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CORROSION INHIBITING COMPOSITIONS

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This invention relates to metal corrosion inhibitors and, more particularly, to the inhibition of corrosive attack on ferrous metal surfaces by the elements normally existing in the atmosphere.

Effective protection of finished and even unfinished ferrous metal surfaces to corrosive attack is a complex problem ever present in the metal fabricating and processing art. It is unnecessary here to go into great detail but the object is to minimize the loss in material, time and effort occasioned by the corrosion of metal parts during the relatively short lapses of time between operations for processing metal into a finished product and between the application of the finished product in final assembly.

Many techniques have been devised in the attempt to alleviate the degree of corrosive attack. By one method, the metal part is packaged in a sealed container or wrapping to minimize infiltration of corrosive elements over and above that which is originally sealed with the part in the package. The flexible wrappings are themselves sufficiently vapor permeable to permit transmission of elements such as moisture, which is one of the corrosive substances normally existing in the atmosphere. The technique of employing sealed containers is otherwise adapted primarily for use with relatively small parts.

By another method, the metal surface to be protected is treated with the substance such as phosphoric acid or chromic acid, and their salts. These operate by etching to become a permanent part of the metal surface and they are objectionable in most instances on this account. Temporary protective coatings have been applied, but, as in all instances where such measures are used, the burden of removing the protective coating sometimes out-weighs or detracts from its advantages and resort is had to other systems. Furthermore, the protective coating technique presupposes that the surface to be protected is readily accessible, but there are many occasions where access is either difficult or cannot be had.

This invention embodies the concept wherein the corrosive elements normally existing in the atmosphere are inhibited by a vaporizable substance in the near vicinity of the surface to be protected. The reaction of inhibition may be with the vapor layer concentrated adjacent the metal surface, or protection may result from a vapor layer which collects as a protective film directly on the surface to be protected. In any event, the protective action is of a nature lasting many weeks, or even years, depending upon the

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amount and concentration of material originally deposited as the protective medium, as well as the manner in which the wrapper is applied.

It is an object of this invention to provide a corrosion inhibiting composition for metal surfaces, wherein, the desired effect can be had in a simple and expeditious manner without limitation to the size of the object or the accessibility of the surface to be protected.

Another object is to provide a corrosion inhibiting composition which does not require direct treatment of the surface to be protected by agents which modify the surface itself or which require removal before use in the manner for which it is intended.

A further object is to provide a metal corrosion inhibiting composition which develops a vapor barrier between the surface to be protected and the corrosive elements normally existing in the atmosphere, the vapor barrier having access to areas heretofore unaffected by other treating systems for combating corrosion.

A still further object is to produce the combination of a carrier, and a metal corrosion inhibiting composition which under conditions of use provides vapors capable of inhibition of corrosive attack of metal surfaces by elements normally existing in the atmosphere.

According to this invention, inhibition of metal corrosion by elements normally existing in the atmosphere is derived from a composition of an organic amide with an inorganic nitrite. For deposition in suitable carriers by which the composition is disposed in the near vicinity of the surface to be protected, it is desirable to combine the substances with diluents into a single treating composition, although the substances may be mixed dry for use with or without the carrier. Incorporation of a dry mix into the carrier may be accomplished by known methods of dusting, rubbing, and the like. For solution, it is best to select the water soluble modifications of nitrites and amides to enable formulation and application in the most economical manner; however, solvent solution is possible, permitting the use of amides and nitrites soluble in suitable solvents. The use of solvents also permits the attainment of higher solids content in the treating composition, as will hereinafter be pointed out.

Suitable water soluble nitrites include the alkali metal nitrites, such as sodium nitrite, potassium nitrite, and other water soluble nitrites, such as ammonium nitrite and silver nitrite. Instead of water soluble nitrites, other nitrites soluble in

organic solvents or slightly soluble in water may be used.

