NONCORROSIVE RUST REMOVER
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6 Claims

ABSTRACT OF THE DISCLOSURE

This invention relates to a cleaning agent, in the form of a liquid or paste, for removing oxides from oxidized surfaces of metal articles.

The cleaning agent in the form of a liquid consists of an acidic aqueous solution containing as essential components water, ammonium citrate, sulfuric acid, sodium phosphate and an anti-mold agent. The gel form of the cleaning agent contains the aforementioned components plus a gel imparting agent.

This invention relates to novel compositions of matter for use as a cleaning agent for removing oxides from oxidized surfaces of metal and metal alloy articles. For convenience sake, the term “metal” will be used hereinafter to include both pure metal and metal alloys. The invention is particularly concerned with improved cleaning agents for removing rust from metal. Also, included within the scope of the invention are novel methods of removing rust from metal employing the novel cleaning agents of this invention.

Objects and advantages of the invention will be set forth in part hereinafter and in part will be obvious herefrom, or may be learned by practice with the invention, the same being realized and attained by means of the steps, methods and compositions pointed out in the appended claims.

The invention consists of the novel steps, methods and compositions herein shown and described.

It is an object of this invention to provide improved cleaning agents and method for removing oxide, particularly rust, from oxidized surfaces of metal articles which enable one to remove the undesirable oxide in a simple and efficient manner without corroding or otherwise deleteriously affecting the underlying metal to any significant extent. A further object of this invention is to provide improved, non-corrosive cleaning agents for removing oxides, particularly rust, from oxidized surfaces, and wherein the cleaning agents have no noxious fumes; have no dangerous by-products; are non-flammable; and, are harmless to normal skin. Of course, the above reference to the safety of the composition refers to their normal use in removing rust and one does not mean that such compositions are harmless or non-toxic if taken internally.

Another object of my invention is to provide improved, non-corrosive cleaning agents and methods for removing oxides, particularly rust, from oxidized surfaces, and wherein there is no tendency of the cleaning agents to support mold or like growth.

A still further object of this invention is to provide improved non-corrosive cleaning agents and methods for removing relatively heavy surface oxides, particularly rust, from oxidized surfaces which do not require immersion of the metal to be treated.

It has been found that the objects of this invention may be realized by forming an acidic aqueous solution containing as essential components: ammonium citrate, sulfuric acid and an anti-mold preservative agent. It has been found that in order to obtain efficient rust-removal properties, the cleaning agent of this invention should have a pH below 5 but should not be so acidic in nature as to be corrosive to the underlying metal of the article treated, as would be the case for example, wherein the pH was 1. Excellent results have been obtained wherein the pH is in the range of 4.0 to 4.8.

While the invention is not limited to any theory of action, the cleaning agent of this invention when applied to an oxidized surface appears to break or loosen the bond between the oxide and the base metal without effecting a chemical change in the oxide itself. As far as the mechanism of the components of the cleaning agent themselves are concerned, the sulfuric acid appears to enhance or potentiate the rust removal activity of the ammonium citrate. It has been found desirable to include in the cleaning agent formulation of this invention an alkali metal phosphate such, for example, as basic sodium phosphate (Na₃HPO₄) or sodium meta phosphate. The presence of a phosphate of the above mentioned type appears to have a catalytic effect in accelerating the action of the oxide removal and appears to lessen the deposit of a black residue believed to be an hydroxide. The phosphate also appears to impart some cleansing effect.

It has been found essential that the cleaning agent of this invention contains an anti-mold agent e.g. mercuric acetate, sodium benzoate, etc., in order to counteract the mold supporting tendency of ammonium citrate.

It has been found that the cleansing action of the cleaning agent of this invention may be further improved by including a surfactant to improve the wetting action thereof. Examples of suitable surfactants for this purpose are conventionally used detergent compositions e.g. sodium lauryl sulfate.

In the discussion which follows, reference to parts refers to parts by weight. In general, the ammonium citrate is in an amount from 5 to 30 parts per 100 parts of water. If the ammonium citrate is in an amount substantially below the above indicated minimum, the cleaning agent is slow in action, while an amount substantially above the above-indicated maximum amount is not warranted from an economic viewpoint.

