

2,802,788

CLEANING COMPOSITION FOR AUTOMOTIVE COOLING SYSTEMS

Marcellus T. Flaxman, Whittier, Calif., assignor to Wilco Company, Los Angeles, Calif., a corporation of California

No Drawing. Application April 23, 1952, Serial No. 283,993

4 Claims. (Cl. 252—105)

This invention relates to compositions especially adapted to be employed in water solution for cleaning the cooling systems of internal combustion engines.

An object of the invention is to provide such a cleaning composition which will be readily soluble in water and will be capable of loosening, dissolving and removing iron rust and other oxide accumulations and residues such as calcium and magnesium deposits resulting from the use of hard water.

Another object of the invention is to provide such a composition which may be used in internal combustion engine cooling systems for a considerable number of hours, if desired, while maintaining effectiveness for the required cleansing purposes, and without producing any harmful effect on the parts of the cooling system. It is also an object to provide such a composition which will be effective to remove both iron rust and hard water deposits as indicated, and also to loosen oil and grease deposits which might have accumulated in the system, the composition containing an oil and grease emulsifier which is effective without significant foaming even though the cleaning solution remains in an automotive engine-cooling system for a considerable period.

Heretofore it has been difficult to clean cooling systems of internal combustion engines with a single cleaner where both iron rust and hard water deposits may be encountered, without using an acidic cleaner that will damage the metal parts of the system unless promptly neutralized with an alkali at the end of the cleaning period.

I have discovered that it is possible to use in a single cleaning composition of the type indicated a combination of: two types of sequestering agents which will be highly efficacious for the removal of both hard water deposits and iron rust by dissolving or peptizing relatively large amounts of such deposits; a reducing agent to aid in the above described solubilizing and sequestering of the iron oxides or rust; and an emulsifier of very low foaming characteristics capable of removing deposits of oil and grease. One of the two classes of sequestering agents consists of certain organic compounds, also known as chelating agents, while the second class consists largely of inorganic salts.

While several variations may be made in producing acceptable compositions, a specific, highly effective composition of the above indicated nature has been found to be the following:

Material	Percent by Weight	
	Range	Specific
Disodium ethylene diamine tetraacetate (organic sequestering or chelating agent).....	10-30	18
Sodium tripolyphosphate (inorganic sequestering agent).....		59
Sodium acid sulfite (reducing agent).....	70-50	20
Mixed mono- and di-oleic acid ester of polyoxethylene glycol of about 600 molecular weight (low foaming emulsifier).....	10-40	
	1-10	3
pH (Optimum 7.0-7.5).....	pH 6.5-10	pH 7.3

A practical operating range for the above composition, to yield an optimum pH between 7.0 and 7.5, is from 15% to 18% of the ethylene diamine tetra-acetate salt, about 60% of the tripolyphosphate, about 20% of the alkali sulfite, and about 2% to 4% of the mentioned glycol ester.

The composition is normally used in 2% to 4% water solutions. The resultant pH of the solution is important, inasmuch as it has been found that iron rust is best removed with the present type of material at a pH below about 8.0. Action above pH 8.5 is too slow to be practical. On the other hand, with a pH below 7, the removal of calcium and magnesium deposits is retarded and, in addition, with a pH below 7, care should be exercised to remove the cleaner from the system after cleaning because of corrosive effects which might otherwise develop later.

The optimum pH of such a composition will run from pH 7 to pH 7.5 or preferably about pH 7.3, although an over-all range, especially for some uses, may run between about pH 6.5 and an upper limit not to exceed pH 10. In addition to being too slow, another reason for not exceeding pH 10 is that the composition then becomes inadequate for removal of iron rust where substantial amounts exist. Below pH 6.5 or perhaps 7, the removal of hard water deposits is accomplished with greater difficulty and at the same time the material tends to be more corrosive, particularly toward cast iron and steel.

While the proportion of disodium ethylene diamine tetraacetate may be increased, about 20 parts along with about 50 or 60 parts of the sodium tripolyphosphate appear to represent the most desirable composition for cleaning the average cooling system, from both a functional and economical standpoint. The sodium acid sulfite is used in a higher indicated proportion when the anticipated amount of iron rust is particularly high, as the reducing action of this material on the higher oxides of iron assists in solution of the iron rust. The greater the anticipated proportion of oil and grease to be removed, the higher will be the proportion of the oleic acid ester or esters of polyoxethylene glycol constituting the emulsifier, although for average conditions 3% is considered adequate.

