A corrosion inhibitor composition which contains varying amounts of sodium benzoate and either potassium chromate or potassium dichromate exists in an aqueous solution in such an amount that the concentration is greater than 0.1% by weight of the solution. Another corrosion inhibitor composition contains varying amounts of sodium benzoate and potassium tripolyphosphate in an aqueous solution in such an amount that the concentration is greater than 0.1% by weight of the solution.
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CORROSION INHIBITOR CONTAINING SODIUM BENZOATE AND POTASSIUM TRIPOLYPHOSPHATE

CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of my co-pending application Ser. No. 268,763, filed July 3, 1972 and now abandoned.

BACKGROUND OF THE INVENTION

The present invention relates to a corrosion inhibiting solution. More specifically, the present invention relates to an aqueous solution of sodium benzoate and either potassium chromate or potassium dichromate which prevents the formation of corrosion for unusual periods of time. Additionally, the present invention also relates to an aqueous solution of sodium benzoate and potassium tripolyphosphate which prevents the formation of corrosion for unusual periods of time.

Heretofore, numerous compounds have been utilized as corrosion inhibitors for various materials such as metals. Two of the earliest and still most commonly used inhibitors are oils and greases. These compounds, such as low grade motor oil, tend to give good protection over a period of one or two months. However, their application to metals, such as iron or steel, usually requires the utilization of complex and heavy machinery and thus is often costly. Additionally, if the metal is not properly coated, the occurrence of corrosion necessitates further operations to remove it. Probably the most serious disadvantage of oil and grease corrosion inhibitors is that they must be removed before further processing operations may be carried out. This necessary additional operation often requires elaborate equipment as well as degreasing compounds and thereby increases the cost of the item.

Accordingly, the use of other compounds has been sought. One class of compounds which has been found to give adequate protection over short periods of time is generally the use of amines in aqueous solutions. Specifically, most of the primary aliphatic amines have been used as suitable corrosion inhibitors. Although the use of secondary and tertiary amines is much more limited since many of these compounds tend to be insoluble in water, they usually are soluble in alcohol or glycol solutions and thus are frequently used in cooling systems as in an automobile. A cycloalcaline which is often employed as a ferrous corrosion inhibitor is cyclohexylamine or its derivatives.

Another class of corrosion inhibiting compounds are the amino acids. A particular member, di-sec-hexamino acid provides fairly effective protection but is expensive and must be mixed slowly and carefully since it tends to be explosive.

Although these and many other classes of nonoil and grease corrosion inhibitors are known, they are seldom utilized because of their impracticability. Not only do they tend to be costly, but they also tend to break down and lose their effectiveness within short periods of time, often within a matter of days and weeks and very seldom are they effective for a period greater than 6 months. Accordingly, these compounds are generally unsuitable for any materials or items, especially if they are stored or warehoused. Thus, primary reliance is still largely placed on oils and greases.

SUMMARY OF THE INVENTION

It is, therefore, an object of the present invention to produce an effective corrosion inhibitor.

It is also an object of the present invention to produce a corrosion inhibitor, as above, which is inexpensive and readily made.

It is another object of the present invention to produce a corrosion inhibitor, as above, which is readily and easily applied and does not require removal.

It is a further object of the present invention to produce a corrosion inhibitor, as above, which unexpectedly has been found to inhibit corrosion for unusual lengths of time without any signs of losing its effectiveness.

These and other objects of the present invention will be apparent in view of the following detailed description and are accomplished by means hereinafter described and claimed.

In general, an aqueous solution has a concentration of a corrosion inhibiting material which is greater than 0.1% by weight. The inhibitor material comprises various mixtures of sodium benzoate by weight and either potassium dichromate or potassium chromate by weight. Additionally, the inhibitor material comprises various mixtures by weight of sodium benzoate and potassium tripolyphosphate.

PREFERRED EMBODIMENTS OF THE INVENTION

A corrosion inhibitor according to the concept of the present invention basically includes a mixture of two compounds which when prepared and placed in an aqueous solution, offers an unexpected degree of protection and far exceeds any protection which either compound may separately possess. Such corrosion inhibiting solution has been found to be particularly effective in enclosed systems such as automobile radiators and the like, and on metals placed in the solution.

One of the compounds is sodium benzoate. The other compound is preferably potassium dichromate although a very similar compound, potassium chromate, may be used. Unlike most chemical compositions, however, it has been found that these compounds have no chemical equivalents which will give any similar favorable results or results which approach the effectiveness of these particular compounds. In other words, the use of a combination of sodium benzoate and either potassium dichromate or potassium chromate is unique in the formation of an extremely effective corrosion inhibitor which is not duplicated or approached by chemically similar compounds.

