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2,739,872

COMPOSITION AND SHEET MATERIAL FOR INHIBITION OF CORROSION OF METALS

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No Drawing. Application September 15, 1950,
Serial No. 185,143

15 Claims. (Cl. 21—2.5)

My invention relates to improvements in corrosion inhibitors and more particularly to corrosion inhibitors for use in conjunction with ferrous metal surfaces which are subject to attack by the elements normally existing in the atmosphere.

In the U. S. patent of Edward A. Schwoegler and Clemens A. Hutter, No. 2,521,311, dated September 5, 1950, effective metal corrosion inhibiting compositions are disclosed containing organic amides and inorganic metal nitrates. As is disclosed in said patent, a synergistic effect is secured by virtue of the conjoint use of the aforesaid two types of materials.

Among the inorganic nitrates which can be utilized pursuant to the teachings of the aforesaid patent are the alkali metal nitrites, including ammonium nitrite, sodium nitrite, potassium nitrite and lithium nitrite. Of particular utility are the water-soluble nitrites. Other nitrites can be utilized including those which are soluble in organic solvents and those which are mutually soluble with the organic amides in organic or other solvent media.

As described in the aforementioned patent, among the amides which can be used in combination with the nitrites are the mono-amides, diamides, and polyamides. The term mono-amide is meant to include organic compounds having the general formula $RCONH_2$, where R is an aliphatic group having from 1–25 or more carbon atoms. These include such amides as acetamide, propionamide, N-butyramide, N-valeramide, stearamide, palmitylamide, fatty acid amides and the like. Although less activity results when R is alicyclic, aromatic or mixed aliphatic aromatic, amides of this type can be used. For example, the amide can be benzamide or aromatic acid amides of the type of benzenesulfonic acid amide, toluenesulfonic acid amide, naphthalenesulfonic acid amide and the like. The most suitable amides are the diamides, which can be represented by the general formula R_2NCONR_2 , where R can be hydrogen or an organic radical of the type previously described for the mono-amide formula. Illustrative of suitable diamides are urea, guanidine, biuret, and the like, or N-substituted ureas and unsymmetrical ureas such as N,N-dibutyl urea, N-butyl urea, N-propyl urea, dimethyl urea, tertiary butyl urea, tertiary amyl urea, ethyl butyl urea and the like. Of particular utility is urea.

As is further described in the foregoing patent, good results are obtained when the aforesaid compounds are utilized in the ratio of one part of the inorganic nitrite to from about 0.05–20 parts of the amides, said parts being by weight, and particularly advantageous results are obtained by the employment of substantially equal parts by weight of the inorganic nitrite and the organic amide.

My invention is based upon the discovery that the functioning of the aforesaid compositions, in relation to the inhibition of corrosion of ferrous objects, is substantially improved by the incorporation therein or conjoint use therewith of alcohols containing not more than 18 carbon atoms. The action of said alcohols appears to synergize the activity of the organic amide-inorganic nitrite compo-

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sitions so as to bring about a marked enhancement of the corrosion inhibiting properties of the latter compositions. The term "alcohols" is used herein to encompass alcohols consisting only of carbon, hydrogen and oxygen.