The pH will vary with changes in the relative proportions of the disodium salt of ethylene diamine tetraacetic acid and the sodium acid sulfite, and is best controlled by using a particular salt of the tetraacetic acid. For example, the unneutralized ethylene diamine tetraacetate yields dilute water solutions having a pH of about 2.3, the disodium salt solutions a pH of about 5.0, the trisodium salt a pH of about 8.4 and the tetrasodium salt a pH of about 10.3. Thus with this specific composition pH can readily be controlled by selection of the proper salt or mixture of salts. The effectiveness in removing deposits is not involved as it is proportional in any event to the amount of the ethylene diamine tetraacetic acid present. All of these materials are commercially available.

The organic chelating agent represented by the first item in the above table acts to sequester polyvalent metal ions and prevents their precipitation in otherwise unfavorable media. Such an agent also dissolves certain precipitated salts of the metals. Oxides of such metals as copper and iron appear to be put into solution. Members of this class of organic sequestering or chelating agents vary somewhat in effectiveness for solubilizing the different ions involved but are effective in chelating and taking into apparent solution relatively large amounts of the salts or compounds of calcium, magnesium and iron. These three metals are of primary interest with regard to the cleanliness of cooling systems. The ethylene diamine tetra-acetic acid and its salts are relatively stable in water solutions even at the boiling point.

The second item in the above formulation, the sodium tripolyphosphate, is an inorganic sequestering agent. It is effective in sequestering alkaline earth materials such as calcium and magnesium and is particularly effective, in combination with an organic chelating agent such as the first item, in promoting the solution of the calcium and magnesium salts deposited by hard water, although it is not particularly effective in dissolving the oxides of metals such as iron.

As has been mentioned, the ethylene diamine tetraacetate may be employed in the form of an acid or in the form of any available sodium salt, depending on the pH desired from a water solution of the final composition. Aside from the sodium salts, both the potassium and amine salts may be used.

In place of the preferred ethylene diamine tetraacetate, fairly satisfactory results may be obtained with corresponding proportions of sodium, potassium or amine salts of diethylene triamine pentaacetic acid or triethylene tetraamine hexaacetic acid. In addition to the above indicated group of salts, another group which may be used as chelating agents comprises salts of iminotriacetic acid and salts of hydroxyethyl iminodiacetic acid. With the first of these groups, mono-, di-, and tri-salts are formable and with the second the mono- and di-salts. Less desirable, but still effective, salts are those of gluconic acid. A similarly usable commercial organic chelating agent which might be employed in some connections is 2-thenoyltrifluoro-acetone.

With respect to the inorganic sequestering agent, the previously mentioned sodium tripolyphosphate has been found to be the preferable material for this purpose. However, it is possible to use with reasonably good results such materials as sodium tetraphosphate, sodium pyrophosphate, sodium hexametaphosphate, and corresponding potassium salts, all of which are reasonably satisfactory for dissolving or peptizing the hard water salts of calcium and magnesium. It would, of course, be in order, from the standpoint of speed and efficiency, to employ the organic chelating agents mentioned in place of these phosphates, but, since the cost of the former is in the order of four to six times that of the phosphates, and, since the phosphates are sufficiently satisfactory, particularly when used in combination with the organic chelating agents, the phosphates to the extent indicated are economically preferable.

Concerning the reducing agents, the described sodium bisulfite is generally preferred, although sodium sulfite is equally suitable when the pH of the mixture makes its use desirable. Less suitable for the purpose are materials such as sodium thiosulfate and ammonium thioacetate.

From the standpoint of the surface active agent or emulsifier, the preferred material is the mentioned oleic acid ester of polyoxethylene glycol, which is commercially obtainable as a mixture of the mono- and di-oleic acid esters (glycol molecular weight about 600). Although not preferred, other satisfactory acid esters of polyoxethylene glycol, wherein the glycol varies in molecular weight from about 200 to about 1,000, may be employed. The preferred acid is oleic acid, and less desirable acids are linoleic acid and linolenic acid. Other fatty acids are permissible so long as the esters are dispersible in water at the temperatures of use, namely in the order of 150° F. to 200° F. and usually around 170° F. to 180° F. All of these materials possess low foaming characteristics and have good detergent and emulsifying properties. They are used to remove by emulsification oil and grease deposits which have developed in the cooling systems to be cleaned.

The present composition is produced in dry form, and is used by dissolving in water in the cooling system to be cleaned or in water which is then introduced into the cooling system.

