

UNITED STATES PATENT OFFICE

2,388,155

INHIBITION OF CORROSION

Edwin Hastings Keller, Chester Heights, Pa., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

No Drawing. Application December 17, 1942, Serial No. 469,349

3 Claims. (Cl. 252-74)

This invention relates to the inhibition of metallic corrosion caused by alcohols alone or in aqueous solution, and more particularly relates to the inhibition of metallic corrosion caused by ethanol antifreeze mixtures, such as those containing denatured alcohol. Still more particularly, this invention relates to a method and means whereby borax can be solubilized in ethanol of any concentration.

Heretofore, ethanol, especially full-strength commercial ethanol of about 190 proof suitably denatured, has been extensively employed as an antifreeze agent for addition to the aqueous medium utilized in automobile cooling systems. Unfortunately, aqueous ethanol of the concentrations usually employed to prevent the freezing of automobile radiators has a corrosive action upon the metals and alloys usually employed in constructing automobile cylinder blocks, cylinder heads, radiators and the like. In order to overcome this corrosion, it has previously been proposed to add one or more corrosion inhibitors to the antifreeze mixture. Among them may be mentioned alkali and alkaline earth metal phosphates, carbonates, lactates, chromates, and the like, but none have been entirely satisfactory. One reason for the lack of success with many corrosion inhibitors is that while they are sufficiently soluble in dilute ethanol, they are scarcely at all soluble in the concentrated ethanol prepared as an antifreeze. However, to be entirely satisfactory as a corrosion inhibitor, the compound must be sufficiently soluble in concentrated ethanol so that upon dilution with water in the automobile radiator there will be present enough corrosion inhibitor to be effective.

One of the best readily available corrosion inhibitors for ethanol antifreeze is borax, which substantially prevents corrosion of all the metals and alloys employed in radiator and cooling system construction. While sufficiently soluble in dilute ethanol to afford protection, borax is practically insoluble in concentrated full-strength commercial ethanol of about 190 proof, normally sold for antifreeze purposes. Therefore borax has heretofore been impractical as a corrosion inhibitor for ethanol.

It is an object of this invention to prepare concentrated non-corrosive ethanol which will, upon subsequent dilution with water, remain non-corrosive to metal parts. A further object is to prepare alcoholic antifreeze solutions whose corrosive tendencies are adequately inhibited by means of borax. A still further object is to dissolve borax in any desired proportion in full-

strength commercial ethanol of about 190 proof. Yet another object is to dissolve corrosion inhibiting proportions of borax in concentrated ethanol such that corrosion is inhibited upon dilution with water. Other objects will appear hereinafter.

These objects are accomplished in accordance with this invention wherein full strength commercial ethanol, borax, and a solubilizing amount of a polyhydric alcohol are dissolved together.

In one preferred embodiment of this invention, borax is first dissolved in a polyhydric alcohol, and thereafter the polyhydric alcohol-borax solution is dissolved in ethanol.

It has been discovered that while borax, otherwise known as sodium tetraborate decahydrate, is soluble in full-strength commercial ethanol of about 190 proof only to the extent of 0.03 per cent by weight, nevertheless by incorporating in ethanol a relatively small amount of a polyhydric alcohol, the solubility of borax is increased to such a large extent that corrosion is substantially inhibited in any subsequent antifreeze solutions of the ethanol.

While it is not intended to limit the invention to any particular theory of the physical or chemical reactions taking place, it is considered entirely probable that the borax forms a loose chemical combination with the polyhydric alcohol, producing a more acidic reaction product which is of much greater solubility in ethanol than is borax alone.

Suitable polyhydric alcohols for incorporation with the borax-ethanol antifreeze include ethylene glycol, glycerol, mannitol, dulcitol, and other lower polyhydric alcohols. Those of the polyhydric alcohols which are normally solid may be employed in strong aqueous solutions or strong ethanol solutions. Preferably, the normally liquid polyhydric alcohols are employed, and of the normally liquid polyhydric alcohols, ethylene glycol is preferred. In general, in dissolving borax in ethanol for corrosion inhibiting purposes, not more than about 15% by weight of a polyhydric alcohol is utilized, and preferably from 2 to 7% by weight is employed, based on the weight of ethanol used. When employing the above proportions of a polyhydric alcohol, it will be found that from 1 to 5% by weight borax and preferably from 2 to 3% by weight borax based on weight of ethanol, can readily be dissolved in full-strength commercial ethanol to yield a non-corrosive antifreeze which will remain non-corrosive upon dilution with wa-

ter, e. g., from 1 to 4 parts of water per part of ethanol.

