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METHOD OF THERMOCHEMICALLY TREATING FERROUS METAL BODIES

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This invention relates to the art of thermochemically removing metal from a ferrous metal body, and more particularly to a method for inhibiting the accumulation and the adherence of such thermochemically removed metal, in the form of slag, to a surface of such body due to a thermochemical metal removing operation thereon.

In the manufacture of ferrous metal bodies superficial flaws or defects such as blowholes, blisters, cavities, scale and the like, are often produced at or near the surface thereof and in order to remove these and similar defects quickly and efficaciously, increased use is being made of the deseaming blowpipe or a desurfacing apparatus having incorporated therein a plurality of such blowpipes.

A deseaming blowpipe is adapted to produce oxy-acetylene preheating flames at a series of orifices in the blowpipe tip or nozzle, which surround a larger central oxidizing gas orifice. To initiate the deseaming operation on a ferrous metal body which is at a temperature below its ignition temperature in oxygen, preheating flames are used to heat a spot on the surface of the body or work to such ignition temperature, i. e. substantially to a red heat. A stream of oxidizing gas is then discharged obliquely against such heated spot from the central orifice in the blowpipe nozzle thereby oxidizing the heated metal and initiating the deseaming operation. To complete the deseaming operation, the metal body or work and the blowpipe are relatively moved with respect to each other in substantially parallel planes. The blowpipe is so positioned that the oxidizing gas stream is directed in the direction of movement along and obliquely against the work surface for thermochemical reaction with successive areas of surface metal. Usually the preheating flames remain burning while deseaming is in progress although in some instances once the metal has been ignited the thermochemical reaction may be self-sustaining by virtue of the heat generated during such reaction.

By proper manipulation of the deseaming blowpipe, a groove or seam is produced in the body coincident with the surface defect or flaw, thereby eliminating such defect or flaw from the ferrous metal body. The thermochemical reaction produced a considerable amount of liquefied metal and iron oxide and such mixture, hereinafter termed slag, is blown forward by the gas stream, while a part of such slag flows over the edges of the groove or seam and solidifies on and adheres to the adjoining work surface. In deseaming and desurfacing operations it has been observed that the slag may consist of about 20% molten oxide and the balance molten metal; the solidification of the latter constituent causes tenacious adherence of the mixture of iron and iron oxide to the surface of the work. The stream of oxidizing gas may be directed at a slight lateral angle with respect to the direction of the deseaming operation thus causing most of the slag to flow laterally over one edge of the groove. Frequently, by inclining one or more nozzles obliquely in the direction of movement several laterally contiguous grooves can be made successively without cleaning from the work surface the slag produced from the previous deseaming operation, and such procedure creates an undesirable accumulation of slag along the last formed edge of the groove. This condition, after several passes of the deseaming nozzle have been made, actually interferes with further deseaming until such adhering accumulation has been removed from the work surface. The existence of a narrow metal fin, produced during the deseaming operation, along the edges of the groove greatly aggravates the accumulation of slag since the latter adheres readily to the fin and tends to cause the balance of the slag, flowing over the edge of the groove, to collect on the work surface. The amount of slag actually adhering to the fin is small in relation to the remainder of the slag on the surface of the work and this invention contemplates a method and means for eliminating this latter condition.

The primary object of this invention is to provide a method for inhibiting the adherence and accumulation of slag on a surface of a ferrous metal body due to a thermochemical metal removing operation thereon, such as a deseaming, desurfacing, or similar operation. Other objects of the invention include the application of a substance to the thermochemical reaction zone, said substance being capable of coacting or cooperating with the resulting slag to inhibit the adherence and accumulation of the latter on portions of the work adjoining those which are superficially melted and oxidized by the action of one or more streams of oxidizing gas; the provision of a method of thermochemically removing metal from a ferrous metal body by depositing thereon a thin layer of a composition containing an inorganic substance such as an alkaline earth metal compound, and simultaneously or subsequently directing a stream of oxidizing gas against such layer on successive heated areas on the

surface of said body; and the provision of a composition containing calcium hydroxide or oxide or both, which is adapted to inhibit the adherence and accumulation of slag on a surface of a ferrous metal body.

According to the present invention, the application of a composition containing an alkaline earth metal compound to the work surface prior to or during a thermochemical metal removing operation facilitates the removal of the resulting slag. Such composition is preferably applied to a ferrous metal body as a liquid coating prior to the thermochemical metal removing operation, and while somewhat less desirable results are obtained, it may be applied in dilute form, or even as a powder, directly with either or both the fuel gas or the oxidizing fas streams.

In general, the coating composition consists essentially of an alkaline earth metal oxide or hydroxide either alone or in admixture with other alkaline earth metal oxides or hydroxides. Preferably, calcium oxide or hydroxide or both are employed as the active ingredients of the composition and the latter is usually applied in the form of an aqueous mixture or suspension commonly known as whitewash. The residue produced in the generation of acetylene from calcium carbide and water is suitable for use in the practice of this invention. If desired suitable binders such as water-glass, as well as anti-dusting agents, such as sodium or calcium chloride, may be incorporated into the lime-water mixture. This mixture may be brushed, sprayed or otherwise coated upon the surface of the work. While the best results are obtained by permitting the coating to dry before effecting the thermochemical metal removing operation, such operation may be effected while the coating is still wet, as the intense heat of the preheating flames and the heat evolved during the thermochemical metal removing operation rapidly dries the coating.

As will be recognized, the results obtained may vary somewhat depending largely upon the concentration of the coating material and the conditions under which it is employed. Especially desirable results have been obtained by the application of a thin layer or film of hydrated or slaked lime to a surface of a ferrous metal body in the vicinity of a flame desurfacing or deseaming operation to prevent the accumulation and adherence of slag on the remaining surface portions of the metal body.