Among the various alcohols which can be utilized in the practice of my invention are, by way of illustration, monohydric and polyhydric alcohols, straight chain and branched chain, water-soluble, water-dispersible and water-insoluble. In general, where the monohydric alcohols are employed, I find it most advantageous to use those containing from 6 and preferably from 8 to 18 carbon atoms since the lower molecular weight alcohols are, generally, so volatile that they become dissipated too soon and thus shorten the effective life of the corrosion inhibiting compositions. In the usual case, I find the water-soluble polyhydric alcohols to be particularly useful. Typical examples of the alcohols are isopropyl alcohol, isobutyl alcohol, amyl alcohol, isoamyl alcohol, octyl alcohol, decyl alcohol, dodecyl alcohol, tetradecyl alcohol, hexadecyl alcohol, octadecyl alcohol; 2-ethylhexyl alcohol, 2-butyloctyl alcohol; pentaerythritol and polypentaerythritols; glycols such as ethyleneglycol, propyleneglycol, trimethyleneglycol, polyoxyethylene and polyoxypropylene glycols having from 3 to 7 ethanoxo or propenoxo groups; glycerol, polyglycerols such as diglycerol, triglycerol, tetraglycerol and mixtures thereof; hexitols such as mannitol, sorbitol, dulcitol, and arabitol; mannide, sorbide, mannitan and sorbitan; 2-ethyl-1,3-hexanediol; 2-methyl-1,3-pentanediol; the "Cellosolves" such as "Cellosolve," ethyl "Cellosolve," propyl "Cellosolve," butyl "Cellosolve," 2-ethylhexyl "Cellosolve," and the like. It will, of course, be understood that mixtures of any two or more of the alcohols can be utilized.

The following examples are illustrative of corrosion inhibiting compositions made in accordance with my invention. It will be understood that various changes may be made therein in relation to proportions of the ingredients and numerous other compositions can readily be evolved in the light of the teachings disclosed herein. Said compositions may be utilized, among other ways, to impregnate carriers or solid bodies of various types to deposit therein the materials comprising the corrosion inhibiting compositions. All parts given are by weight.

Example 1

Sodium nitrite	30
Urea	30
2-ethyl-1,3-hexanediol	30
Ethyl alcohol	10
Water	50

Example 2

Sodium nitrite	6
Acetamide	12
2-ethyl hexanol	12
Ethyl alcohol	10
Water	90

Example 3

Potassium nitrite	12
Stearamide	18
2-ethyl hexyl "Cellosolve"	20
Water	45
Isobutyl alcohol	45

Example 4

Sodium nitrite	4
Guanidine	18
Diethylene glycol	15
Water	85

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Example 5

Ammonium nitrite -----	8
Benzene sulfonic acid amide -----	8
Butyl "Cellosolve" -----	10
Water -----	95

Example 6

Ammonium nitrite -----	20
Urea -----	20
n-Octyl alcohol -----	10
Ethyl alcohol -----	10
Water -----	80

Example 7

Ammonium nitrite -----	15
N-butyl urea -----	8
Ethyl "Cellosolve" -----	18
Water -----	100

Example 8

Sodium nitrite -----	20
Urea -----	20
Methyl "Cellosolve" -----	35
Water -----	70

Example 9

Sodium nitrite -----	30
Urea -----	30
Propylene glycol -----	20
Water -----	60

Example 10

Sodium nitrite -----	30
Urea -----	30
Glycerol -----	10
Water -----	70

The three components comprising the corrosion inhibiting compositions which are utilized in accordance with my invention can be employed in varying proportions. Good results are obtained, for example, where, for each part of inorganic nitrite, from 0.05 to 20 parts each of the organic amide and the alcohol are employed, said parts being by weight. Especially advantageous results are obtained where the ingredients are employed in proportions amounting to substantially equal parts of inorganic nitrite and organic amide with a somewhat lesser proportion of the alcohol.

When the corrosion inhibiting composition is embodied or incorporated into a solid carrier or support member as, for example, a sheet of paper, a corrugated or other carton, a separator, or a wrapper or the like, good results are obtained where the corrosion inhibiting composition is present in a concentration of from about 0.1 to 5 or 10 grams per square foot of surface of the carrier sheet or the like. In the usual case, the corrosion inhibiting composition is very effective when it is present in or on the carrier or support member in the total amount of the order of about 2 to 4 grams per square foot of sheet surface area to which the ferrous article to be protected is exposed.

