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[54] NONCORROSIVE CLEANING COMPOSITION AND PROCESS

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[57]

ABSTRACT

An improved composition and process for cleaning metal surfaces, and particularly aluminum and aluminum alloy surfaces wherein the cleaning is effected by using an aqueous alkaline solution which contains borates as the main alkaline component and, additionally, contain one or more vanadium compounds. Additionally, if desired, the cleaning compositions may also contain one or more non-ionic surface active agents and/or an ionic wetting agents.

10 Claims, No Drawings

NONCORROSIVE CLEANING COMPOSITION AND PROCESS

This invention relates to an improved process and composition for cleaning metal surfaces and more particularly it relates to an improved process and composition for cleaning aluminum and aluminum alloy surfaces, without appreciable attack or pitting of the surfaces.

Heretofore, it has been known that metal surfaces may be cleaned by spraying or immersion, using various aqueous alkaline solutions. Typically, the aqueous alkaline cleaning solutions used contain hydroxides, carbonates, phosphates, silicates, and borates, as well as mixtures of one or more of these materials, to provide the alkalinity in the solution. It has been found, however, that when the more highly alkaline solutions are used, appreciable corrosion, such as pitting and/or discoloration, is frequently encountered in the cleaning of surfaces of aluminum, zinc, or their alloys. Although it is known that this problem may be substantially avoided by using cleaners based on the alkali silicates, the surfaces cleaned with these materials frequently have extensive deposits thereon which not only detract from the appearance of the metal but also have an adverse affect on subsequent treatments, such as lacquering, chemical surface treatments, and the like. Apparently, these deposits consist mainly of silicates which, due to their insolubility, are not easily removed by rinsing with water.

It has recently been proposed in British Pat. No. 933,514 that the anti-corrosive cleaning of aluminum and aluminum alloy surfaces may be achieved by using an aqueous solution containing about 3 to 10 percent by weight borax in combination with suitable wetting agents. Although with this composition, the deposits and problems resulting therefrom, obtained when using the silicated cleaners, are essentially overcome, some difficulties were still encountered with respect to corrosion. It was found that particularly in the treatment of surfaces which had been spot welded, there were undesirable corrosive attacks by the borax containing solutions.

It is, therefore, an object of the present invention to provide an improved composition and process for the cleaning of metal surfaces.

A further object of the present invention is to provide improved compositions and process for cleaning aluminum and aluminum alloys surfaces, wherein corrosive attack of the surface by the cleaning composition is substantially eliminated.

These and other objects will become apparent to those skilled in the art from the description of the invention which follows.

Pursuant to the above objects, the present invention includes a composition useful for the cleaning of metallic surfaces, which composition comprises an aqueous alkaline solution in which the inorganic alkalizing component is a borate and wherein the composition further contains from about 0.1 to 10 grams per liter vanadium ions, calculated as V. This composition has been found to be particularly suitable for the cleaning of surfaces of aluminum and aluminum alloys because of the substantial corrosion inhibiting effect of the cleaning solution, but is also very useful for the cleaning of zinc and zinc alloy surfaces, as well as ferrous metal surfaces.

More specifically, the compositions of the present invention are aqueous alkaline solutions which desirably contain from about 10 to 100 grams per liter of a borate. Numerous borate compounds which are soluble in the aqueous alkaline cleaning solutions may be used. Exemplary of such materials are the alkali metal borates alkali tetraborates, alkali polyborates, and the like. Of these, particularly good results have been obtained when using sodium tetraborate ($\text{Na}_2\text{B}_4\text{O}_7 \cdot 10\text{H}_2\text{O}$) and sodium polyborate ($\text{Na}_2\text{B}_6\text{O}_{13} \cdot 4\text{H}_2\text{O}$), so that hereinafter, particular reference will be made to these materials as being the preferred borates for use in the present composition. This is not, however, to be taken as a limitation on the borate compound which may be used as other borate materials which are soluble in the aqueous alkaline solutions are also suitable.

