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PROCESS FOR INHIBITING CORROSION OF METALS

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This invention relates to a new process for corrosion inhibition of metallic substances. This process may be employed in aqueous-oil systems, in finished petroleum products, in protective coating, and in industrial water systems.

Corrosion of metallic substances represents a major industrial problem. Every year the loss to industry through corrosion amounts to millions of dollars. In general, this corrosion takes place when the metallic substances, especially ferrous-containing metals, come in contact with a watery media, i.e., water, aqueous solutions, water vapor, and the like. Various methods are presently known and utilized for preventing or inhibiting the corrosive activity of the various aqueous media. The most frequently employed method for inhibiting and preventing corrosion is to cover the surface of the metallic substance with a protective coating.

It has now been discovered that a tenacious protective film of essentially mono-molecular dimensions having corrosion inhibition properties is formed when one of the compounds of the general structural formula

$$R'NHCR_2CR_2COOX,$$
$$(R'NHCR_2CR_2COO)_2Y,$$
$$R'N(CR_2CR_2COO)_2X_2,$$
$$R'N(CR_2CR_2COO)_2Y$$

where R is hydrogen or a lower alkyl group containing less than four carbon atoms, R' is a high molecular weight, straight or branched chained, hydrocarbon radical containing 8 to 22 carbon atoms, X is hydrogen or an alkali metal, and Y is an alkaline earth metal, comes in contact with the metallic surface to be protected. These compounds are readily available commercial compounds. All may be classified as substituted products of beta-amino propionate where the hydrocarbon radical, R'—, is derived from various high molecular weight acids and contains the same number of carbon atoms as the original acid. Common sources of these acids are rosin acids and the fatty acids such as those obtained from tall oil, soybean oil, coconut oil, cottonseed oil, linseed oil, soapstock, safflower oil, castor oil, tallow, lard, and other fats and oils. It will be appreciated that the acids contained from each source are generally a complex mixture, which are, for all intents and purposes, relatively uniform in composition. Thus, R'—is defined in many of the fol-

lowing compounds according to the source of the original acids, i.e., "coco"-coconut oil, "tallow"-tallow, "rosin"-rosin acids, and so forth.

A unique application of this discovery is the use of these compounds in wire drawing as a combination lubricant and corrosion inhibitor. Fatty acids are extensively utilized as lubricants in this process and may be used in combination with the corrosion inhibitors of this invention.

Another advantage to the use of these compounds as corrosion inhibitors lies in the fact that they are known surfactants. For instance, they are especially useful surface active agents for incorporation in shampoo formulations and when employed in aerosols contained in metal cans, they serve the dual purpose of surfactant in the shampoo and protect the metal aerosol can from corrosion during storage.

These anti-corrosive characteristics make them useful additives in all detergent compositions packaged in metallic containers.

This invention may be illustrated further by reference to the following examples in which all "parts" are expressed as parts by weight and all "percentages" are expressed as percent by weight, unless specified otherwise.

EXAMPLE I

A quantitative method for determining the anti-corrosive activity using a kerosene-sour brine system has been devised. In this test #1020 mild steel coupons are immersed in a static sour brine-kerosene system, and the amount of corrosion is measured by the loss in weight of the coupon during the test period. At a concentration of 25 parts per million (p.p.m.) calcium N-tallow beta-aminopropionate was 95% effective as a corrosion inhibitor when compared to the loss in weight of a control coupon exposed to the same test under identical conditions.

EXAMPLE II

In the Navy static water drop test no rust resulted when sodium N-coco-beta-aminopropionate was employed at a concentration of 0.1%.

Similar results were obtained using 0.1% of disodium N-tallow beta-iminodipropionate.

EXAMPLE III

The following results were obtained using the ASTM D-665 turbine oil rusting test:

Inhibitor	Concentration, percent	Results
(1) sodium N-coco-beta aminopropionate	0.1	very light rust.
(2) disodium N-tallow-beta iminopropionate.	0.1	Do.
(3) Sodium N-tallow-alpha-methyl-beta-aminopropionate.	0.1	no rust.
	0.0067	Do.
	0.005	Do.
	0.0033	very light rust.
	0.0017	light rust.

