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COMPOSITION FOR TREATING METAL SURFACES PREPARATORY TO PAINTING

Clete L. Boyle and Martin D. Sclar, Detroit, Mich.; said Sclar assignor to said Boyle

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3 Claims. (Cl. 148—6)

This invention relates to an improved composition adapted to be applied to and allowed to remain upon a metal surface as a conversion treatment preparatory to painting the surface.

An object is to provide an improved liquid composition which can be readily applied to a metal surface such as the oxide coated surface of structural steel or the metal sheets used in the construction of buildings to prepare the same for painting, which composition will react effectively and thoroughly with an oxide coated metal surface and which will spread thereover into complete and intimate contact with the irregularities of such surface and which will spend itself completely thereon without leaving any residue on the surface to act as a promoter of corrosion underneath the paint coat.

Heretofore metal etching acid solutions have been applied to rusty surface of iron and steel to assist in removal of the rust preparatory to painting and phosphoric acid solutions have been used for this purpose and for the additional purpose of reacting with the surface to render it less susceptible to corrosion. It has also heretofore been the practice to rinse or wash the residue of such solution from the surface of the metal after the reaction has taken place to remove any corrosion promotion constituents such as unspent acid from the metal surface before applying the paint coat thereto. It was recognized that all paint coats were to a more or less degree pervious to moisture and that corrosion would develop underneath the paint coat if such corrosion promotion agents were present on the metal surface underneath the paint.

In copending application of one of the applicants, Clete L. Boyle, Serial No. 177,656, filed December 1, 1937, which issued May 14, 1940 as U. S. Patent No. 2,200,615, there was set forth an improved method of preparing a steel surface for painting by treating it with a phosphoric acid water solution which method included allowing the phosphoric acid solution to remain and dry upon the surface of the metal and painting over such surface so treated without the removal of any residue of the solution from the surface prior to the painting. Such method was found to be economical and highly efficacious.

We prefer to apply our improved composition to a metal surface according to the disclosure of such copending application. According to the teaching of the method of such application a dilute aqueous solution of phosphoric acid was applied to an oxide coated metal surface and allowed to remain thereon. If the surface were soiled with oil such solution might preferably contain a small amount of a water soluble oil solvent to promote the wetting of the surface. Such solution might preferably also contain certain metallic ions to increase the concentration of phosphate on the surface and promote sealing of irregularities and filling of crevices therein.

Such solution preferably contained a wetting agent to lower the surface tension and thin out the solution over the surface of the metal and to intimately wet the same and penetrate into the crevices of the oxide coating, insuring thorough wetting of the metal surface and conversion of the oxide coating into a phosphate coating thereby reducing the possibility that unreacted acid might remain on the surface following evaporation of the volatile ingredients of the solution.

In the application of the improved composition herein set forth to a metal surface, we prefer not only to employ the method disclosed in said copending application but to employ a generally similar composition with changes in the wetting agent as hereinafter set forth. As applied to the metal surface this improved composition preferably comprises 5 to 15% by volume of 75% by weight phosphoric acid with water making up the bulk of the remainder of the solution. An aqueous solution of approximately 7 to 10% of phosphoric acid has been found highly satisfactory. 2 to 3% of the water may be replaced by water soluble oil solvents such as alcohol, ethyl methyl ketone or the butyl ether of ethylene glycol. Metallic ions whose phosphates or acid phosphates are insoluble in water may be added in a small amount not to exceed the saturation point of the solution. For example, 0.07 gram atomic weight per liter has been found satisfactory. Many different metallic ions are suitable as, for example, chromium, zinc, iron, magnesium, aluminum, tin, nickel, etc. A small amount of a wetting agent is added to the solution, for example, 1–20 grams per liter of solution. The character of this wetting agent is hereinafter more particularly discussed.