The sulfuric acid should be in an amount sufficient to enhance in a significant manner the rust removal properties of the ammonium citrate but should not be in an amount wherein the resulting solution will be corrosive to the underlying metal of the article treated. Good results are obtained when the sulfuric acid is in an amount of .03 to .30 part, and preferably .05 to .1 part per part of ammonium citrate.

In general, the sodium phosphate is in an amount from .05 to .4 part, and preferably .15 to .25 part, per part of ammonium citrate.

In general, the anti-mold preservative agent is in an amount from .0005 to .005, and preferably .001 to .002 part, per part of ammonium citrate.

If a surfactant is included as a component of the cleaning agent, it is generally in an amount up to 2% by weight of the total composition.

The following is an example of the aqueous acid cleaning solution formed in accordance with the present invention:

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Example 1

Water—4000 ml.
Ammonium citrate—500 gm.
Sodium phosphate—100 gm.
Sulfuric acid (S.P.)—30 ml.
Sodium benzoate—5 gm.

In utilizing the cleaning agent of Example 1, the solution may be used full strength or diluted with water up to 20 parts of water per part of cleaning solution. Heat increases the speed of cleansing action, as does concentration. For light rusty surfaces, or prepainting treatment of rust and super, good results have been obtained when the cleaning solution of Example 1 is diluted with 4 parts of water to 1 part of cleansing solution, the article to be treated being wiped with a saturated cloth. With liquid solutions of the type exemplified by Example 1, and diluted with 20 parts of water to 1 part of the cleansing solution, good results for heavy surface rust are obtained when the metal article to be treated is immersed in the solution for a period long enough as determined by observation, to remove the iron oxide from the treated metal article. Of course, the time required varies with the condition of the metal article treated (may be up to 90 hours). For fast action the cleaning solution may be warmed to elevated temperatures (160° F). After soaking in the above-described manner, the treated metal article is then rinsed with water and dried by air or suitable drying apparatus, after which paint, oil or other preservative coating may be applied.

In reusing the cleansing solution, the amount of the liquid lost through evaporation is replaced by adding water. When the mixture turns black it is exhausted.

The cleaning agents of this invention have wide industrial applications. They have been used successfully in the treatment of moulds, tools, fasteners, pipes, vats, tanks and other objects. It, of course, also has wide home use. It will clean and derust screws, tools, golf clubs, water-pipes, gun barrels, garden equipment, antique metals, etc.

While the cleaning agents of this invention may safely be applied to most metals without attacking them, and will not attack most woods, rubber, fabrics or plastics, it has been found to attack zinc and hence should not be used on zinc-containing articles.

As indicated herebefore, when employing the cleaning agent of Example 1 for removing heavy surface rust, the cleaning solution is diluted with water and the article to be treated is immersed in the resulting mixture. In certain applications, however, it has been found desirable to provide a cleaning agent for removing relatively heavy surface rust which does not require the immersion of the object to be derusted. It has been found that such a cleaning agent may be formulated by incorporating in an aqueous acidic cleaning formulation of the type described hereinafter, a non-toxic hydrophilic gel forming agent in an amount sufficient to impart to the cleaning agent gel-like characteristics.

The hydrophilic gel forming agent used in accordance with this invention must be stable in the acidic environment of the cleaning agent. An example of a hydrophilic gel forming agent which has been found to give excellent results is a thixotropic, powdered, non-toxic, hydrophilic non-ionic, non-polyethylene colloid obtained from Cyamopsis tetragonoloba and other leguminous seeds sold under the trade designation "Burtonite 7." This product is a water soluble guar gum. The amount of gel-forming agent used of course varies depending upon the gel forming ability of the agent employed for this purpose. When a surfactant is included as a component of the cleaning agent, a higher amount of gelling agent is normally required than if no surfactant is present when Burtonite 7 is used alone. Typically an amount from 1–10 parts, and preferably 2 to 8 parts, per 100 parts of water.

