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CORROSION INHIBITOR CONTAINING ALKAN- NOYLOXYACETIC ACID AND METHOD OF USING SAME

Lester W. Kalinowski, Chicago, Ill., assignor to Sinclair Refining Company, New York, N. Y., a corporation of Maine

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My invention relates to corrosion inhibition and more particularly to vapor phase corrosion inhibition in which the inhibiting agent vaporizes to deposit a protective coating on metals.

In the transportation and storage of metals and metal products such as sheet steel and machine parts in the channels of manufacture and commerce, the metal objects are usually subject to the corrosive action of water vapor. In order to prevent corrosion of metal objects it has been customary to wrap and seal them in moisture-proof wrappers or packages, and in some instances, three or four layers of moisture-resistant wrapping have been used. However such precautions have not been wholly successful for despite the best efforts corrosion still takes place since some water vapor is usually trapped in the wrapping or packaging when it is sealed, and additional moisture penetrates the interior of the wrapping or packaging after it is sealed.

These and other problems are overcome according to my invention by surrounding the metal objects to be protected with an atmosphere containing a vaporized alkanoyloxyacetic acid having from eight to twelve carbon atoms in the alkanoyl group such as octanoyloxyacetic acid, decanoyloxyacetic acid and lauroyloxyacetic acid. The corrosion inhibiting vaporized acid deposits as a protective film on the metal objects, making absolute sealing of the metal objects in moisture-proof wrappings or packaging unnecessary, and negating the corrosive effect on the metal objects of the moisture trapped in the wrapping or packaging when it is sealed.

In one aspect of my invention an atmosphere containing the corrosion inhibiting vaporized acid, advantageously lauroyloxyacetic acid, is formed by vaporization of the alkanoyloxyacetic acid from a coating composition applied to a wrapping or packaging material on the surface to be placed adjacent to the metal objects. The coating composition consists essentially of a heavy hydrocarbon vehicle and the alkanoyloxyacetic acid. The heavy hydrocarbon vehicle must be non-volatile, inert, capable of forming a dispersion with the alkanoyloxyacetic acid, and capable of being applied to a packaging material. For example, the vehicle may be a virgin gas oil, a heavy lube fraction, e. g. a conventionally prepared neutral of about 80 SSU at 212° F. or a bright stock, a paraffin or a microcrystalline wax, an asphalt or a bituminous product. The alkanoyloxyacetic acid may be of the type commercially available and its effective proportion is in the range of about 3% to about 10% by weight based on the total composition. The wrapping or packaging material may be fibrous material such as paper, cardboard, textile, wood, fibreboard, etc., or it may be a non-fibrous material such as cellophane, plastic compositions, etc. The inhibitor-hydrocarbon composition is applied as a coating to the wrapping or packaging material by any suitable means.

In another aspect of my invention an atmosphere containing the corrosion inhibiting vaporized acid is formed by vaporization of the alkanoyloxyacetic acid in a closed

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container. Thus the alkanoyloxyacetic acid may be distributed directly within the container in solid state in the form of dust or larger particles, indirectly enclosed in porous bags, etc. or it may be distributed in the liquid state in the form of molten acid or dissolved in a volatile solvent. Here again the alkanoyloxyacetic acid may be of the type commercially available and it should be distributed within the closed container in amounts such that at least 0.01 pound of inhibitor are present for each 100 cubic feet of air space.

The actual amount of inhibitor employed is ordinarily directly related to the amount of sealing of the wrapping or packaging material, the type of metal to be protected, the degree of exposure to which the packaged metal will be subjected, and the period of time during which it is to be protected. In particular, enclosed or open air transportation or storage with constantly varying temperature and humidity are capable of affecting corrosion considerably. However, if a coating composition containing the alkanoyloxyacetic acid is applied to a packaging material carrier, the alkanoyloxyacetic acid should in general be present in amounts of about 2 grams per square foot of treated carrier. From an economic viewpoint, it is generally unnecessary to use more than about 10% by weight of alkanoyloxyacetic acid in the coating composition.

Other closely related members of the same homologous series do not appear to have the special advantages of the alkanoyloxyacetic acids having between eight and twelve carbon atoms in the alkanoyl group. For instance, hexanoyloxyacetic acid and myristoyloxyacetic acid, each removed by only two carbon atoms from the acids in the above series evidence extremely poor vapor phase corrosion inhibiting capacity, as is demonstrated by the tests described in Example I (infra).

