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METAL SURFACE CLEANING

James Harvey Noble, Rolfe Llewell Pottberg, and Urlyn Clifton Tainton, Baltimore, Md.; Rolfe Pottberg, administrator of said Urlyn C. Tainton, deceased, assignors, by direct and mesne assignments, to Freeport Sulphur Company, New York, N. Y., a corporation of Delaware

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This invention relates to an improved process for the cleaning, descaling and deoxidizing of metals, more particularly the ferrous alloys usually referred to as stainless steel. In present practice, these operations are usually carried out by immersing the metal in strong acids which operate by attacking the metal itself, and so bringing about a detachment of the surface scale or oxide.

The object of this invention is to provide a treating bath directly acting on the scale or oxide itself.

According to this invention the oxide coating on the metal is dissolved or converted into easily soluble form by immersion in a bath of a fused compound containing appropriate ingredients to bring about this conversion. For example, a ferrous alloy containing iron, nickel and chromium may be effectively treated by the use of a bath of fused sodium hydroxide containing an oxidizing agent such as sodium nitrate or sodium peroxide. This treatment removes either the whole of the scale or oxide, or any remaining is in such form as to be very readily soluble by a short treatment with a weak solution of acid.

Oxide films on hot rolled chromium nickel alloy steel may be removed by treatment in baths of fused sodium hydroxide containing oxidants in minor amount usually less than 10%, for instance, as follows:

(a) Sodium nitrate, the sodium nitrate liberating oxygen according to the reaction

$$2NaNO_3 = 2NaNO_2 + O_2$$

the resulting films being easily removed in a subsequent short acid treatment.

(b) Sodium peroxide (Na_2O_2), plus a subsequent short acid treatment.

These baths in which further oxidation of some or all of the components of the oxide film occur, permit reaction between one or more of the metal oxides and the composition forming the fused bath, with complete or partial conversion, so that upon removal any residual film exists in a form which, possibly due to the removal of some of its original component oxides, and partly due to the changed form of the remaining compounds, is removed much more readily with acids.

There is thus combined with a fused bath alkaline in character a further oxidizing effect favorable to the formation of higher oxides.

In certain cases it is advantageous to give material a preliminary treatment in an acid solution, 10% sulphuric or nitric acid being particularly effective, applied for a short period of two

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to five minutes after which it is washed off in hot water, drying before immersion in the fused compound.

The fused bath may consist of a compound or compounds of the desired basic properties, such as NaOH or Na_2CO_3, or may be composed largely of other suitable fusible substances which act as inert vehicles for a requisite percentage of such compound or compounds. Such reaction products as are not soluble in the fused bath itself, are removed by subsequent treatment after removal from the bath.

The reaction compounds usually formed, when they are not soluble in the bath itself, may show one or more of the following characteristics:

(1) They are decomposed by water, or are soluble in water.

(2) They are much more readily reacted upon by acids than the original oxide or oxides.

The oxidizing conditions of the fused bath can be produced in various ways. For example:

(1) By the addition of oxidizing substances such as nitrates, chlorates, peroxides, perchlorates, persulphates, etc., principally as salts of the alkali or alkaline earth metals;

(2) By formation by electrolytic means in the fused bath of oxidizing compounds, or of oxygen itself. For example, under controlled electrolytic conditions the formation of Na_2O_2 in fused baths of NaOH can be promoted.

The oxidant in the fused bath has proven very effective and the resulting compounds are either directly soluble in the bath or are more easily removable by after-treatment than the oxides in their original form.

The numerous advantages of the process as herein described are of great economic importance when considered in comparison with standard commercial present day practices of descaling, pickling and metal oxide film removal in general. Some of the more outstanding advantages are now briefly pointed out:

(1) The great reduction in time necessary for the cleaning operation by our process over the acid pickling process. The cycle of operations in our process can be completed in substantially under ten minutes. For example, in cleaning Ni-Cr alloy steel, an illustrative complete cycle for satisfactory oxide removal is as follows:

(a) 6–7 minutes fused NaOH+5% $NaNO_3$ 900° F.; or 4–5 minutes at 950° F.

(b) Water quench, then

(c) Treatment in 10% HCl at 180° for 1 minute followed by a 15 second treatment in 15% HNO_3 at 180°. In the normal acid pickling