The corrosion inhibiting composition may be incorporated into or upon a suitable carrier, which may be sheet stock, finely divided particles of relatively inert material, and the like, in any one of several ways disclosed, for example, in the aforementioned patent. Thus, all of the ingredients may be dissolved in a suitable solvent, for instance, water, or an organic solvent or a mixture of solvents, and the carrier impregnated with the solution after which the solvent material may be evaporated. Alternatively, the corrosion inhibiting composition may be utilized in the form of a dispersion or emulsion and deposited into or upon a carrier by dipping, brushing, spraying and other ways known in the art. While, in commercial practice, it is desirable that all of the ingredients comprising the corrosion inhibiting compositions of the pres-

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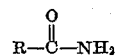
ent invention be deposited on or into the carrier from a single solution or dispersion or the like, it will be appreciated that such procedure need not be followed. Thus, for example, the inorganic nitrite may initially be deposited in or upon the carrier after which the organic amide may be deposited followed by the deposition of the alcohol, or the order of the deposition of the aforesaid ingredients may be altered in any way desired. The important thing is that all three of said ingredients be present so that they can exert their conjoint effects.

As described in the aforesaid patent, it is frequently desirable to coat one side of a sheet of paper or other absorbent cellulosic or fabric material or the like, which has been impregnated with a corrosion inhibiting composition, with a water-repellent or moisture-proof material for the purposes of preventing too rapid dissipation of the corrosion inhibiting composition and to insure against undue moisture absorption by said carriers where one or more of the ingredients of the corrosion inhibiting composition utilized is of a hygroscopic character. A number of water-repellent materials is readily available for use in this connection as, for example, waxes, such as microcrystalline waxes, asphaltums, soaps of normally solid fatty acids such as sodium stearate, and various other materials of this type. For a more detailed description thereof, and for a detailed description of various carriers and manners of utilizing in practical commercial ways corrosion inhibiting compositions of the type here involved, reference may be had to the aforementioned patent and application as well as to the application of Clemens A. Hutter, Serial No. 124,852, filed November 1, 1949, now Pat. No. 2,534,201, dated December 12, 1950. The teachings and practices disclosed in said patent and applications can be and advantageously are utilized in the practice of my present invention.

What I claim as new and desire to protect by Letters Patent of the United States is:

1. A vapor phase inhibiting composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere comprising, as essential ingredients, an organic amide, an inorganic metal nitrite, and an alcohol having a degree of volatility not greater than that of isopropyl alcohol, said alcohol containing not more than 18 carbon atoms, said ingredients being present in the ratio of about 1 part by weight of said nitrite to 0.05-20 parts by weight each of said amide and said alcohol.

2. A vapor phase inhibiting composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere comprising, as essential ingredients, a mono-amide having the formula



where R is an organic radical having at least one carbon atom but less than 25 carbon atoms, a water-soluble inorganic nitrite, and a water-soluble polyhydric alcohol containing from 2 to 12 carbon atoms, said ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of said amide and said polyhydric alcohol.

3. A vapor phase inhibiting composition for inhibiting corrosive attack on metal by elements normally existing in the atmosphere comprising, as essential ingredients, urea, a water-soluble inorganic nitrite, and a water-soluble polyhydric alcohol containing from 2 to 12 carbon atoms, said ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of the urea and said polyhydric alcohol.

4. A vapor phase inhibiting composition of matter for inhibiting corrosive attack on metal by elements normally existing in the atmosphere comprising, as essential ingredients, urea, an alkali metal nitrite, and 2-ethyl-1,3-hexanediol, said ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of the urea and the 2-ethyl-1,3-hexanediol.

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5. A vapor phase inhibiting composition of matter for inhibiting corrosive attack on metal by elements normally existing in the atmosphere comprising, as essential ingredients, 1 part alkali metal nitrite and 0.05-20 parts each of urea and an alcohol having a degree of volatility not greater than that of isopropyl alcohol, said alcohol containing not more than 18 carbon atoms.