The present material is used in a concentration of about 2% to 4% in the water of the cooling system to be cleaned, and normally the concentration is about 3%. However, a higher concentration may be usefully employed under some circumstances, for example up to around 7% or 8%. The resultant pH is to be preferably between 7 and 7.5 because this results in satisfactory removal of deposits and at the same time any remaining residue presents less hazard from the standpoint of corrosion.

The use of sodium acid sulfite, or alternatively sodium sulfite, as the reducing agent permits still further adjustment of the pH. When adjustment to the desired pH of 7.3 or thereabouts cannot conveniently be obtained by selection of a particular salt of the aforementioned ethylene diamine tetraacetic acid, then either the sodium acid sulfite or sodium sulfite or a mixture of the two can be used as required to adjust the pH. The acid sulfite can, of course, be used when desirable along with sufficient caustic soda or other alkaline neutralizing agent for pH adjustment, according to requirements, as will be apparent to any chemist familiar with the components.

Compositions of this invention have been used with great effectiveness in the cleaning of all types of automotive cooling systems for the purpose of removing iron rust and scale. Depending upon the severity of the deposits of rust and scale, the time of treatment may be varied from about one-half hour to one and one-half hours or 6 hours or more up to a total of 18 to 25 hours, as conditions may require. Cleaning is effected by operating the engine with the indicated percentage of cleaning material in solution in the cooling system water. All types of cooling systems have been successfully cleaned including those of diesel and gasoline engines for trucks and busses having service records from 25,000 miles to 80,000 miles. In many instances one pound or more of scale has been removed and one pound or more of rust has been removed. The cooling system of a diesel electric locomotive having a capacity of 120 gallons has been successfully cleaned with the removal of about nineteen pounds of scale and about nine pounds of rust. Engines used for irrigation pumping, without radiators, but equipped for cooling of the circulating cooling liquid with a continuous supply of fresh cold water, have also been cleaned. Scale deposits in some areas where very hard water prevails are often very heavy, and long periods of treatment are required.

However, in all instances oil and grease deposits and scale and rust deposits have been removed so that subsequent lower operating temperatures have resulted and previous overheating conditions have been eliminated. In instances in irrigation engines where water passages were found almost closed by scale deposits, such passages have been cleared almost to their original size.

I claim as my invention:

1. A cleaning composition for automatic cooling systems consisting essentially of: disodium ethylene diamine tetraacetate, about 18%; sodium tripolyphosphate, about 59%; sodium acid sulfite, about 20%; and a mixed mono- and di-oleic acid ester of polyoxethylene glycol having a molecular weight of about 600, about 3%, each of the specified percentages being on a percent-by-weight basis.

2. A cleaning solution for automotive cooling systems consisting essentially of water containing about 2% to 4% of a cleaning composition dissolved therein, the solution having a pH between about 7.0 and about 7.5, the composition consisting essentially of: about 15% to 18% of a salt of ethylene diamine tetraacetic acid; about 60% of an alkali metal tripolyphosphate; about 20% of an alkali metal sulfite; and about 2% to 4% of mixed mono- and di-oleic acid esters of polyoxethylene glycol of about 200 to about 1,000 molecular weight, each of the specified percentages being on a percent-by-weight basis.

3. A cleaning composition for automotive cooling sys-

terms consisting essentially of: 10% to 30% of disodium ethylene diamine tetraacetate as an organic sequestering agent; 70% to 50% of sodium tripolyphosphate as an inorganic sequestering agent; 10% to 40% of sodium acid sulfite as a reducing agent; and 1% to 10% of mixed mono- and di-oleic acid ester of polyoxethylene glycol wherein the glycol molecular weight is about 600, a 2% to 4% water solution of the composition yielding a pH of about 7.0 to about 7.5, each of the specified percentages being on a percent-by-weight basis.

4. A composition as in claim 3 wherein the tetraacetate is about 15% to 18%, the tripolyphosphate is about 60%, the sulfite is about 20%, and the glycol ester is about 2% to 4%.

References Cited in the file of this patent

UNITED STATES PATENTS

1,967,394	Calcott et al.	July 24, 1934
2,215,814	Hall	Sept. 24, 1940
2,396,938	Bersworth	Mar. 19, 1946
2,472,684	Rossi	June 7, 1949

OTHER REFERENCES

- 10 The Modern Chelating Agent, Versene, pub. of Bersworth Chem. Co., Framingham, Mass., Tech.-Bull. No. 1 (1949), pages 1(a) and 8-11.

Polyethylene Glycol Esters, pub. of Kessler Chem. Co. Inc., Philadelphia (1948), pages 8 and 26.