Amides, which have been successfully used, fall into the groups of mono-amides, diamides, and polyamides. By the term mono-amide is meant a compound having the general formula

$$R-\overset{O}{\overset{\|}{C}}-NH_2$$

where R is an aliphatic group having from 1 to 18 or 25 or more carbon atoms. These include such amides as acetamide, propionamide, and N-butyramide, N-valeramide, stearamide, palmitylamide, fatty acid amides, and the like. Although less activity results when R is aromatic or aliphatic-aromatic, amides of that type may be used. For example the amide component may be benzamide and the aromatic acid amides of the type benzene sulphonic acid amide, toluene sulphonic acid amide, naphthalene sulphonic acid amide, and the like.

Best use is made of the diamides having the formula

$$RN-\overset{O}{\overset{\|}{C}}-NHR$$

where R is hydrogen or an organic radical of the type previously described. Illustrative of suitable diamides are urea, N-substituted ureas, and unsymmetrical ureas, such as N-N,-dibutyl urea, N-butyl urea, N-propyl urea, dimethyl urea, t-butyl urea, t-amyl urea, and the like, and other diamides, such as buramines (the reaction product of amines such as butyl amine with urea), the reaction product of amines with biuret, and guanidine and derivatives thereof. A suitable polyamide is illustrated by biuret.

Also depending on the duration of exposure and the conditions existing during exposure, the amount of amide and nitrite in the near vicinity of the metal surface to be protected may vary from small quantities of less than one half gram to several grams per square foot of surface to be protected. To achieve uniform distribution and maintenance of the composition in the near vicinity of the surface to be protected, the composition is usually disposed upon a carrier which may amount to an absorbent, such as paper, textile, and wood, or the support may constitute finely divided particles such as silica, diatomaceous earth, chalk, glass particles, and the like. For most purposes, a solid concentration of from one half to four grams per square foot of surface area is most suitable and, in all formulations, a ratio of about 1 part nitrite to 0.05–20 parts amide give properties of the desired character.

Impregnation or coating of the carrier may be expeditiously effected from diluted solution, preferably from an aqueous medium, the extent of impregnation and coating to deposit the desired concentration of solids depending a great deal on the absorbency of the carrier and the concentration of solids in the treating composition. Water solutions containing the ingredients in the desired proportion may be formulated with concentration ranging from three up to 75 percent solids, depending a great deal on the molecular weight or the length of the carbon chain in the respective R group of the amide and, more particularly, on the type and rate of impregnation. The longer carbon chain amides are usually less soluble in water and impart thickening characteristics. To gain high concentration for most economical impregnation with longer chain amides, such as the higher fatty acid amides, it is

desirable to employ, as a part of the diluent, a solvent for the amide. For this purpose the solvent may make up to 50 percent of the diluent and will include such materials as the alcohols, such as ethyl alcohol, isopropyl alcohol, butanol, isoamyl alcohol, Cellosolve, and the like. Impregnation of the carrier by the treating composition may be effected by the usual techniques of roller coating, flow coating, brushing, dip-squeeze, spraying, and the like. Removal of the diluent may be by a simple airdry, but it is accelerated by the exposure of the impregnated carrier to a temperature of 150–350° F. for a few minutes to one half hour. We have found that the solution should be adjusted to give a pH in the final product which is above 6. This usually calls for the adjustment of the treating solution to the alkaline side because most papers retain some acids from forming.

When the carrier comprises absorbent sheet stock, such as paper, textile fabric, and the like impregnated with a pre-determined concentration of treating composition, it may be subdivided into small segments for insertion as a packing into confined areas for metal protection purposes; it may be adhered as a contoured segment to cover the area of metal to be protected; it may be used as an interlayer between metal sheets, while in storage or while in shipment from one station to another; or it may be used as a wrapper substantially to enclose the metal object to be protected during the required interval, thereby, not only to protect the metal surface from corrosive attack, but also minimize damage to the metal part by impact or abrasion.

When used as a wrapper, it is expedient to provide the sheet stock with a layer of impervious waterproof material which resists vapor penetration forming an additional barrier to the infiltration of corrosive vapors from the atmosphere, while minimizing loss by dissipation of the protective vapors generated from the corrosion inhibiting composition. Thus, by the use of such means, the amount of corrosion inhibiting composition present as solids in the near vicinity of the metal surface may be lessened or a corresponding increase in the useful life of the combination may be secured.

