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DESCALING OF ALLOYS BY HIGH TEMPERATURE SURFACE VAPORIZATION

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ABSTRACT OF THE DISCLOSURE

Described herein is a method for removing oxide scales from metal surfaces which comprises applying an aqueous solution containing an alkali metal hydroxide to the surface to be descaled after heating same to a temperature sufficiently high to evaporate the water of solution and to fuse the resulting salt and thereafter removing the conditioned scale.

This invention relates to the removal of oxide scale from metals, and more particularly to a process for removing oxide scale continuously from a strip of stainless steel.

In the past it has been usual practice to pass strips of stainless steel and other metals through a fused caustic bath such as sodium hydroxide or potassium hydroxide to condition the scale on the material for removal. Following this conditioning treatment, the material was subjected to rinsing and acid pickling to remove the scale which had been conditioned for removal. These caustic baths some times contain specific addition agents, for example oxidizing agents such as nitrates, to aid in the conditioning process.

These prior art caustic baths must be maintained in the molten condition, and the fusion point of these baths is above 600° F. This necessitates expensive heat resisting equipment for containing and maintaining such bath, and also a substantial length of tank must be provided so that the moving strip of material will be immersed in the bath a sufficient amount of time for the necessary reaction to take place to condition the scale for removal. This equipment is expensive and somewhat difficult to maintain.

Another prior art proposal for conditioning the material for descaling is to spray fused caustic materials such as sodium and potassium hydroxide onto a moving strip of material. This practice, however, has not been entirely satisfactory, inasmuch as at the temperatures required to maintain the caustic liquid, the life of the nozzles used to spray the material is relatively short, which necessitates frequent changing of the nozzles.

It is therefore a principal object of this invention to provide an improved process of conditioning and scale removal from metals.

Another object of this invention is the provision of an improved process for descaling metals having oxide coatings thereon wherein caustic solutions at room temperature are employed for scale removal.

Still another, more specific object of this invention is the provision of a process of applying aqueous solutions of a caustic material which are liquid at ambient room temperature to a strip, which strip is heated to a point above the fusion temperature of the salt, which will condition the scale for easy removal.

A still further object of this invention is the provision of a process for spraying aqueous solutions of caustic material at ambient temperature onto a moving strip of material heated to a sufficient degree to cause the water to be evaporated and the salt to fuse, to thereby condition the oxide scale for removal.

These and other objects, together with a fuller understanding of the invention, will become apparent when taken in conjunction with the following description and the appended claims.

This invention will be described in conjunction with its utilization to remove scale from continuously annealed strips of stainless steel. However, in its broader aspects this invention is not limited to stainless steel, nor to material in strip form. The invention can be practiced on any metal or alloy which has an oxide scale which can be conditioned for removal by fused alkali metal hydroxides, and hence the term "alloys having oxide coatings thereon" is intended to include any such metal or alloy with such a type of oxide coating.

In its more general aspects, this invention is practiced by spraying or otherwise applying an aqueous solution of alkali metal hydroxide onto the surface of an alloy having an oxide scale thereon and having the surface of the alloy at a temperature sufficiently high to drive off the water from the solution, and to fuse the resulting alkali metal hydroxide salt residue. This fused salt residue will chemically react with the oxide coating on the alloy to condition it for removal. Following this conditioning, the scale is removed, preferably by a water rinse, followed by a pickle in an acid medium.

This invention finds specific use in descaling stainless steel as it emerges from a continuous high temperature anneal. In such an application of the invention a spray nozzle or group of spray nozzles, depending upon the size of the strip, are positioned at the exit side of the furnace on opposite sides of the strip, and an aqueous solution of alkali metal hydroxide is sprayed from the nozzles onto both sides of the strip at a rate and in an amount to cover the entire surfaces of the strip. These nozzles are preferably placed at a position where the temperature of the strip will be between 900 and 1,000° F. If the temperature is below 900° F., adequate fusion of the salt residue after evaporation of the water does not occur, and hence the process is inefficient. If the temperature of the strip is over about 1,000° F., there is a tendency for the fused salt to pit and attack the stainless steel.