Since, according to the teaching of such method, we do not choose to remove any solution residue from the metal surface but leave the same in its entirety thereon, there will remain upon the surface all solution ingredients not consumed in a reaction or which have not evaporated. Due to the dilute character of the solution and its thinning out in wetting the surface practically

all the phosphoric acid will have been consumed in the reaction and the water and soluble oil solvent will evaporate. However, the wetting agent being a solid will remain upon the surface. Because it remains, it is important that it should not exhibit any tendency to set up corrosion. It is with this aspect of the composition, namely, the capacity of its wetting agent ingredient, to cause corrosion that we are specifically concerned in this application.

The wetting agent used in the solution must possess certain properties if it is to function properly. It must be soluble in water. It must be stable and function in acid. When metallic ions are present they must not form an insoluble compound with the wetting agent and so render it useless. It must function to cause the solution to wet the surface whether clean or oily. Wetting agents which have these properties, especially the last, have two essential parts to their molecular structures, a hydrophobic portion and a hydrophilic portion.

First, in order to lower the surface tension there must be present in the molecule a hydrocarbon group of high molecular weight. For example, this may be a straight chain of 8 to 16 carbon atoms, with 12 and 14 being the most desirable. Such straight chains are found in soaps which of course are materials commonly used to lower surface tension. This hydrocarbon group of high molecular weight may be a saturated or unsaturated cyclic group which may or may not possess substituent groups of 3 or more carbon atoms. This hydrocarbon part of the wetting agent molecule is called the hydrophobic part because it does not dissolve in water, it being normally an oil soluble part.

The second part of the molecule, the hydrophilic part, can be said to have great solubility in water, and when attached to the hydrophobic part makes the whole wetting agent molecule that the present application is particularly concerned.

Heretofore those skilled in the art of preparing metal for painting by means of acid solutions, who have included wetting agents in their solutions, have always employed wetting agents whose hydrophilic groups were derivatives of sulphuric acid. Such hydrophilic groups were sulphonates or sulphates. Sulphonate wetting agents have the general formula R—SO_3H, where R is the oil soluble hydrocarbon hydrophobic part of the molecule and —SO_3H the water soluble sulphonate hydrophilic group or R—OSO_3H where R is again the hydrophobic group and —OSO_3H the sulphate group hydrophilic in nature.

In the presence of moisture, certain ions, especially the chloride, sulphate and nitrate ions, have a tendency to cause corrosion of metals. Those wetting agents which contain as part of their molecules hydrophilic groups which are derivatives of sulphuric acid are similar to the sulphate ion and similarly also have a tendency to cause the corrosion of metals.

In the method we prefer to use, where the treating solution is allowed to dry upon the metal and the dried surface is not further treated except for painting, it will therefore be of great advantage to employ a wetting agent of non-corrosive tendency. More particularly we might say, a wetting agent which contains in its molecule a hydrophilic group which has no tendency to promote corrosion. Since it is the hydrophilic group of the sulphonate and sulphate type of wetting agent which is the potential corrosion stimulant, we propose to use a wetting agent whose hydrophilic group has no such tendency.

We have found that wetting agents whose molecules contain hydrophilic groups which include phosphorus and oxygen are suitable in an acid solution for preparing metals for painting, and particularly suitable where the solution is allowed to dry upon the metal because these hydrophilic groups have no tendency to set up corrosion. Suitable hydrophilic groups containing phosphorus and oxygen are the phosphate and phosphonate groups, respectively. Wetting agents having the phosphate group in their molecule have the following general formula:

$$R—O—PO_3X_2$$

where R is the hydrocarbon residue and

$$—O—PO_3$$

the phosphate group, and X a positive radical of such a nature that the wetting agent is soluble in water, as, for example, hydrogen or an ammonium or sodium and potassium. Wetting agents containing the phosphonate group in the molecule have the general formula R—PO_3X_2 where —PO_3 is the phosphonate group.