6. An article of manufacture for inhibiting the corrosion of metal by means of vapor phase inhibition comprising a solid carrier embodying therein an organic amide, an inorganic nitrite, and an alcohol having a degree of volatility not greater than that of isopropyl alcohol, said alcohol containing not more than 18 carbon atoms, said ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of said amide and said alcohol.

7. An article of manufacture in accordance with claim 6, in which the carrier is an absorbent cellulosic sheet, and the ingredients which are embodied therein are present in a total amount of from about 2 to about 4 grams per square foot of sheet surface area.

8. An article of manufacture in accordance with claim 7, in which one surface of the cellulosic sheet is backed by a layer of moisture-repellent material.

9. An article of manufacture for inhibiting corrosion of metal by means of vapor phase inhibition by the elements normally existing in the atmosphere comprising a carrier embodying therein urea, an alkali metal nitrite, and a water-soluble aliphatic polyhydric alcohol containing from 2 to 12 carbon atoms, said ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of the urea and said polyhydric alcohol.

10. An article of manufacture for inhibiting corrosion of metal by means of vapor phase inhibition by the elements normally existing in the atmosphere comprising a cellulosic sheet carrier embodying therein substantially equal parts of urea and sodium nitrite, and a slightly lesser proportion of 2-ethyl-1,3-hexanediol, said parts being by weight, the aforesaid ingredients being present in said cellulosic sheet carrier in a total amount of about 2 to about 4 grams per square foot of sheet surface area.

11. An article of manufacture for inhibiting the corrosion of metal by means of vapor phase inhibition comprising sheet stock impregnated with a water-soluble amide, a water-soluble inorganic nitrite, and a water-soluble aliphatic polyhydric alcohol containing from 2 to 12 carbon atoms, the amide and the nitrite being present in the sheet stock in approximately equal parts by weight, and the polyhydric alcohol being present in the sheet stock in slightly lesser proportions than the amide, the aforesaid ingredients being present in said sheet stock in a total amount of about 2 to about 4 grams per square foot of sheet surface area, one surface of said sheet stock carrying a backing comprising a layer of moisture-repellent material.

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12. An article of manufacture for inhibiting the corrosion of metal by means of vapor phase inhibition comprising paper sheet stock impregnated with urea, an alkali metal nitrite, and a water-soluble aliphatic polyhydric alcohol containing from 2 to 12 carbon atoms, the urea and alkali metal nitrite being present in the paper in approximately equal parts by weight, and the polyhydric alcohol being present in the paper in slightly lesser proportions than the urea, one surface of said paper sheet stock carrying a backing comprising a layer of moisture-repellent material, the urea, the alkali metal nitrite and the aliphatic polyhydric alcohol being present in a total amount of about 2 to about 4 grams per square foot of sheet surface area.

13. An article of manufacture for inhibiting the corrosion of metal by means of vapor phase inhibition comprising paper impregnated with urea, sodium nitrite, and 2-ethyl-1,3-hexanediol, the aforesaid ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of the urea and the 2-ethyl-1,3-hexanediol.

14. An article of manufacture for inhibiting the corrosion of metal by means of vapor phase inhibition comprising paper sheet stock impregnated with urea, sodium nitrite, and 2-ethyl-1,3-hexanediol, the aforesaid ingredients being present in the ratio of 1 part of said nitrite to 0.05-20 parts each of the urea and the 2-ethyl-1,3-hexanediol, one surface of said paper sheet stock carrying a backing comprising a layer of moisture-repellent material.

15. An article of manufacture for inhibiting the corrosion of metal by means of vapor phase inhibition comprising paper sheet stock impregnated with urea, sodium nitrite, and 2-ethyl-1,3-hexanediol, the urea and sodium nitrite being present in the paper in approximately equal parts by weight, and the 2-ethyl-1,3-hexanediol being present in the paper in slightly lesser proportions than the urea, one surface of said paper sheet stock carrying a backing of an impervious layer of moisture-repellent material, there being from about 2 to about 4 grams of a total of said ingredients per square foot of sheet surface area.

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