It has also been found that another compound, namely potassium tripolyphosphate, which is not an equivalent of potassium dichromate or potassium chromate, when used in association with sodium benzoate also offers an unexpected degree of protection which exceeds any protection that potassium tripolyphosphate or sodium benzoate may separately possess. These compounds also have no known chemical equivalents which will give any similar favorable results or results which approach the effectiveness of a mixture of these particular compounds. In other words, the use of a combination of sodium benzoate and potassium tripolyphosphate is unique in the formation of an extremely effective corrosion inhibitor which is not duplicated or approached by chemically similar compounds.
Good results can be obtained by using percentages of sodium benzoate ranging from 25% to about 65% or from 90% to about 95% of the total mixture with the remaining weight percent being the potassium dichromate or the potassium tripolyphosphate compound on one hand or being the potassium tripolyphosphate compound on the other hand. The amount of sodium benzoate required to give very good results generally ranges between 65% and 90% of the total weight of the mixture. Although the exact reasons for the unusual effectiveness of these compounds or mixtures when placed in an aqueous solution is not fully understood, favorable results are obtained when the pH of the solution is neutral or in the vicinity of 7.0. A range of sodium benzoate which gives a fairly neutral pH, that is from about 6.0 to about 8.0, extends from about 25% to about 95%. The most effective weight percentage ratio has been found to be approximately 80 parts of sodium benzoate to approximately 20 parts of either of the chromate compounds or to the potassium tripolyphosphate compound.

The concentration of the compounds in water will, of course, generally vary depending upon the environment in which the corrosion inhibiting solution is used. If, for example, a generally noncorrosive environment such as an automobile cooling system is to be protected, the concentration may be very low, generally as low as 0.1% by weight of the mixture to the total weight of the inhibitor solution.

If the solution is to be applied to various metals such as stamped steel or other items, a concentration greater than 0.1% and generally from 0.5% up to 10% can be used with the higher concentrations being preferred where the likelihood of corrosion is unusually high. The extent of the upper concentration is generally very high, that is, at least as high as 75%. In fact, it is often desirable to have the concentration greater than 75% so that a gel or paste may be formed and applied as such to materials or metals.

Application and uses of the corrosion rust inhibiting solution is very versatile. It may be applied to numerous closed systems such as piping, heat exchangers and the like or may be applied to sheet metal, coiled metal, stampings and the like. Upon drying, generally a white protective barrier or film will appear. The exact manner by which this solution or the barrier inhibits corrosion is not fully understood but it is thought that both the sodium benzoate compound and the particular chromate compound will work in harmony so that the mixture reacts with the corrosion agent and thereby "ties it up" as well as applies a protective coating which prevents any oxide or further corrosion from forming. Such a reactive occurrence, which may be termed neutralization of the corrosion agent, also extends to any oxygen such as that which generally exists dissolved in most water.

The corrosion inhibiting solution may be applied in any conventional manner such as by dipping the material to be coated in the solution or by spraying the solution on the material. Moreover, any type of metal may be protected for example, steel, iron, copper, silver, brass, aluminum and cast iron. Furthermore, the inhibiting solution may be directly applied to hot metals since the ratio of the sodium benzoate compound to either of the chromate compounds or to the potassium tripolyphosphate remains substantially identical upon the evaporation of the water. In fact, the inhibiting solution can be applied to materials at least up to 600°F. or to materials which are subsequently heated to 600°F. and still respectively form or maintain their protective coating without any substantial adverse effects. Unlike oil or grease coatings, the corrosion inhibiting coating formed by the present invention need not be removed before any further processes such as working, rolling, stamping or even painting are conducted. However, should a particular process scratch or rub off the inhibitor coating, it should be replaced after completion of the processes to prevent corrosion before the material or metal is used in the next operation.

Due to the strict modern day pollution laws, it often will be necessary to use the sodium benzoate-potassium tripolyphosphate mixture to coat various metals, metal stampings, metal slabs, metal rolls or the like since whenever the metal items are washed before being subjected to the next operation, the waste liquid which is discharged into streams, rivers or lakes will often contain a chromate level above that permitted by the pollution laws.

In order to prevent beading of the corrosion inhibiting solution on the surface of the material to be protected, preferably a wetting agent is used. As well known to those skilled in the art, any conventional wetting agent may be used in any conventional amount so that a uniform film is formed. A suitable wetting agent range is between one to ten parts by weight to 100 parts of the corrosion inhibiting solution and depends to a great extent upon the affinity of the material for the aqueous solution. As known to one skilled in the art, the sodium dialkyl sulfosuccinates constitute a particular class of wetting agents. Specific examples include sodium diacyl sulfosuccinate, sodium dihexyl sulfosuccinate, and sodium dioctyl sulfosuccinate which are sold by various manufacturers under several different product names. Another class of suitable wetting agents include the naphtalenesulfonates. Specific examples of this class include sodium isopropyl naphthalenesulfonate and sodium butyl naphthalenesulfonate. Another class includes the Tergitol amionic surfactants produced by Union Carbide Corporation. These include Tergitol 7, sodium heptadecyl sulfate; Tergitol 4, sodium tetradecyl sulfate and a preferred wetting agent, Tergitol 08, sodium 2-ethylhexyl sulfate. Generally, these wetting agents are neutral, that is, have a pH of about 7 or if otherwise are adjusted to a pH of 7 so as not to interfere with the effectiveness of the corrosion inhibitor.

