladle was about half full and was followed by the customary addition of aluminum shot equal to two pounds per ton of steel. The treated steel was cast in preheated ingot molds (8 in. x 8 in. x 30 in.) for subsequent examination. Composition of the treated steel by analysis was: carbon 0.30%, manganese 1.22%, phosphorus 0.023%, sulphur 0.019%, silicon 0.23%.

Cross-sectional samples were cut from the ingot at locations 2 in., 14 in., and 23 in. below the hot top, representing top, center, and bottom sections of the ingot respectively. The ingot was particularly solid. Both macro and micro examination of the several sections showed the steel to be slag free, clean and sound. The mild turbulence of the bath effected after introduction of the new mixture and the low viscosity of the resulting slag, which was lower than the slag formed from ferro-silicon additions alone, account for the excellent condition of the ingot steel.

The invention is not limited to the mode of usage disclosed in the example, but is applicable to many types of ferrous metal treatment and particularly to those applications wherein the addition of the special agent is made directly in the ladle as, for example, in cast iron graphitization.

What is claimed is:

1. A mixture for use as an addition agent for treating molten ferrous metal, composed of between 50% and 85% of a silicon-containing alloy, said alloy containing at least 40% silicon; between 5% and 30% manganese dioxide; and between 2% and 20% of an alkaline sodium compound.

2. A mixture for use as an addition agent for treating molten ferrous metal, composed of between 50% and 85% ferrosilicon, said ferrosilicon containing at least 40% silicon; between 5% and 30% manganese dioxide as manganese ore; and

between 2% and 20% of an alkaline sodium compound.

3. A mixture for use as an addition agent for treating molten ferrous metal, composed of between 50% and 85% ferrosilicon, said ferrosilicon containing at least 40% silicon; between 5% and 20% calcium-silicon, said calcium-silicon containing at least 25% calcium and 50% silicon; between 5% and 30% manganese dioxide as manganese ore; and between 2% and 20% of an alkaline sodium compound.

4. An agglomerated mixture in the form of a briquette for treating molten ferrous metal, composed of between 50% and 85% comminuted ferrosilicon, said ferrosilicon containing at least 40% silicon; between 5% and 30% manganese dioxide as manganese ore; and between 2% and 20% of an alkaline sodium compound.

5. An agglomerated mixture in the form of a briquette for treating molten ferrous metal, composed of between 50% and 85% comminuted ferrosilicon, said ferrosilicon containing at least 40% silicon; between 5% and 20% comminuted calcium-silicon, said calcium-silicon containing at least 25% calcium and 50% silicon; between 5% and 30% manganese dioxide as manganese ore; and between 2% and 20% of an alkaline sodium compound.

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