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METAL CLEANING PROCESS

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This invention relates to a process for cleaning metal and more particularly to a method for removing oxide scale from metal surfaces.

In the removal of oxide scale from iron, steel and other metals the common method is to immerse the metal in a bath of a strong acid solution. For example, steel is commercially descaled by dipping in solutions of acids such as sulfuric acid, hydrochloric acid and the like. Various materials are added to modify the action of the acid to inhibit the action of the acid on steel after the oxide scale has been removed. A common disadvantage of such acid pickling operations is that steel thus treated, after removal from the pickling bath, tends to rust very easily. Consequently, unless the metal is covered immediately with a rust-resistant coating, as by electroplating, it is necessary to cover the cleaned surface with oil or grease or similar protective coating to prevent rusting while in storage.

An object of the present invention is to provide a new and improved method for removing oxide coatings from metal surfaces. A further object is to provide a method whereby steel may be treated to remove oxide scale and simultaneously be provided with a corrosion-resistant surface. Other objects will be apparent from the following description of my invention.

I have discovered that when oxide-coated iron, steel or similar ferrous metal is treated with a sodium-lead alloy at a sufficiently elevated temperature, the oxide scale thereon is substantially completely removed in a very short period of time, leaving a surface which is highly resistant to rust formation. In order that the sodium-lead alloy treatment may effectively remove the oxide coating it is essential that the operation be carried out at a temperature not lower than about 500° C.; preferably I carry out the operation at a temperature of 600–800° C.

I am aware that it has previously been proposed to provide steel with a coating of lead by immersing the steel in fused bath of lead-sodium alloy at a temperature of 380 to 420° C. (720 to 820° F.). The present method is distinctly different in that such high temperature is used that the lead coated product of the prior method is not formed.

A convenient method of practicing my invention is to melt a sodium-lead alloy containing about 5% by weight of sodium and introduce into the melt the steel to be cleaned for a period of time necessary to effect the desired removal of scale. The time of treatment required will depend upon various factors such as the nature of the steel and the oxide scale thereon, the temperature of the melt and the concentration of alkali metal in the treating bath. In general the required time of treatment will be in proportion to the temperature and to the alkali metal concentration. The alkali metal concentration may be varied considerably but in general it will not be less than 0.5% by weight. While in general I prefer to use an alloy containing 2–10% by weight of sodium the concentration may be varied over wide limits. It is preferred to maintain the alkali metal content not higher than about 10% by weight in order to avoid excessive loss of metal by oxide formation. During continual use the alkali metal content of the descaling bath will continuously decrease due to the reaction of the alkali metal with the oxide film being removed and to some extent by oxidation caused by any air coming into contact with the bath surface or carried into the bath on the surface of the articles being treated. Hence, in order to maintain the bath constantly effective, alkali metal should be added to the bath from time to time, to maintain a suitable concentration of alkali metal in the bath.

When the steel is removed from the bath after having been immersed therein for a sufficient length of time, the oxide scale will have completely disappeared and loosely adhering droplets of the lead alloy are on the steel surface. Usually, it is necessary only to keep the steel in the bath to bring it to the temperature of the bath, to accomplish this result. If the oxide scale is heavy, it is sometimes necessary to keep the steel in the bath for several minutes after coming to the bath temperature. Longer times may be employed, without deleterious effect on the steel surface. If the time of treatment selected does not completely remove the oxide, the steel may be reimmersed in the bath until the desired effect is obtained or, if desired, the steel may be subjected to the next step in the process, for removing the droplets of lead alloy. These may readily be removed by a simple mechanical operation such as wiping, scratch-brushing, scraping or the like. After such mechanical treatment, the steel will have a smooth, dark surface, which is highly rust resistant. The corrosion resistant coating is microscopically thin, hard, durable and very adherent. The mechanical treatment, to remove the loosened oxide scale, is essential in order to produce the rust-proof surface on iron or steel. If this step is omitted, little or no rust-proofing effect is obtained. On the other hand, when the mechanical treatment is used as above described, excellent rust-proofing is obtained.

The above mentioned mechanical treatment to remove the drops of lead alloy should be sufficiently gentle so as not to cause substantial scratching or abrasion of the steel surface, if the rust-proofing effect is desired. Usually the best results are obtained by washing the surface with water before, during, or after the mechanical operation for removal of the lead alloy drop-

lets. The washing assists in the removal of the particles and also removes any alkali metal oxide present. A preferred method is to brush the surface slightly with a steel wire brush, while flowing a stream of hot water over the surface. Other brushes, e. g. a stiff bristle or fiber brush, may be used in place of the wire brush. Various other means of removing the droplets of lead alloy without substantial abrasion of the steel will be apparent to the skilled operator.