It is desirable to add yet another ingredient, commonly called a binder, to the corrosion inhibiting solution in order to prevent washout of the inhibitor and in order to enhance the wearing abilities of the inhibitor when it serves as a protective barrier or film. Plausible binders include any conventional varnish and any conventional binder of a water system paint or a water base paint and such compounds are well known to those skilled in the art. Another class of binders includes the various resins manufactured by the B. F. Goodrich Company and distributed under the brand names of Carbotet and Carbopol. A few of these specific compounds which are suitable are Carbotet 511 and Carbopol 934, 940 and 941. Generally, any binder range commensurate with the binder range used in water base paints, in varnishes or in Carbopol systems can be used. Depending upon the inhibitor application these ranges will vary, but generally the range will vary from about
0.5% to approximately 25% by weight based upon the total weight of the corrosion inhibiting solution. Usually, the required amount of Carboset and Carbopol binder is very small and thus is at the lower end of the range whereas the required amount of varnish and water base binders is large and therefore is at the upper end of the range. Thus, for economic reasons, the Carboset and Carbopol binders are preferred. Generally, binders tend to be neutral or have a pH near 7. If they do not, in order to maintain the neutral properties of the aqueous corrosion inhibitor, the pH of the binder is perfectly adjusted in any well known manner to make it approximately 7.0.

The invention will be more fully understood by reference to the following examples which set forth the preparation as well as the results obtained with the above corrosion inhibiting solutions.

EXAMPLE I

To a large clean container, 0.8 oz. of sodium benzoate and 0.2 oz. of potassium dichromate was added to 22 quarts of water (704 oz.) and briefly stirred to dissolve the compounds to give approximately 0.14% concentration of an 80/20 corrosion inhibiting solution. To a portion of this solution a piece of cold rolled steel was immersed. Normally, rust will develop on the piece of cold rolled steel within a matter of hours if it is simply placed in water. However, the cold rolled steel placed in the corrosion inhibiting solution did not show any signs of rust over a period of time greater than 2 months and no precipitation or crystallization occurred.

In a similar manner, different weight ratios of the compounds were used in varying concentrations and cold rolled steel immersed therein with similar results, that is, no occurrence of rust, precipitation or crystallization. The table below lists the varying concentrations and inhibitor ratios.

<table>
<thead>
<tr>
<th>RESULTS AFTER TWO AND ONE-HALF MONTHS IN SOLUTION</th>
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<tbody>
<tr>
<td>Ration by Weight of Potassium Tripolyphosphate</td>
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<tr>
<td>Sodium Benzoate to Weight of Inhibitor Solution Concentration</td>
</tr>
<tr>
<td>65/35</td>
</tr>
<tr>
<td>70/30</td>
</tr>
<tr>
<td>75/25</td>
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<td>80/20</td>
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<td>85/15</td>
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<td>90/10</td>
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It can be seen that the disclosed invention carries out the objects of the invention set forth above. As will be apparent to those skilled in the art, many other weight ratios and concentrations can be made without departing from the spirit of the invention herein disclosed and described, the scope of the invention being limited solely by the scope of the attached claims.

I claim:
1. A corrosion inhibitor composition, consisting essentially of, a mixture of sodium benzoate and potassium tripolyphosphate, an amount of water such that the concentration of said mixture in the corrosion inhibitor composition is at least 0.1% by weight, and said mixture containing by weight from about 25% to about 95% of said sodium benzoate and from about 5% to about 75% of said potassium tripolyphosphate.
2. A corrosion inhibitor composition, as set forth in claim 1, wherein said mixture contains by weight from about 65% to about 90% of said sodium benzoate and by weight from about 10% to about 35% of said potassium tripolyphosphate.
3. A corrosion inhibitor composition, as set forth in claim 1, wherein said concentration includes a large amount so that a gel or paste is formed.
4. A corrosion inhibitor composition, as set forth in claim 1, wherein the pH of the composition is from about 6.0 to about 8.0.
5. A corrosion inhibitor composition, as set forth in claim 1, wherein said mixture contains about 90 parts...
by weight of said sodium benzoate and about 20 parts by weight of said potassium tripolyphosphate.

6. A corrosion inhibitor composition, as set forth in claim 1, wherein said concentration range is from 0.1% to about 10.0% by weight.

7. A corrosion inhibitor composition, as set forth in claim 1, wherein the composition has a wetting agent.

8. A corrosion inhibitor composition, as set forth in claim 7, wherein said wetting agent range is from 1 to 10 parts by weight per 100 parts of the corrosion inhibitor solution.

9. A corrosion inhibitor composition, as set forth in claim 1, wherein the composition has a binding agent.

10. A corrosion inhibitor composition as set forth in claim 9, wherein said binder range is from about 0.5% to about 25% of the corrosion inhibitor solution.

11. A corrosion inhibitor composition, as set forth in claim 8, wherein said wetting agent is selected from the class consisting of sodium heptadecyl sulfate, sodium tetradecyl sulfate and sodium 2-ethylhexyl sulfate.