

1

2,829,114

CORROSION INHIBITOR

George L. Hervet, Downers Grove, Ill., assignor to Universal Oil Products Company, Des Plaines, Ill., a corporation of Delaware

No Drawing. Application May 4, 1955

Serial No. 506,081

12 Claims. (Cl. 252—395)

This invention relates to a novel method of preventing corrosion of aluminum or aluminum alloys.

Aluminum has long been known as a metal that is extremely resistant to corrosion when used in normal applications as a decorative or structural metal. This is seemingly incongruous since the position occupied by aluminum in the electromotive series would indicate that it is a very active metal which should react with water to form aluminum hydroxide and hydrogen. This seeming incongruity is explained by the formation of epsilon-alumina on the surface of aluminum metal when exposed to air, water, or moist air. Epsilon-alumina forms an inert, tough and tenacious coating upon the surface of the metal which resist the actions of various corroding agents. In many applications, however, aluminum is used in an atmosphere that attacks the epsilon-alumina coating, thereby exposing the bare metal to the action of corroding agents and making aluminum unsuitable as a material in that atmosphere. The most common applications in which aluminum is unsuitable are those in which aluminum is to be used in a basic atmosphere. Basic materials tend to dissolve the epsilon-alumina coating and attack the metal whereby extreme corrosion is effected. This tendency makes aluminum unsuitable for such applications as laboratory or commercial uses wherein basic materials are treated, used or produced.

The present invention is particularly effective in preventing corrosion of aluminum or aluminum alloys utilized in systems in which organic basic compounds are converted, treated, stored, etc. Reaction zones, piping, pumps, storage tanks, etc., and liners therefor are constructed of aluminum or aluminum alloys, and undergo corrosion during contact with the organic basic compound. Illustrative examples of organic basic compounds include alkyl amines, alkylene polyamines, aromatic amines, aliphatic amino alcohols, aromatic amino alcohols, etc., and solutions containing these compounds. As will be illustrated in the following examples, soluble organo metallic sulfonates serve to prevent the corrosion of aluminum in a system containing such compounds. It is believed that a peculiar association exists between the organo metallic sulfonate and the aluminum surface which renders the surface inert towards basic materials that ordinarily would cause severe corrosion.

In one embodiment, the present invention relates to a method of inhibiting corrosion of an aluminum-containing metal in contact with a basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising a soluble organo metallic sulfonate.

In a specific embodiment, the present invention relates to a method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of an alkali metal organic sulfonate.

Any suitable organo metallic sulfonate may be utilized in the present invention. Preferred organo metallic sulfonates comprise alkali metal, alkaline earth metal or magnesium hydrocarbon sulfonates and particularly

2

alkaryl sulfonates. An especially preferred organo metallic sulfonate comprises sodium dodecylbenzene sulfonate. Another preferred organo metallic sulfonate comprises sodium lignosulfonate. Other organo metallic sulfonates include sodium nonylbenzene sulfonate, sodium decylbenzene sulfonate, sodium dodecylbenzene sulfonate, sodium tridecylbenzene sulfonate, sodium tetradecylbenzene sulfonate, sodium pentadecylbenzene sulfonate, etc., sodium nonyltoluene sulfonate, sodium decyltoluene sulfonate, sodium dodecyltoluene sulfonate, sodium tridecyltoluene sulfonate, sodium tetradecyltoluene sulfonate, sodium pentadecyltoluene sulfonate, etc., sodium nonylxylene sulfonate, sodium decylxylene sulfonate, sodium dodecylxylene sulfonate, sodium tridecylxylene sulfonate, sodium tetradecylxylene sulfonate, sodium pentadecylxylene sulfonate, etc., sodium lauryl sulfonate, sodium palmityl sulfonate, sodium stearyl sulfonate, sodium lignosulfonate, etc., and the corresponding sulfonates in which the metal component comprises potassium, lithium, rubidium, cesium, calcium, strontium, barium, or magnesium. In some cases, a mixture of sulfonates can be employed. It is understood that the various sulfonates are not necessarily equivalent but that all of them will serve to retard corrosion of aluminum or aluminum alloys.

The organo metallic sulfonate generally is utilized in a small concentration, which usually will be within the range of from about 0.001% to about 3% by weight of the organic basic solution, although higher or lower concentrations may be utilized in certain cases.

It generally is preferred to commingle the organo metallic sulfonate with the basic solution prior to passing the same into contact with the aluminum-containing metal. However, when the basic solution is to be stored in containers constructed of aluminum or aluminum alloys, the basic solution and organo metallic sulfonate may be introduced separately into the container or storage tank.

