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PROCESS OF REMOVING SURFACE OXIDE FILMS ON METAL

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This invention relates to an improved process for the cleaning, descaling and deoxidizing of metal surfaces, more particularly of alloys of the ferrous group, and especially of those usually referred to as stainless steel. In present practice these operations are usually carried out by immersing the metal in an aqueous solution of strong acids, which operate principally by attacking the metal itself and so bringing about a detachment of the surface scale or oxide. This is a continuation-in-part of our co-pending application Serial No. 538,536, filed June 2, 1944, now Patent No. 2,538,702, dated January 16, 1951.

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

Another object of this invention is to provide means for preliminarily affecting the character of the scale to make it more amenable to this and other scale removing operations.

According to this invention the oxide coating on the metal is substantially converted, by immersion in a bath of fused salts containing appropriate ingredients to bring about this conversion, so as to be soluble in the bath itself or more readily removed by subsequent treatment in suitable acids. Oxide films on many alloy steels of widely varying composition may be removed by treatment in baths of fused alkali metal hydroxides containing a minor proportion of oxidizing agents or which has been made oxidizing in character.

These baths favor further oxidation of some or all of the components of the oxide film to higher, more acid forms which will more readily react with the fused alkalies of the bath, so that upon removal from the bath any residual oxide 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.

In certain cases it is advantageous to give the material to be descaled a preliminary treatment in a weak inorganic acid solution applied for a short period of 2 to 5 minutes before immersion in the fused salt. It is thought that certain oxide components amenable to solution during this preliminary acid treatment may be removed, resulting in a degree of porosity of the film and facilitating penetration of the fused salts.

Another method by which the character of the scale may be preliminarily affected in order to make it more amenable to removal by various methods, is that of treating the metal surface at

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scale forming temperatures in the presence of sodium chloride applied to already scaled surfaces. This would consist of heating in the presence of sodium chloride when fused or in the vapor state. However, this method of modifying the character of the scale may be used coincidentally with the necessary scale forming operations themselves. For instance, annealing may be carried out in a sodium chloride atmosphere or the material coated with crystalline sodium chloride prior to annealing, hot rolling or other scale forming operation. The coating may be applied by heating and immersion of the material in a saturated sodium chloride solution which forms a continuous coating of crystalline sodium chloride on the surface immediately on removal.

Such a treatment so preconditions the scale that it is more easily removed by any of the existing descaling methods, including acid, or by fused sodium hydroxide alone followed by acid, or, under properly controlled conditions is capable of producing a scale which is so loosely bonded to the surfaces that it separates upon quenching from high temperatures.

In addition to the two essential types of active components previously listed, these baths, which are both basic and oxidizing, may contain proportions of salts which contribute little or nothing to their action, but which are added to act as inert vehicles to satisfy other criteria such as cost, melting point, etc.

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. Free oxygen, air or ozone may be introduced into the fused bath.

It should be noted that this method results in effecting a modification of the scale in spite of the fact that the surfaces in being heated need not be in contact with the gases being introduced in order to be further oxidized. This is thought to be due possibly to the formation of an iron-oxygen couple in which the added oxygen becomes the cathode and the surfaces being treated the anode, where an external circuit is completed, but due also to physical or chemical retention of the added oxygen by the bath as evidenced in the continuation of the effect for a