Among the advantages of my coating compositions, are that I may coat a packaging material on one side only with a composition consisting of microcrystalline wax (which penetrates the fibrous material to a limited extent) and an alkanoyloxyacetic acid so that the inhibiting agent vaporizes from only one side of the packaging material and none is lost by penetration of the inhibiting vapor through the fibrous material into the outside air. I thus dispense with the need for laminating the packaging material to keep the inhibiting vapor in the enclosed space containing the metal objects. Or I may impregnate the packaging material with a composition consisting of a heavy lube oil or a paraffin wax (which completely penetrate the fibrous material) and an alkanoyloxyacetic acid so that the inhibiting agent vaporizes from both sides of the packaging material, such material being useful to separate, for example, steel plates shipped or stored in layers.

The following examples are offered to illustrate more clearly the nature and effectiveness of certain alkanoyloxyacetic acids alone or incorporated in coating compositions as vapor phase rust inhibitors according to my invention. However, it should be noted that the tests described in the examples were conducted under extreme conditions of temperature and humidity. In commercial use of my inhibitor these conditions are not likely to exist.

I compared alkanoyloxyacetic acids having 8 to 12 carbon atoms in the alkanoyl group with other alkanoyloxyacetic acids and lauroyloxyacetic acid with a well-known commercial vapor phase type rust inhibitor, apparently dicyclohexylammonium nitrite, which I shall designate Compound A. I then compared wax-lauroyloxyacetic acid and mineral oil-lauroyloxyacetic acid coated kraft paper with two commercial papers impregnated with other vapor phase type corrosion inhibitors which appeared to be the most widely accepted of the inhibitor impregnated papers presently on the market. These two commercial papers I shall designate

as Paper X and Paper Y. Paper X apparently was impregnated with dicyclohexylammonium nitrite. Paper Y was apparently impregnated with monoethanolamine.

Example I

I first compared homologs of the alkanoyloxyacetic acid series having between six and sixteen carbon atoms in the alkanoyl group according to Procedure I which in outline is as follows. A short form, four ounce bottle was fitted with a Bakelite screw cap in which a small hole was drilled. A glass hook was inserted in the cap through this hole. A freshly ground, mild steel strip $2\frac{3}{4}$ " x $\frac{1}{2}$ " x $\frac{1}{8}$ " with a $\frac{1}{4}$ " hole drilled through one end was hung from the hook. Five ml. of distilled water and a known quantity of the substance to be tested were put in the bottle. The cap with the suspended steel coupon was screwed on and the assembly placed in an oven at 100° F. for twenty-four hours. The coupon was then removed, dried, and rated as follows:

A	Perfect—no corrosion
B++	Less than $\frac{1}{4}$ % of total surface covered with rust
B+	0.25% to 5% of total surface covered with rust
B	5% to 25% rust
C	25% to 50% rust
D	50% to 75% rust
E	75% to 100% rust

Before reuse in another test, the bottles, caps and hooks were cleaned with chromic acid cleaning solution to insure against carry-over of material from a previous test.

For research projects, little differentiation has been drawn between A results wherein no rust is observed on the test coupons and B++ results which describe test coupons containing a maximum of rust covering 0.25% of the total surface area under test. Practically, this is not a sharp differentiation, in that inaccuracy of test specimen preparation frequently leaves minute, sensitive areas and as a result, B++ results are frequently obtained with compositions which should give no rust. I therefore conclude that B++ or A results are substantially equivalent within the accuracy of the test.

I then compared the same alkanoyloxyacetic acids in accordance with Procedure II which was the same as Procedure I except that a known quantity of the compound to be tested was coated on the inside wall of the bottle instead of being admixed with the water so that it would not dissolve in or remain below the water phase.