In addition to the borate compound, the aqueous alkaline cleaning solutions of the present invention also contain from

about 0.1 to 10 grams per liter of vanadium ions, with amounts of vanadium ions within the range of about 0.1 to 3.0 grams per liter being preferred. The vanadium ions may be incorporated in the aqueous alkaline borate solutions by means of any vanadium compounds which are sufficiently soluble in the solutions to provide the requisite amount of vanadium ions. Exemplary of the suitable soluble vanadium compounds which may be used are the various vanadates, such as NaVO_3 , KVO_3 , NH_4VO_3 , K_3VO_4 , $(\text{NH}_4)_3\text{VO}_4$, $\text{Na}_4\text{V}_2\text{O}_7$, $\text{K}_4\text{V}_2\text{O}_7$, $(\text{NH}_4)_4\text{V}_2\text{O}_7$, vanadium chloride, vanadium sulfate, vanadium nitrate, vanadium oxide; as well as in the form of vanadyl compounds. Of these, in many instances, the alkali meta-, alkali ortho- and alkali pyrovanadates have been found to be preferred. Accordingly, hereinafter primary reference will be made to these compounds as the source of vanadium ions in the compositions of the present invention. This is not, however, to be taken as a limitation on the vanadium compounds which may be used as other vanadium compounds, such as the vanadium oxides and vanadyl compounds are also suitable.

Additionally, it is further to be appreciated that where reference herein is made to alkali compounds, such as the alkali vanadates and the alkali borates, it is intended that this reference shall include the compounds of the alkali metals, i.e., sodium, potassium, lithium, cesium and rubidium. Additionally, for purposes of the present invention, it is to be understood that the term alkali shall also include the ammonium compounds. In many instances, it has been found that the sodium and potassium compounds, such as the sodium borates and potassium vanadates, are the preferred alkali compounds for use in the present compositions. This is not, however, to be taken as a limitation on the alkali compounds which may be used but merely as being exemplary thereof.

In addition to the borate and vanadium compounds, the aqueous alkaline cleaning solutions of the present invention may also contain one or more surface active agents. It has been found, that particularly where the solutions are used for cleaning very dirty and/or very greasy surfaces, the addition of such surface active agents serve to increase the cleaning effect of the present solutions, thus making them more effective.

It has been found that the non-ionic surface active agents are particularly well suited as additives for the cleaning compositions of the present invention. Exemplary of specific non-ionic surface active agents which may be used are mixtures of low ethoxylated lipophilic compounds and highly ethoxylated condensation products, such as mixtures of alkyl aryl polyglycols with two to six ethylene oxide groups and alkyl aryl polyglycol ethers with 15 to 20 ethylene oxide groups. With such materials, it has been found that the turbidity point of the cleaning solution is about 3° to 10° higher than the temperatures at which the solutions normally are used. Additionally, however, anionic surface active agents may also be used, such as the alkyl aryl sulfonates. These have been found to be particularly advantageous in improving the rinsing characteristics of the cleaning solutions. In general, where one or more surface active agents are included in the composition they are desirably present in a total amount within the range of about 1 to 10 grams per liter.

In utilizing the aqueous alkaline cleaning solutions of the present invention, they are brought into contact with the metal surfaces to be cleaned for a period sufficient to effect substantial cleaning of the surfaces. Although various means may be used for bringing the solutions into contact with the metal surfaces, these solutions have been found to be particularly well suited for immersion cleaning processes, although in some instances, spray applications may also be used. Desirably, the cleaning solutions of the present invention are used at elevated temperatures, temperatures within the range of about 60° to 95° C being preferred. In many instances, effective cleaning has been found to be carried out, without any corrosion, such as pitting or discoloration of the metal surfaces, in contact times within the range of about 5 to 10 minutes, which times have been found generally to be typical.

In order that those skilled in the art may better understand the present invention and the manner in which it may be practiced, the following specific examples are given. In these examples, unless otherwise indicated, parts and percent are by weight and temperatures are in degrees centigrade.

EXAMPLE 1

Aluminum sheets were immersed for 5 minutes at 75° C in an aqueous cleaning solution containing 40 grams per liter of borax. During the treating time, appreciable hydrogen generation was observed and the metal losses on the aluminum sheets by corrosion were found to be 130 milligrams per square meter. Subsequently, 0.6 grams per liter of potassium metavanadate was added to the cleaning solution. Additional sheets of aluminum were then immersed in the solution for 5 minutes at 75° centigrade. In this instance, no hydrogen generation was observed and there were no measurable metal losses during the cleaning process.

EXAMPLE 2

Aluminum sheets were immersed for 5 minutes at 75° C in an aqueous solution containing 40 grams per liter of a mixture having the following composition:

Components	Percent by Weight
Borax	95
Non-ionic wetting agent	2
Sodium dodecyl benzene sulfonate	3

Following the treatment in this manner, interference colors were found on the surfaces of the treated sheets and hydrogen evolution was observed during the treatment. Similar aluminum sheets which had been spot welded were also treated in this solution under the same treating conditions. During the treatment of these sheets, appreciable hydrogen generation was observed and after rinsing the sheets, considerable dark discoloration on the spot weld was found.