The carrier may constitute wooden pegs used in the metal industry to space one metal strip from another and while impregnated will generate such amounts of vapors as will militate against the corrosion of the surfaces of the separated metal strips. The carrier may constitute dry pellets or powders of inert absorbent substances, such as silica generated from silica gel, formulated with a concentration of amides and nitrites of the type and in proportions previously described. Diatomaceous earth or other absorbent filler may be impregnated with treating compositions of the type described. These substances containing proper concentration of corrosion inhibiting elements may be dusted as a powder as on a surface to be protected or otherwise applied in the area in an obvious manner.

The following formulations of suitable treating compositions are given by way of merely illustrating the practice of this invention.

Example 1

30 percent sodium nitrite
30 percent urea
40 percent water

Example 2

12 percent acetamide
6 percent sodium nitrite
82 percent water

Example 3

18 percent stearamide
12 percent potassium nitrite
35 percent water
35 percent isobutyl alcohol

Example 4

18 percent guanidine
4 percent sodium nitrite
78 percent water

Example 5

8 percent benzene sulphonic acid amide
8 percent ammonium nitrite
84 percent water

Example 6

20 percent ammonium nitrite
20 percent urea
60 percent water

Example 7

8 percent N-butyl urea
15 percent ammonium nitrite
77 percent water

Although not absolutely necessary, it may be desirable to adjust the pH of the above formulations to above 8 and preferably about 9. The following are examples of utilizing the treating compositions in the preparation of structures for inhibiting metal corrosion.

Example 8

40 lb. kraft paper is impregnated by dipping into the composition of Example 1, and allowed to dry over night. This material may then be used as a wrapper or as a packing to inhibit corrosion of metal surfaces in close vicinity thereof. By comparison, in an accelerated test, a steel panel arranged in a jar lined with the treated paper showed no signs of rusting after forty days exposure in an atmosphere of 100 percent relative humidity and 120° F., whereas another steel panel, not in the presence of the wrapper, was covered by 30 percent rust within one day exposure under the same conditions.

Example 9

Diatomaceous earth impregnated with the composition of Example 6 and allowed to dry over night is suitable as a dusting power for application onto various surfaces for corrosion protective purposes. It may be dusted or otherwise coated onto certain carriers to be associated with the metal surface to be protected.

Example 10

A silica gel may be formulated with a composition of Example 2, which upon removal of diluent at 260° F. for 30 minutes, breaks down into a fine powdery substance having the characteristics embodying features of this invention.

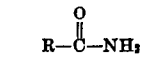
It will be understood that numerous changes may be made in the selection of materials, their amounts present in the formulations, and the arrangement thereof in suitable carriers, without departing from the spirit of the invention, especially as defined in the following claims:

What is claimed is:

1. A composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of an organic amide and an inorganic metal nitrite present in the ratio of about one part by weight nitrite to 0.05–20 parts by weight of the amide.

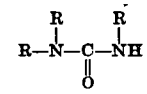
2. A composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of an amide selected from the group consisting of mono- di- and polyamides and a water soluble metal nitrite which in combination with each other provide a vapor that constitutes a barrier to corrosion by elements existing in the atmosphere the essential materials being present in the ratio of about one part by weight nitrite to 0.05–20 parts by weight of the amide.

3. A composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of a mono amide having the formula



where R is an organic radical having at least one carbon atom but less than 25 and a water soluble inorganic nitrite present in the ratio of 1 part nitrite to 0.05–20 parts of the amide.

4. A composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of a diamide having the formula



where R is selected from the group consisting of hydrogen and an organic radical having less than 25 carbon atoms, and a water soluble inorganic nitrite present in the ratio of 1 part nitrite to 0.05–20 parts of the diamide.