Specific examples of wetting agents containing the phosphate group which are suitable for the purpose are

$$C_4H_9—O—CH_2—CH_2—O—CH_2CH_2—OPO_3Na_2$$

Sodium salt of phosphoric acid ester of the monobutyl ether of diethylene glycol.

$$CH_3—(CH_2)_{12}—CH_2OPO_3Na_2$$

Sodium salt of myristyl phosphate.

$$CH_3(CH_2)_{10}COO—\underset{\displaystyle CH_3}{\underset{|}{CH}}—CH_2—OPO_3Na_2$$

Sodium salt of the phosphoric acid ester of propylene glycol monolaurate.

Specific examples of a wetting agent containing the phosphonate group are:

$$CH_3—(CH_2)_{12}—CH_2—PO_3Na_2$$

Sodium salt of myristyl phosphonate.

$$CH_3—(CH_2)_{12}—COOCH_2—PO_3—Na_2$$

Sodium salt of myristoyl methyl phosphonic acid.

It is emphasized that practically all of these wetting agents are solids and are not employed as oil solvents or as substitutes for oil solvents. They are used in very small concentration 0.1 to 2% by weight of the solution. Their function is to reduce the surface tension of the solution and so assist it in its work. They aid the solution to contact and wet all parts of the surface being treated. They facilitate the action of oil solvents if oil solvents are used by reducing the interfacial tension between an oily surface and the treating solution. When oil solvents are not required due to absence of oil, these wetting agents increase the penetration of the solution into all pores and crevices.

The outstanding characteristic of the wetting agents whose hydrophilic groups contain phosphorus and oxygen is that they have practically no tendency to cause corrosion of metal. This is in contrast to the wetting agents whose hydrophilic groups contain sulphur and oxygen, which, being considered derivatives of sulphuric acid, do have a well known tendency to promote corrosion of metal in the presence of moisture. It is well known that the presence of corrosion promoters under paint will initiate corrosion because all paint coats are to some degree pervious to mois-

ture. Hence, these wetting agents whose hydrophilic portions contain phosphorus and oxygen are particularly useful in a process for preparing metal for painting, such as that of my copending application wherein the solution is applied to the metal and allowed to react with it and dry thereon and the surface is then painted without any further treatment such as wiping or washing to remove excess treating solution or reaction products.

What we claim is:

1. A composition adapted to be applied to a metal surface prior to painting comprising a water solution of phosphoric acid wherein the acid ingredient is present in an amount varying from 5% to 15% by volume of 75% by weight acid and a wetting agent selected from a group consisting of

$$C_4H_9—O—CH_2—CH_2—O—CH_2CH_2—OPO_3X_2$$

$$CH_3—(CH_2)_{12}—CH_2OPO_3X_2$$

$$CH_3(CH_2)_{10}COO—CH(CH_3)—CH_2—OPO_3X_2$$

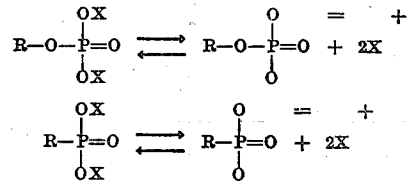
$$CH_3—(CH_2)_{12}—CH_2—PO_3X_2$$

and

$$CH_3(CH_2)_{12}—COOCH_2—PO_3X_2$$

where X is a positive radial of such a nature that the wetting agent is soluble in water and is selected from a group consisting of hydrogen, ammonium, sodium and potassium.

2. A composition adapted to be applied to a ferrous metal surface prior to painting comprising a water solution of phosphoric acid and a wetting agent, which wetting agent is selected from a group consisting of organic phosphates and organic phosphonates having the structural formulas which are shown respectively on the left side of the following equations and which when dissolved in water disassociate as shown on the right hand side of the following equations:



where X is selected from the group consisting of a sodium, potassium, hydrogen, and ammonium, and where R is an organic radical.

3. A composition adapted to be applied to a ferrous metal surface prior to painting comprising a water solution of phosphoric acid and a wetting agent, which wetting agent is selected from a group consisting of organic phosphates and organic phosphonates.

CLETE L. BOYLE.
MARTIN D. SCLAR.