The proportions of calcium hydroxide in the liquid coating composition may vary within relatively wide limits. Heavy concentrations are to be avoided as caking may occur, and likewise excessively dilute concentrations are to be avoided as being inefficient. In general, the concentration of slaked lime in the liquid composition is not critical and good results have been obtained either by using relatively viscous mixture or a relatively dilute mixture.

The reason for the action of calcium oxide or hydroxide in preventing the accumulation of slag on the work surface is not clearly known. While the invention is not limited to any theory as regards the mechanism of the reaction, it appears that lime may assist in the thermochemical reaction of the metal and oxygen and produce a more complete and uniform oxidation of the removed metal. Another theory suggests that calcium oxide or hydroxide becomes a heat insulator and prevents the chilling of the slag on the surface of the metal body. A further theory suggests that each particle of lime forms a nucleus about which portions of the molten slag adhere, thus resulting in the formation of small and generally hollow spherical globules which are readily blown from the surface of the work. A still further theory suggests the possibility that calcium hydroxide, which at elevated temperatures becomes calcium oxide, goes into solution with the molten slag and decreases the surface tension thereof, thereby allowing it not only to flow more easily from the work surface but also to form smaller hollow spheres which are blown away more easily.

In the practice of this invention, defects on the surface of a metal body may be marked by spraying or painting the area in question with whitewash. This material dries white and can be easily seen by the operator during a subsequent deseaming operation thereby assisting him to follow the defect more closely and to avoid the removal of sound metal. For the desurfacing of larger or entire lateral areas of the metal body, the surface of the latter may be completely coated with a film of whitewash.

The composition containing an alkaline earth metal compound is also useful for inhibiting the formation of undesirably large amounts of slag on a surface adjacent to one produced by a flame desurfacing operation. This function is secured by coating the composition on the surface of the metal body on which the slag is driven or tends to accumulate by the action of the oxidizing gas stream or streams. For example, in desurfacing vertical sides of ingots or billets a whitewash composition of suitable consistency may advantageously be applied to the horizontal top and bottom surfaces of the billet to prevent the accumulation and adherence of slag thereto.

While the invention has been particularly described as relating to the thermochemical desurfacing or deseaming of a ferrous metal body it is not to be construed that it is so limited, as it is applicable to all thermochemical metal removing operations in general. It will be obvious to those skilled in the art that the invention may be otherwise embodied and practiced without departing from the principles or scope of the invention.

I claim:

1. In a method of thermochemically removing metal from a ferrous metal body by applying an oxidizing gas stream to a surface of said body while said surface is at ignition temperature, to melt and oxidize a portion of said body and to form a molten slag containing such removed metal, the step which comprises bringing said molten slag in contact with an alkaline earth metal compound coating on the surface of said body which compound inhibits the adherence and accumulation of the slag on a surface of said body.

2. In a method of thermochemically removing metal from a ferrous metal body by applying an oxidizing gas stream to a surface of said body while said surface is at ignition temperature, to melt and oxidize a portion of said body and to form a molten slag containing such removed metal, the step which comprises bringing said molten slag in contact with a composition containing an alkaline earth metal compound selected from the group consisting of calcium oxide and calcium hydroxide, said composition coacting with said slag to inhibit the adherence and accumulation of the latter on a surface of said body.

3. In a method of thermochemically conditioning a surface of a ferrous metal body by applying an oxidizing gas stream against successive portions of said surface while at ignition

temperature, to melt and oxidize said portions superficially and thereby remove a stratum of metal from such surface and form a molten slag containing such removed metal, the step which comprises conducting the thermochemical metal removing operation and reaction in the presence of a composition containing as the essential ingredient thereof, an alkaline earth metal compound which coacts with such resulting slag to reduce substantially the adherence and accumulation of the latter on portions of said surface adjoining those surface portions which are superficially melted and oxidized.

4. A method of thermochemically conditioning a surface of a ferrous metal body as claimed in claim 3, in which the alkaline earth metal compound is selected from the group consisting of calcium oxide and calcium hydroxide.

5. In a method of thermochemically conditioning a surface of a ferrous metal body by applying an oxidizing gas flame comprising an oxidizing gas stream and a preheating gas stream against successive portions of said surface while at ignition temperature, to melt and oxidize such portions superficially and thereby remove a stratum of metal from such surface and form a molten slag containing such removed metal, the step which comprises introducing into at least one of such gas streams an alkaline earth metal compound which cooperates with such molten slag to substantially eliminate the adherence and accumulation of the latter on portions of said surface adjoining those surface portions which are superficially melted and oxidized.

6. A method as claimed in claim 5, in which said alkaline earth metal compound is selected from the group consisting of calcium oxide and calcium hydroxide, and said compound is introduced into said gas stream in a state selected from the group consisting of liquid and powder.

7. In a method of thermochemically conditioning a surface of a ferrous metal body by applying an oxidizing gas stream against successive portions of said surface while at ignition temperature to melt and oxidize said portions superficially and thereby remove a stratum of metal from such surface and form a molen slag containing such removed metal, the step which comprises initially, and prior to such metal removing operation, coating such surface portions of said body with an alkaline earth metal compound which coacts with such resulting slag to substantially eliminate the adherence and accumulation of said slag on portions of said surface adjoining those surface portions which are superficially melted and oxidized.

8. A method of thermochemically conditioning a surface of a ferrous metal body as claimed in claim 7, in which said alkaline earth metal compound is selected from the group consisting of calcium oxide and calcium hydroxide.

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