EXAMPLE IV

The following results were obtained using the NACE screening test:

Inhibitor	Concentration (Parts per million in water)	Percent Inhibition
(1) sodium N-coco-beta aminopropionate	25	97
	10	95
	5	86
(2) sodium N-tallow-beta aminopropionate	25	98
	10	97
(3) sodium N-hydrogenatedtallow-beta-aminopropionate	25	95
	10	82
(4) sodium N-rosin-beta-aminopropionate	25	94
	10	92
	5	81
(5) sodium N-tallow oil-beta aminopropionate	25	95
	10	97
	5	77
(6) disodium N-dodecyl-beta-iminopropionate	25	86
(7) disodium N-tallow-beta-iminopropionate	25	94
	10	87
(8) disodium N-soy-beta-iminopropionate	10	77
(9) sodium N-coco-beta-methyl-beta-aminopropionate.	100	95
(10) disodium N-tallow-beta-methyl-beta-aminopropionate	25	98
	10	91
	5	70
(11) sodium N-coco-alpha-methyl-beta-aminopropionate	10	92
	5	90
	2	74
(12) sodium N-coco-beta-methyl-beta-aminopropionate	10	91
	5	88
	2	64
(13) sodium N-tallow-alpha-methyl-beta-aminopropionate	10	89
(14) disodium N-tallow-beta iminodibutyrate	10	89
	(Parts per million in oil)	
(15) calcium-di-N-tallow-beta-aminopropionate	75	91
(16) sodium N-tallow-beta-methyl-beta-aminopropionate	80	79
	60	71
	40	62

EXAMPLE V

Table I shows the effectiveness of various compounds as corrosion inhibitors as measured qualitatively at 75 parts per million in a sealed static water test. The testing procedure was conducted as follows:

Step A: 1"×1"×1/16" S.A.E. 1020 mild steel coupons having a 5/32" diameter hole were pickled as follows—

(1) Soak coupons in reagent grade acetone and dry in air.

(2) Pickle 10.0 min. in concentrated HCl at room temperature with agitation.

(3) Rinse in distilled water, acetone dip, and dry at reduced pressure in a desiccator.

Step B: Suspend each coupon from a Pyrex hook in 150 ml.±ml. of test solution (prepared from distilled water to 75 p.p.m. inhibitor±1 p.p.m. based on 100% active material) so as to be fully immersed with the coupon's top edge 1/8" to 3/8" below test solution surface using 250 ml. Pyrex Erlenmeyer flasks as the test container.

Step C: Leave the coupon suspended for three days±two hours at room temperature.

Step D: Remove coupons from test flasks and visually observe the condition of the coupon.

Table I

Test Compound	Observed Result
(1) control (distilled water)	Heavy rust.
(2) sodium N-hydrogenated-tallow-beta-aminopropionate.	Slight rust.
(3) sodium N-tallow-beta-aminopropionate	Do.
(4) calcium di-N-tallow-beta-aminopropionate	No rust.
(5) sodium N-tall oil-beta-aminopropionate	Very slight rust.
(6) sodium N-rosin-beta-aminopropionate	Moderate rust.
(7) sodium N-coco-beta-aminopropionate	No rust.
(8) sodium N-dodecyl-beta-aminopropionate	Do.
(9) sodium N-tetradecyl-beta-aminopropionate	Very slight rust.
(10) sodium N-hexadecyl-beta-aminopropionate	Slight rust.
(11) disodium N-tallow-beta-iminopropionate	Do.
(12) sodium N-tallow-alpha-methyl-beta-aminopropionate.	Very slight rust.
(13) disodium N-dodecyl-beta-iminopropionate	Do.
(14) disodium N-soy-beta-iminopropionate	Slight rust.

Many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

Now, therefore, I claim:

1. A process for corrosion inhibition of metallic substances which comprises covering said metallic substance with a mono-molecular film of a compound selected from the group consists of

$$R'NHCR_2CR_2COOX,$$
$$(R'NHCR_2CR_2COO)_2Y$$
$$R'N(CR_2CR_2COO)_2X_2$$
$$R'N(CR_2CR_2COO)_2Y$$

where R is selected from the group consisting of hydrogen and lower alkyl radicals containing less than four carbon atoms, R' is a hydrocarbon radical containing 8 to 22 carbon atoms, X is selected from the group consisting of hydrogen and an alkali metal, and Y is an alkaline earth metal.

2. A process for corrosion inhibition of metallic substances which comprises covering said metallic substances with a mono-molecular film of a compound having the general formula, $R'NHCR_2CR_2COOX$ where R' is a straight chain hydrocarbon radical containing 8 to 22 carbon atoms, R is hydrogen or a lower alkyl radical containing less than five carbon atoms, and X is an alkali metal.

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