Although alkali metal hydroxides other than sodium hydroxide and potassium hydroxide may be used, the sodium and potassium hydroxides are preferred because of their ready availability at economical prices.

It is preferred that the concentration of the hydroxide in the solution be less than 50%, inasmuch as at greater concentrations the solution is not liquid at room temperature and requires heating to make it liquid. Although there is no specific lower limit of the concentration, if the concentration of the hydroxide is less than about 3%, excessive amounts of solution must be applied in order to get a sufficient amount of salt residue on the strip to be effective for conditioning the scale. For this reason it is preferred that there be at least 3% of the hydroxide in the solution.

In practicing this invention it is also contemplated that certain additions may be made to the solution for specific purposes; for example, oxidizing agents such as nitrates may be added to aid in the conditioning of the scale. Other additives for specific purposes may be utilized provided they do not interfere with the action of the salt residue in conditioning the scale.

After the strip has been sprayed with caustic solution, it is passed through a water tank, followed by a water spray rinse where the salt residue and loosened scale are removed. After passing through the water tank rinse, the strip is pickled in an acid medium which will remove all of the salt residue and scale, which pickling is followed by a water rinse to remove the acid, and thereafter the strip is dried and coiled. The pickling may take

place in two steps such as a first pickle in sulfuric acid followed by a pickle in a mixture of nitric and hydrofluoric acid. The exact steps for removal of the conditioned scale after spraying of the hydroxide solution will vary, depending upon the alloy being treated and the nature of the scale after it has been conditioned.

Although it is preferred to spray the strip as it emerges from the annealing operation, it is possible that material from which the oxide scale is to be removed have the hydroxide solution applied thereto while the material is cold. The material is thereafter heated to a sufficiently high temperature to evaporate the water and fuse the salt, and as was previously described, this temperature is preferably between 900° F. and 1,000° F. The salt residue will fuse, as previously described, which will condition the scale, and the scale is then removed, preferably the removal including a pickling step in an acid medium.

One of the outstanding features of this invention is that the solution to be applied to the strip can be maintained at ambient room temperature. This means that the handling equipment and the equipment containing the solution need not be insulated or heated, and can be built substantially more economically. Also, the equipment for applying the solution, and particularly the spray nozzles, have an extremely long life as compared to nozzles which spray material heated well above 600° F., such as are necessary when molten hydroxides are sprayed.

In practicing this invention the heat in the strip is utilized to fuse the hydroxide salt residue thereon, which will provide all the advantages of molten salt oxide scale conversion without the disadvantage of having to handle and maintain such molten salt in the fused condition.

I claim:

1. A method of descaling a moving strip of stainless steel having an oxide scale on the surface thereof comprising the steps of applying an aqueous solution containing an alkali metal hydroxide selected from the group consisting of sodium hydroxide and potassium hydroxide on the surface to be descaled which surface has been

previously heated and is at a temperature within the range of from about 900° F. to about 1,000° F., whereby water of solution is evaporated and the resulting salt fused to said surface and thereafter pickling the surface in an acid medium to remove the scale.

2. In a method of descaling alloys having oxide scale on the surface thereof wherein an aqueous solution containing an alkali metal hydroxide is applied to the oxide-bearing surface, the improvement which comprises heating said oxide-bearing surface prior to contact thereof with said aqueous solution to a temperature within the range of from about 900° F. to about 1,000° F. to evaporate the water of solution and fuse the resulting salt, applying said aqueous solution containing an alkali metal hydroxide to said heated oxide-bearing surface whereby said water of solution evaporates and the resulting salt fuses to said surface and thereafter removing the oxide scale.

3. An improvement in the method according to claim 2 wherein said alloy is a stainless steel.

4. An improvement in the method according to claim 2 wherein said alkali metal hydroxide is a composition from the group consisting of sodium and potassium hydroxides.

5. An improvement in the method according to claim 4 wherein said solution contains about 3 to 50% of the hydroxide.

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