The following examples are introduced to illustrate further the novelty and utility of the present invention but not with the intention of unduly limiting the same.

Example I

In this example, the corrosion inhibitor utilized was sodium dodecylbenzene sulfonate. This material is marketed under the trade name of "Nacconol NRSF" and comprised 88% sodium dodecylbenzene sulfonate and 12% sodium sulfate. 450 grams of distilled water, 50 grams of monoethanolamine, 5.68 grams of "Nacconol NRSF" and 18 grams of aluminum chips, approximately 1/8" wide, 1/4" long and 1/16" thick, were charged to a one liter pyrex flask fitted with a high speed stirrer. The mixture in the flask was heated to 100° C. and was violently agitated (stirrer speed 1500 R. P. M.) for 6 hours. At the end of the 6 hour period, the contents were discharged, the supernatant liquid was filtered off and the solid product examined. In this reaction, only 15.6% by weight of the aluminum reacted.

Example II

This example may be considered as a blank or control run. This run was made under the same conditions as described in Example I except that the inhibitor was omitted. After the 6 hours contacting, the solid products were examined and it was found that 99.8% of the aluminum reacted. In contrast to these results, only 15.6% of the aluminum reacted with the inhibitor as reported in Example I.

Example III

The inhibitor used in this example was sodium lignosulfonate. The specific material is marketed under the name of "Maracell-E" and comprises a partially desulfonated sodium lignosulfonate. In a run under the same

conditions as described in Example I but utilizing 1% by weight of "Maracell-E," 27.8% of the aluminum reacted. Here again, it will be noted that the inhibitor served to considerably retard the reaction of the aluminum.

It will be seen from the above examples that the addition of 1% by weight of the inhibitor to the basic solution served to considerably reduce the amount of aluminum undergoing reaction. The aluminum in these examples was in finely divided form so that a maximum of surface was exposed and, therefore, it was treated under very severe conditions, both from the standpoint of the corrosiveness of the basic medium in which it was immersed and the kinetic energy of the medium (boiling point of the solution and violent agitation). Even under these extreme conditions, the use of the inhibitor was very effective in retarding the reaction of the aluminum.

Example IV

Potassium nonylbenzene sulfonate is utilized as inhibitor to retard corrosion of aluminum alloy in a system handling an aqueous solution of piperidine. The inhibitor in this case is utilized in a concentration of 1.5% by weight of the aqueous piperidine solution. This serves to retard corrosion of the aluminum alloy.

Example V

The inhibitor used in this example is calcium tridecylxylene sulfonate. 0.05% by weight of the inhibitor is utilized in a system handling an aqueous solution of butyl amine in a reaction zone constructed of aluminum. The inhibitor serves to retard corrosion of the aluminum when effecting reaction of the butyl amine at a temperature of 50° C. with vigorous stirring of the reaction mixture.

I claim as my invention:

1. A method of inhibiting corrosion of an aluminum-containing metal in contact with a basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising a soluble metal hydrocarbon sulfonate.

2. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising an alkali metal hydrocarbon sulfonate.

3. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising an alkaline earth metal hydrocarbon sulfonate.

4. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium

which comprises effecting said contact in the presence of a corrosion inhibitor comprising a magnesium hydrocarbon sulfonate.

5. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising a sodium alkaryl sulfonate.

6. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising sodium dodecylbenzene sulfonate.

7. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising sodium lignosulfonate.

8. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising sodium lauryl sulfonate.

9. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising potassium dodecylbenzene sulfonate.

10. A method of inhibiting corrosion of an aluminum-containing metal in contact with an organic basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising potassium lignosulfonate.

11. A method of inhibiting corrosion of an aluminum-containing metal in contact with a basic medium which comprises effecting said contact in the presence of a corrosion inhibitor comprising a soluble metallic alkaryl sulfonate.

12. A method of inhibiting corrosion of an aluminum-containing metal in contact with a basic medium which comprises effecting said contact in the presence of a corrosion inhibitor selected from the group consisting of soluble metal hydrocarbon sulfonates and soluble metal lignosulfonates.

References Cited in the file of this patent

UNITED STATES PATENTS

2,113,453 Mitchell et al. Apr. 5, 1938
2,402,793 White et al. June 25, 1946

OTHER REFERENCES

Fagen et al.: Article in Ind. Eng. Chem., 21, p. 357 (1929).

French: Article in Ind. Eng. Chem., 15, pages 1239-43 (1923).