Thereafter, 0.6 grams per liter of potassium metavanadate was added to the solution. Additional quantities of aluminum sheets, some of which had been spot welded, were treated in this solution for 5 minutes at 75° C. During the treatment of these sheets, there was no hydrogen evolution and following the treatment, no interference colors were found on the aluminum surface nor was there any dark discoloration on the spot weld.

EXAMPLE 3

An aqueous solution was prepared containing 35 grams per liter borax, 1.5 grams per liter nonyl phenol polyglycol ether containing four ether groups per molecule, 3.5 grams per liter dibutyl phenol polyglycol ether containing 50 ether groups per molecule, and one gram per liter sodium dodecyl benzene sulfonate. This solution was divided into two portions, the first portion being designated solution A and the second portion, to which was added 0.6 grams per liter of potassium metavanadate, was designated as solution B. In both of these solutions, dirty, oily aluminum and aluminum alloy sheets, as well as sheets of galvanized steel and high grade steel were cleaned by immersion for 5 minutes at 95° C. During the treatment of the aluminum and galvanized steel sheets in solution A, appreciable hydrogen generation was observed and although, after rinsing and drying the sheets were found to be degreased and cleaned, their appearance was very spotty with

a matt finish. All of the sheets which were treated in solution B, however, were found to be smooth and without spots after rinsing and drying. Additionally, after a throughput of 2 square meters of the metal surfaces per meter of cleaning solution, no hydrogen generation was observed and excellent cleaning of the sheets was obtained.

While there have been described various embodiments of the invention, the compositions and methods described are not intended to be understood as limiting the scope of the invention as it is realized that changes therewithin are possible and it is intended that each element recited in any of the following claims is to be understood as referring to all equivalent elements for accomplishing substantially the same result in substantially the same or equivalent manner, it being intended to cover the invention broadly in whatever form its principle may be utilized.

What is claimed is:

1. A cleaning composition useful in the cleaning of metal surfaces which consists essentially of an aqueous alkaline solution in which the alkalizing component is a borate in an amount from about 10 to 100 grams/liter wherein said borate is independently selected from the group consisting of alkali metal tetraborates and alkali metal polyborates and wherein the solution also contains from about 0.1 to 10 grams/liter vanadium ions, calculated as V wherein the vanadium ions are added in the form of a compound selected from the group consisting of alkali metal metavanadates, alkali metal orthovanadates, alkali metal pyrovanadates, vanadium chloride, vanadium sulfate, and vanadium nitrate.
2. The composition as claimed in claim 1 wherein the solution contains from about 10 to 100 grams per liter of a borate and from about 0.1 to 3.0 grams per liter vanadium ions.
3. The composition as claimed in claim 2 wherein the solution also contains at least one surface active agent agent selected from non-ionic surface active agents and anionic surface active agents, in a total amount within the range of about 1 to 10 grams per liter.
4. The composition as claimed in claim 3 wherein vanadium ions are added to the solution in the form of a compound selected from alkali metavanadates, alkali orthovanadates and alkali pyrovanadates, and the borate compound is selected from sodium tetraborate and sodium polyborate.
5. The composition as claimed in claim 3 wherein the borate compound is selected from sodium tetraborate and sodium polyborate.
6. A method for cleaning surfaces of aluminum and aluminum alloys, zinc and zinc alloys, or ferrous metal which comprises contacting the surface to be treated with the cleaning solution of claim 1 and maintaining the solution in contact with the surface for a time sufficient to effect substantial cleaning thereof.
7. The method as claimed in claim 6 wherein the metal surfaces are immersed in the aqueous cleaning solution.
8. The method as claimed in claim 7 wherein the aqueous cleaning solutions contain from about 10 to 100 grams per liter of the borate and from about 0.1 to 3.0 grams per liter of vanadium ions.
9. The method as claimed in claim 8 wherein the solutions also contain at least one surface active agent selected from non-ionic surface active agents and anionic surface active agents in a total amount within the range of about 1 to 10 grams per liter.
10. The method as claimed in claim 9 wherein the borate compound is selected from sodium tetraborate and sodium polyborate.

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