

UNITED STATES PATENT OFFICE

2,225,866

CORROSION INHIBITOR

John B. Holtzclaw, Roselle, and Anton Harmsen
and Henry H. Cooke, Elizabeth, N. J., assignors
to Stanco, Inc.

No Drawing. Application December 31, 1938,
Serial No. 248,866

6 Claims. (Cl. 252-75)

This invention relates to an improvement in heat transfer media for use in automobile radiators, heating systems where the transfer of heat depends upon the circulation of aqueous fluids and any other mechanical devices where aqueous solutions come in contact with metals.

More particularly, this invention pertains to heat transfer media containing freezing point depressants, such as alcohols, glycols and glycerine. Water alone is very corrosive to iron, steel and the alloys of base metals. The corrosive action of water upon metals is greatly enhanced by the addition thereto of freezing point depressants, such as alcohol or glycol, which is presumed to be due to the oxidation products of the freezing point depressant formed in the aqueous solution. The cooling system of an automobile consists of a water jacket around the cylinders, a radiator for exposing a large surface to the cooling action of the air, a pump for circulating the cooling fluid and necessary flexible couplings between the parts. The water jacket is generally made of iron and provides the source of the most troublesome corrosion problem due to the fact that the iron rust formed therein circulates with the cooling fluid lodging in and clogging up the small passageways in the radiator. An automobile radiator is ordinarily made of brass which is also subject to corrosion by aqueous solutions, but the products of corrosion of brass are not so voluminous as iron rust and therefore do not obstruct the passageways of the radiator to so great an extent. The corrosion problem in radiators is one of preventing leaks. The radiator is made of very thin metal which would soon be eaten thru if unabated corrosion were permitted. The major part of the corrosion in automobile cooling systems occurs in the water jacket and radiator, and affords the most serious obstacle to efficient control of the temperature in the combustion chamber.

Various attempts have been made using corrosion inhibitors, such as sodium nitrite or sulfonic acid salts, to control corrosion. The results obtained by these attempts have not been entirely satisfactory owing to the varied composition of the component parts of the mechanism.

An object of this invention is to provide a composition which will furnish a means for eliminating substantially all corrosion from systems using aqueous fluids as heat transfer media. In addition, as will be evident from the description which follows, this new composition possesses further advantages over previously employed materials, and it is a further object of this invention to utilize these advantages to the fullest extent as they may appear.

Oil-soluble salts of sulfonic acid have been used to inhibit the corrosion of metals. A typical anti-

freeze solution in which an oil-soluble sulfonate provides the protection against corrosion is:

Formula A

	Percent by volume	
Methanol	53.40	
91% Isopropanol	44.50	
Mineral oil distillate	1.50	
Water	0.50	
Water-soluble dye (1% solution)	0.10	
	100.00	

	Per cent wt./vol.	
Sodium rosinate or equivalent	.10	
Oil-soluble sulfonates	.15	

It has also been quite common to use sodium tetraborate or borax as a corrosion inhibitor. A typical anti-freeze mixture employing borax as the corrosion inhibitor would be:

Formula B

	Percent by volume	
Methanol	53.25	
91% Isopropanol	44.65	
Mineral oil distillate	1.50	
Water	0.50	
Water-soluble dye (1% solution)	0.10	
	100.00	

	Per cent wt./vol.	
Borax	0.2	

It has now been found that if a combination of borax and oil-soluble sulfonates are used in aqueous solutions as the corrosion inhibitor, the combination is much more effective in preventing metal corrosion than either one used separately. A typical anti-freeze formula, employing both borax and oil-soluble sulfonates, is:

Formula C

	Percent by volume	
Methanol	53.55	
91% Isopropanol	44.57	
Mineral oil distillate	1.50	
Water	0.50	
Water-soluble dye (1% solution)	0.10	
	100.00	

	Per cent wt./vol.	
Sodium rosinate or equivalent	.05	
Borax	0.1	
Oil-soluble sulfonates	.08	

The marked superiority of Formula C over either Formulae A or B will be made readily apparent by a comparison of the corrosion data tabulated in Table 1.

The further surprising discovery has been made

that if sufficient alkali, either in the form of sodium hydroxide, sodium carbonate or other alkali, is added to a 40% solution of Formula C in tap water to raise the pH of the solution to 11 or 12, the anti-corrosion action of borax and oil-soluble sulfonates is further greatly enhanced. A typical example, employing this principle, is:

Formula D

	Per cent by volume
Methanol	63.90
91% isopropanol	31.40
Mineral oil distillate	2.00
Water	2.40
Water-soluble dye (1% solution)	0.10
	100.00

	Per cent wt./vol.
Borax	0.2
Sodium rosinate or equivalent	0.1
Sodium hydroxide	0.2
Oil-soluble sulfonates	0.3

The pH value of a 40% solution in tap water of the above disclosed examples would be as follows:

Formula A	6.5 to 7
Formula B	9.5 to 10
Formula C	9.5 to 10
Formula D	11 to 12

A certain latitude is permissible in Formulae C and D as to the amounts of borax, sodium rosinate, oil-soluble sulfonates or sodium hydroxide added. The range within which these substances may be used is:

	Per cent wt./vol.
Borax	.1-.5
Sodium rosinate	.05-.2
Oil-soluble sulfonates	.08-.3
Sodium hydroxide	.2-.5

In order to obtain comparative data on the corrosive effect on metals of the above described formulae, strips of steel, cast iron, aluminum, brass and solder of uniform size were obtained. 40% solutions of the previously described formulae were made up and placed on a steam bath where they could be maintained at a uniform temperature of about 160° F. The metallic strips, after being weighed, were suspended from glass rods and immersed in the hot solution where they remained for one month. After one month the strips were removed, washed, dried and weighed. This test is equivalent to approximately one season's use of the solution under ordinary conditions. The results of the test appear in Table 1 below wherein the loss in weight is expressed in milligrams per square centimeter of surface area.