The results are indicated in the data given below:

Compound	Proce- dure	Wt. (gms.)	Result
hexanoyloxyacetic acid	I	0.25	E
octanoyloxyacetic acid	I	0.25	E
decanoyloxyacetic acid	I	0.25	A
lauroyloxyacetic acid	I	0.25	B+
myristoyloxyacetic acid	I	0.25	E
stearoyloxyacetic acid	I	0.25	E
hexanoyloxyacetic acid	II	0.001	E
octanoyloxyacetic acid	II	0.001	B
decanoyloxyacetic acid	II	0.001	B+
lauroyloxyacetic acid	II	0.001	B+
myristoyloxyacetic acid	II	0.001	E
stearoyloxyacetic acid	II	0.001	E

Example II

I next compared lauroyloxyacetic acid with Compound A according to Procedure III which differed from Procedure I in one respect. The cap, hook, coupon and bottle with a known quantity of test compound coated on the wall were assembled without water and placed in the oven at 100° F. for twenty-four hours to allow the inhibitor to precoat the test strip. The assembly was then removed from the oven, 5 ml. of distilled water added, and the assembly replaced in the oven at 100° F. for an additional twenty-four hours. At the end of this second twenty-four hour period, the coupons were removed and rated as before.

The results are indicated in the data given below:

Quantity, Grams	Lauroyl- oxyacetic Acid	Comment	Com- pound A	Com- ment
0.02	B++			
0.10	B+	2% rust	A	6% rust.
0.005	B+	do	B	Do.

¹ These were long term tests run for 23 days with water present after the initial 24-hour period without water.

Example III

Blends of lauroyloxyacetic acid and wax and lauroyl-acetic acid and mineral oil were made and used to coat kraft paper as follows:

Coated Paper	Coating
A	135/137° F. M. P. fully refined wax +10% lauroyloxyacetic acid.
B	Bleached microcrystalline wax +5% lauroyloxyacetic acid.
C	Lube oil viscosity 80/SS U at 212° F. +10% lauroyloxyacetic acid.

These were compared with two commercial coated papers:

Paper	Inhibiting Agent
X	Dicyclohexylammonium nitrite.
Y	Monoethanolamine.

The above papers were cut into strips $\frac{1}{4}$ " x 4" and placed in the test bottles along with the water. Test results are indicated in the data which follow:

Paper	Result	Comment
A	B+, B+	4% to 8% light rust.
B	B+, B+	5% to 12% light rust.
C	B+, B+	3% to 6% light rust spots.
X	B+, B+	2% light rust.
Y	B++, B++	1% light rust.

I claim:

1. An article of manufacture which is useful in the packaging of metal objects in order to prevent their corrosion, said article being a material to which has been applied a vapor phase corrosion inhibiting composition consisting essentially of a non-volatile heavy hydrocarbon vehicle and about 3 per cent to 10 per cent by weight based on the total composition of an alkanoyloxyacetic acid having from 8 to 12 carbon atoms in the alkanoyl group.

2. An article of manufacture which is useful in the packaging of metal objects in order to prevent their corrosion, said article being a material to which has been applied a vapor phase corrosion inhibiting composition consisting essentially of a non-volatile heavy hydrocarbon vehicle and about 3 per cent to 10 per cent by weight based on the total composition of lauroyloxyacetic acid.

3. An article of manufacture which is useful in the packaging of metal objects in order to prevent their corrosion, said article being paper to which has been applied a vapor phase corrosion inhibiting composition consisting essentially of a non-volatile heavy hydrocarbon vehicle and about 3 per cent to 10 per cent by weight of lauroyl-oxyacetic acid.

4. An article of manufacture which is useful in the packaging of metal objects in order to prevent their corrosion, said article being paper to which has been applied a vapor phase corrosion inhibiting composition consisting essentially of a petroleum wax and about 3 per cent to 10 per cent by weight of lauroyloxyacetic acid.

5. A composition of matter useful as a vapor phase inhibitor of corrosion of metal objects, consisting essen-

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tially of petroleum wax and about 3 per cent to 10 per cent by weight based on the total composition of lauroyl-oxyacetic acid.

6. A method of inhibiting corrosion of metal objects in closed containers which comprises surrounding said metal objects with an atmosphere containing an alkanoyl-oxyacetic acid having from 8 to 12 carbon atoms in the alkanoyl group in amounts such that at least 0.01 pound of alkanoyloxyacetic acid are present for each 100 cubic feet of air space.

7. A method of inhibiting corrosion of metal objects in closed containers which comprises surrounding said metal objects with an atmosphere containing lauroyl-oxyacetic acid in amounts such that at least 0.01 pound of lauroyloxyacetic acid are present for each 100 cubic feet of air space.

8. A method of inhibiting corrosion of metal objects which comprises surrounding said metal objects with an atmosphere containing an alkanoyloxyacetic acid having from 8 to 12 carbon atoms in the alkanoyl group.

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