Additional examples of typical gel forming agents that may be used in accordance with this invention are hydroxyethyl cellulose (a commercial form sold under the trade designation Cellosolve Hydroxyethyl Cellulose QP 4400) and corn starch.

In forming the gel of my invention, the best results are obtained when all of the components of the cleaning agent, apart from the gelling agent, are mixed together after which the gelling agent is added.

The following is an example of a formulation for the gel-like cleaning agent of the instant invention.

Example 2

Water—1000 gm.
Ammonium citrate—200 gm.
Sodium phosphate—40 gm.
Sulfuric acid—17 ml.
Phenolic mecurial acetate—2 gm.
Burtonite 7—40 gm.

If so desired, sodium lauryl sulfate may be included in the aforesaid composition in an amount of 1.0% by weight of the total composition. In such instance, the amount of Burtonite 7 is increased to 80–100 gm.

In applying the gel-like cleaning agent of this invention to the metal to be treated, the gel mass is smeared on the rusted surface, allowed to stand for a few minutes, e.g., ten minutes, or until dry depending upon the depth of the rust on the surface with water and a rag or sponge. The surface is then ready to preserve with oil, paint, plating, etc.

While ammonium citrate is the preferred ammonium salt, other ammonium salts of weakly or moderately ionizable organic acids may be used to varying degrees. Examples of such other salts are the ammonium salts of oxalic, tartaric, malic, gluconic, glucolactonic, glycolic or saccharic. The preferred ammonium salts are those of alliphatic polybasic acids which are also alpha hydroxy acids with the most preferred of this type being ammonium citrate.

In like manner, while sulfuric acid is the preferred inorganic acid for enhancing the rust removal action of the ammonium salt, other inorganic acids may be used with less effectiveness such, for example, as phosphoric acid. Nitric acid and hydrochloric acid have not been found to be effective to any great degree.

The invention in its broader aspects is not limited to the specific steps, methods and compositions described, but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A cleaning agent for removing oxides from oxidized surfaces of metal articles consisting essentially of an acidic aqueous solution having the following formulation: water in an amount of 100 parts, ammonium citrate in an amount from 5–30 parts per 100 parts of water, sulfuric acid in an amount of .03–.30 part per part of ammonium citrate, alkali, metal phosphate in an amount from .05–.4 part per part of ammonium citrate and an anti-mold preservative agent in an amount from .0005–.005 part per part ammonium citrate.

2. A cleaning agent for removing oxides from oxidized surfaces according to claim 1 wherein sodium lauryl sulfate is added as a surfactant in an amount up to 2% of the total composition to improve the wetting action thereof.

3. A cleaning agent for removing oxides from oxidized surfaces according to claim 1 having the following formulation:

Water—4000 ml.
Ammonium citrate—500 gm.
Sodium phosphate—100 gm.
Sulfuric acid (S.P.)—30 ml.
Sodium benzoate—5 gm.

4. A cleaning agent in the form of a gel for removing oxides from oxidized surfaces consisting essentially of
water in an amount of 100 parts, ammonium citrate in an amount from 5-30 parts per 100 parts of water, sulfuric acid in an amount of .03-.30 part per part of ammonium citrate, sodium phosphate in an amount from .05-.4 part per part of ammonium citrate, an anti-mold preservative agent in an amount from .0005-.005 part per part ammonium citrate and a gel imparting agent in an amount from 1-10 parts per 100 parts of water, said gel imparting agent being selected from the group consisting of hydroxy ethyl cellulose, water-soluble guar gum and corn starch.

5. A cleaning agent in the form of a gel according to claim 4 wherein the gel imparting agent is a hydroxyethyl cellulose.

6. A cleaning agent in the form of a gel according to claim 4 having the following formulation:
   Water—1000 gm.
   Ammonium citrate—200 gm.
   Sodium phosphate—40 gm.
   Sulfuric acid—17 ml.
   Phenolic mercurial acetate—2 gm.
   Water soluble guar gum—40 gm.

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