5. A composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of an N-substituted urea, and a water soluble inorganic nitrite present in the ratio of 1 part nitrite to 0.05–20 parts of the N-substituted urea.

6. A composition of matter for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of an unsymmetrical substituted urea and a water soluble inorganic nitrite present in the ratio of 1 part nitrite to 0.05–20 parts of the unsymmetrical substituted urea.

7. A composition of matter for inhibiting corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of 1 part alkali metal nitrite and 0.05–20 parts urea combined by deposition from aqueous solution.

8. A composition for use in the inhibition of corrosive attack on metal by elements normally existing in the atmosphere consisting essentially of a compatible aqueous solution of an amide having less than 25 carbon atoms in chain-like arrangement and an inorganic nitrite present in the ratio of 1 part nitrite and 0.05–20 parts amide.

9. A treating composition containing substances which in solid form emit vapors under condition of use for the inhibition of corrosive attack on metal surfaces by elements normally existing in the atmosphere consisting essentially of an aqueous solution of a water soluble organic amide and a water soluble inorganic nitrite present in amounts ranging up to 75 percent solids by weight and in the ratio of about one

part by weight nitrite to 0.05–20 parts by weight of the amide.

10. A treating composition which operates by the emission of vapor under conditions of use to provide a barrier to the corrosion of metal surfaces by elements normally existing in the atmosphere consisting essentially of an aqueous solution of urea and sodium nitrite present in the ratio of 1 part nitrite and 0.05–20 parts urea.

11. A treating composition which operates by the emission of vapor under conditions of use to provide a barrier to the corrosion of metal surfaces by elements normally existing in the atmosphere consisting essentially of an aqueous solution of an aliphatic amide and an alkali metal nitrite present in the ratio of about one part by weight nitrite to 0.05–20 parts by weight of the amide and in amounts ranging up to concentrations which exceed the tolerance of water for the ingredients, and an organic solvent for the amide to stabilize the solution at higher concentration.

12. An article of manufacture for inhibiting the corrosion of metal comprising a solid carrier and uniformly distributed throughout the carrier a composition of an organic amide having less than 25 carbon atoms and an inorganic nitrite the material being present in the ratio of about one part by weight nitrite to 0.05–20 parts by weight of the amide.

13. An article of manufacture claimed in claim 12 in which the carrier is an absorbent fabric in the form of sheet stock and the composition which impregnates the fabric is present in amounts ranging up to 5 grams per square foot.

14. An article of manufacture as claimed in claim 13 in which the fabric is backed by an impervious layer of moisture repellant material.

15. An article of manufacture as claimed in claim 12 in which the carrier comprises finely divided particles of relatively inert material with which the composition is associated for sprinkling onto the surface to be protected.

16. An article of manufacture for inhibiting corrosion of metal by the elements normally existing in the atmosphere comprising a carrier, and uniformly distributed with the carrier a composition of an organic amide with a water soluble inorganic nitrite present in the ratio of 1 part by weight nitrite to 0.05–20 parts by weight amide.

17. An article of manufacture for inhibiting corrosion of metal by the elements normally existing in the atmosphere comprising a carrier, and uniformly distributed with the carrier a composition of an organic amide with a water soluble inorganic nitrite present in about equal parts by weight.

18. An article of manufacture for inhibiting the corrosion of metal comprising paper impregnated with urea and sodium nitrite, said materials being present in the paper in a ratio of about one part by weight of the sodium nitrite to 0.05–20 parts by weight of the urea.

19. An article of manufacture for inhibiting the corrosion of metal comprising paper sheet stock impregnated with urea and sodium nitrite, said materials being present in the paper in a ratio of about one part by weight of the sodium nitrite to 0.05–20 parts by weight of the urea, one surface of said paper sheet stock carrying a backing of an impervious layer of moisture repellant material.

20. An article of manufacture for inhibiting the corrosion of metal comprising paper sheet stock impregnated with urea and sodium nitrite, said materials being present in the paper in approximately equal parts by weight, one surface of said paper sheet stock carrying a backing of an impervious layer of moisture repellant material.

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