In one modification of my invention I may cover the molten metal bath with a layer of a suitable material which is substantially chemically inert to the bath and to the metal being treated, in order to inhibit or prevent contact of the bath surface with the surrounding atmosphere. Materials for this purpose may be gaseous, solid or liquid. For example, I may maintain the bath in an atmosphere of a non-oxidizing gas such as nitrogen, hydrogen or hydrocarbon vapor. The entrance of oxygen or moisture also may be inhibited by maintaining a layer of carbon, sand, or other similar solid material which will float on the surface of the lead alloy. Preferably, I prevent contact of air with the bath by maintaining thereon a floating layer of fused salt, fused alkali metal hydroxide or other fused alkali metal compound, stable at the operating temperature. For example, I may use a fused alkali metal hydroxide, such as caustic soda, various fused salts or mixture of fused salts, which have a sufficiently low melting point so as to be molten at the operating temperature. Various of the fused salts and mixtures suitable for heat treating metals may be used for this purpose. There is a large variety of such fused salt mixtures, well known to those experienced in treating metals and such need not be described in detail here. The fused salt baths suitable for my process include the halides of the alkali and alkaline earth metals and mixtures thereof. Alkali metal hydroxides also may be mixed with the salts. Large concentrations of oxidizing salts such as nitrates are to be avoided, as these tend to attack the metals present.

Example

A bath of molten sodium-lead alloy containing 5.3% by weight of sodium was covered with a layer of fused sodium hydroxide and heated to 620° C. Sheet steel, having a heavy coating of oxide scale was treated by immersion in the bath for two minutes. On removal from the bath, the steel was cooled to room temperature in the air and then lightly brushed with a steel wire brush in a stream of hot water. The resulting surface did not rust when exposed to a humid, industrial atmosphere for several weeks. Some sheets were wire-brushed on one side only. In such, the unbrushed side rusted badly within a week, while the side which had been brushed showed no evidence of rust formation after standing several weeks.

My invention is not restricted to the methods described above and illustrated by the above example, since it is obvious that various modifications thereof may be made without departing from the spirit and scope of this invention. For example, the invention is not restricted to the descaling of ferrous metals such as iron or steel but is likewise applicable to the removable of oxide coatings from other metals such as copper, brass, nickel and the like which can be operated on at the required temperatures. In place of pure sodium-lead alloy, lead alloys containing alkali metal with or without the addition of other ingredients such as antimony, tin, bismuth or the like may be used. In fact, any desired metallic ingredient may be added to the lead alloy bath as long as the bath remains fusible at the required temperature and the required amount of alkali metal remains in solution. Although it is preferable to use sodium as the alkali metal in carrying out this invention, other alkali metals such as potassium, lithium or rubidium may be used in place of sodium.

An advantage of the present invention over the methods heretofore used for removing oxides from metals is that the treating bath has no tendency to react with or to etch the underlying metal surface but reacts only with the oxide layer to be removed. The method has no adverse effect upon the properties of the metal to be treated. In fact the bath may be used in some cases to improve the properties of the metal by annealing or other heat treating operations which may be simultaneously carried on by leaving the metal in the bath for a sufficient period of time. A further advantage is that ferrous metals may be treated according to my invention to form thereon an excellent rust-proof surface.

I claim:

1. The process for removing an oxide film from a ferrous metal surface which comprises bringing said surface into contact with a fused metal bath composed principally of a lead-sodium alloy containing 0.5 to 10% by weight of sodium, at a temperature of 600 to 800° C. and thereafter, before cooling, wiping any adhering fused metal or oxide from said ferrous metal surface.

2. The process for removing an oxide film from the surface of a ferrous metal which comprises bringing said surface into contact with a fused alloy composed principally of lead and containing at least 0.5% by weight of alkali metal, at a temperature of not less than about 500° C. and thereafter mechanically removing any adhering lead alloy from said surface without substantial abrasion of said surface.

3. The process for removing an oxide film from the surface of a ferrous metal which comprises bringing said surface into contact with a fused alloy composed principally of lead and containing at least 0.5% by weight of sodium, at a temperature of not less than about 500° C. and thereafter removing any adhering lead alloy from said surface by subjecting said surface to brushing and washing with water.

4. The process for removing an oxide film from the surface of a ferrous metal surface which comprises immersing said surface into a fused bath of lead-sodium alloy containing 0.5 to 10% by weight of sodium, at a temperature of 600 to 800° C., while maintaining the surface of said bath out of direct contact with the air and thereafter removing any adhering lead alloy from said surface by washing said surface with hot water and brushing it with a wire brush without substantial abrasion of said surface.

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