Where the expression "full-strength commercial ethanol" is employed, it is to be understood that the ethanol may contain denaturing ingredients and small proportions of water, usually about 5%. This ethanol is also known as "190 proof ethanol." Various other grades of ethanol may, of course, be employed.

In preparing the antifreeze compositions of the present invention, it has been found preferable to dissolve the borax first in a polyhydric alcohol, and thereafter to dissolve the resulting polyhydric alcohol-borax solution in the ethanol to be inhibited. In this manner, fully miscible, clear solutions are quickly and easily prepared. Alternatively, the ethanol may first be dissolved together with the polyhydric alcohol, and thereafter the borax can be incorporated to secure a clear solution. However, this latter method suffers from the disadvantage that the time required to effect solution is appreciably longer.

By first preparing a solution of borax in the polyhydric alcohol, any desired amount of borax may then be incorporated in the ethanol by incorporating a known amount of the borated polyhydric alcohol. Thus, for example, 23 parts by weight of borax are dissolved in 77 parts by weight of ethylene glycol. The resulting solution is miscible in all proportions with 190 proof ethanol. Another suitable composition is prepared by dissolving 43 parts of borax in 57 parts by weight of glycerol. The resulting clear solution can be admixed in all proportions with full-strength commercial ethanol and the mixture can then be diluted with water to about 40 per cent ethanol concentration, the usual antifreeze proportions. The resultant antifreeze mixture is fully inhibited against corrosion as will be shown by the following table:

Solution	Percent weight change in one week at 160° F.		
	Aluminum	Iron	Solder
Water.....	-.18	-1.70	0
40- alcohol.....	-.12	-1.52	-.01
40- alcohol.....			
.03 gram borax per 100 cc.....	+.07	-1.06	-.01
40- alcohol.....			
1.3 gm. borax per 100 cc.....			0
4.3 gm. glycol per 100 cc.....	-.07	-.21	

From the above tabulated data, it is apparent that corrosion of metals normally found in a cooling system is greatly inhibited by the practice of the present invention.

One of the prime advantages of the present invention lies in the fact that borax can be completely dissolved in the ethanol antifreeze as manufactured, and thereafter it is available in corrosion inhibiting proportions upon dilution with water. Heretofore it has not been practical to employ borax for inhibiting corrosion of ethanol antifreeze because it is so very slightly soluble in full-strength commercial ethanol that the amount required is precipitated as a sediment. Thus when the ethanol is poured into the automobile or other radiator, the borax is left behind in the container. However, by this invention, the borax is now uniformly distributed in solution and is available to prevent corrosion.

While as above described, the borax can be dissolved in the ethylene glycol in proportions as high as 23 parts borax to 77 parts glycol, it is apparent that larger amounts of glycol can be employed. The same holds true for the borax-glycerol solutions in which 47 parts by weight borax are dissolved in 53 parts by weight glycerol. Larger amounts of glycerol can of course be employed. In the practice of this invention, it is generally preferred to employ sufficient borax so that the final antifreeze when diluted has a borax concentration of from about 1.3 to 1.5 grams borax per 100 cc. Of course, more borax can be present without affecting the prevention of corrosion.

From the foregoing description, it is evident that a novel method has been provided for dissolving borax in any desired quantity in ethanol, and an ethanol antifreeze inhibited against corrosion by the employment of borax has likewise been provided.

Since many apparently different embodiments of the invention will be appreciated by one skilled in the art, it is obvious that various changes may be made without departing from the spirit and scope thereof.

I claim:

1. An antifreeze composition consisting essentially of from 2 to 7 parts by weight of ethylene glycol, 100 parts of ethanol, from 1 to 5 parts of borax and from 1 to 60 parts of water.

2. An antifreeze composition consisting essentially of from 2 to 7 parts by weight of ethylene glycol, 100 parts of ethanol, 2 to 3 parts of borax and 1 to 4 parts of water.

3. An antifreeze composition consisting of from 1.3 to 1.5 grams of borax per 100 cubic centimeters of aqueous ethanol, and about 77 parts by weight of ethylene glycol per 23 parts by weight of the said borax.

EDWIN HASTINGS KELLER.