Table 1

Metals	Formula A	Formula B	Formula C	Formula D
	Mg./sq. cm.	Mg./sq. cm.	Mg./sq. cm.	Mg./sq. cm.
Steel	1.79	0.58	0.13	0.00
Cast iron	4.50	4.33	0.27	0.00
Aluminum	0.13	0.58	0.13	0.00
Brass	0.58	0.31	0.22	0.13
Solder	0.76	0.89	0.18	0.40

The above table shows that Formula C is distinctly better than Formula A except for its action upon aluminum where it is, however, equally as good. It is also shown that Formula C is an

improvement over Formula B in its action upon all of the metals. The most surprising results, however, were obtained in the use of Formula D which was found to have no corrosive action upon either steel, cast iron or aluminum. It is noted that in Formula D the solder strip sustained a greater loss than the solder strip used in testing Formula C but the corrosion exerted upon solder by Formula D is still considerably less than the corrosion of solder exhibited by Formulae A and B. As a general rule, solder is badly corroded by alkaline solutions but is impervious to weak acid solutions. However, cast iron forms the predominant part of either an automobile cooling system or other aqueous heat exchange equipment and consequently must be the metal given prime consideration when experimenting with corrosion inhibitors for use in this connection. A compromise must therefore be made due to the variety of metals and alloys in use to obtain the inhibitor offering the greatest protection to the chief metal at the least possible sacrifice of protection to the other metals. Formula D then is such a formula offering, as it does, complete protection to steel, cast iron and aluminum, and substantially complete protection to copper alloys and solder.

In systems utilizing water, either in the liquid or vapor phase, where freezing point depressants are either unnecessary or undesirable and where cast iron or steel is the prevailing metal, corrosion at times reaches prohibitive proportions. The corrosion inhibitor of this invention is as suitable for preventing corrosion under these conditions as it is where freezing point depressants are present. A typical formula for use in the absence of freezing point depressants would be:

	Per cent
Borax	25.0
Sodium rosinate	12.5
Sodium hydroxide	25.0
Oil-soluble sulfonates	37.5

When added to water in amounts varying between 1.25 grams to 6.25 grams per gallon, according to the hardness of the water, this composition will protect any iron, steel or alloys coming in contact with the treated water against virtually all corrosion.

While there are above disclosed but a limited number of embodiments of this invention, it is possible to produce still other embodiments without departing from the inventive concepts herein disclosed and it is therefore desired that only such limitations be imposed on the appended claims as are stated therein.

We claim:

1. An anti-freeze fluid comprising an alcohol, mineral oil distillate 1 to 3%, oil-soluble sulfonates .08-3%, water 1.0-5.0%, borax .1-5%, soap .05-2%, water-soluble dye .001% and sufficient alkali to give a pH of at least 9.5 to a 40% solution of the anti-freeze in water.

2. An anti-freeze fluid consisting of an alcohol 95.30%, mineral oil distillate 2.00%, water 2.40%, oil-soluble sulfonates 0.3%, sodium rosinate 0.1%, borax 0.2%, water-soluble dye .001% and sufficient alkali to give a pH of at least 9.5 to a 40% solution of the anti-freeze in water.

3. An anti-freeze fluid consisting of methanol 63.90%, isopropanol 31.40%, mineral oil distillate 2%, oil-soluble sulfonates 0.3%, water 2.4%, borax 0.2%, sodium rosinate .1%, water-soluble dye .001% and sodium hydroxide in an amount

sufficient to adjust a 40% solution of the anti-freeze in water to a pH of 11.

4. An anti-freeze fluid consisting of ethyl alcohol 95.30%, mineral oil distillate 2.00%, water 2.40%, oil-soluble sulfonates 0.3%, sodium rosinate 0.1%, borax 0.2%, water-soluble dye .001% and sufficient alkali to give a pH of at least 9.5 to a 40% solution of the anti-freeze in water.

5. An anti-freeze fluid consisting of methyl alcohol 95.30%, mineral oil distillate 2.00%, water 2.40%, oil-soluble sulfonates 0.3%, sodium rosin-

ate 0.1%, borax 0.2%, water-soluble dye .001% and sufficient alkali to give a pH of at least 9.5 to a 40% solution of the anti-freeze in water.

6. A corrosion inhibitor for use in aqueous heat exchange media comprising borax 23-34%, soap 11.5-13%, oil-soluble sulfonates 18.5-20% and alkali 34-46.5%.

JOHN B. HOLTZCLAW.

ANTON HARMSEN.

HENRY H. COOKE.

10