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RADIATOR CLEANING COMPOSITION AND METHOD

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This invention relates to a radiator cleaning composition and method for preventing the formation of and removing the deposits in automobile radiators and the passages in the engine block. It relates more particularly to a radiator cleaning composition containing an alkali-metal hexametaphosphate such, for example, as sodium hexametaphosphate or an alkali-metal tripolyphosphate such, for example, as sodium tripolyphosphate as an essential ingredient.

The present application is a continuation-in-part of my copending application Serial No. 721,314, filed April 19, 1934.

If a temporarily hard water is used in a radiator, that is, a water containing calcium and/or magnesium bicarbonates, the bicarbonates are converted, upon heating the water, into the corresponding carbonates which form deposits on the radiator and the cooling passages in the engine block. If permanently hard water, that is, water containing calcium and/or magnesium sulphates in solution, is used, it will, upon heating, attack the iron or other metal forming oxidized products or iron rust.

The majority of natural waters contain both temporary hardness and permanent hardness and may therefore cause either scale or corrosion, or both. Even though the water contains permanent hardness only, scale may be deposited by the vaporization of water in the radiator and its continuous replenishment with more water. The water in the radiator will eventually become saturated with calcium sulphate and deposit scale, particularly on the heated surfaces of the cylinder block. Corrosion may also occur with a water containing no permanent hardness.

In addition to the deposits of calcium and/or magnesium, and the oxide of the metals, the deposits are likely to contain grease, core sand, dirt, deposits from the water and deposits resulting from the use of certain anti-freeze compounds. Some or all of these deposits may be present and hinder the proper functioning of the cooling system.

My radiator cleaning composition contains as an essential ingredient an alkali-metal hexametaphosphate such, for example, as sodium hexametaphosphate or an alkali-metal tripolyphosphate such, for example, as sodium tripolyphosphate. In addition, the composition also preferably contains a water-soluble alkali and may also contain a corrosion inhibitor such, for example, as a tannin body, an alkali-metal sulphite, or an alkali-metal chromate or bichromate.

The alkali-metal hexametaphosphates or tri-

polyphosphates, for example sodium hexametaphosphate or sodium tripolyphosphate, have the property, when added to water containing calcium and/or magnesium, of sequestering the calcium and magnesium and forming therewith very slightly ionized soluble complexes, thereby preventing the precipitation of these metals. This property of alkali-metal hexametaphosphates and tripolyphosphates by which they can sequester the calcium in slightly ionized condition not only enables them to prevent the precipitation of calcium and magnesium, but imparts to water so treated the property of dissolving or peptizing any calcareous deposits which have already formed. The alkali-metal hexametaphosphates and tripolyphosphates have therefore a solvent effect on any deposits by virtue of their effect in maintaining the water continuously unsaturated with respect to these deposits. This solvent effect on the calcareous deposits loosens the deposits and any corrosion products intermixed therewith and enables the other ingredients of the radiator cleaning composition to more effectively attack other deposits such as dirt and grease which may be embedded in the calcareous deposits.

My composition preferably contains a water-soluble alkali in addition to the alkali-metal hexametaphosphate or tripolyphosphate. Any suitable alkali may be employed, for example, among others, trisodium phosphate, sodium carbonate, borax, modified soda (a mixture of sodium carbonate and sodium bicarbonate or caustic soda), sodium silicate, sodium bicarbonate, sodium ortho- and metasilicates, sodium metaborate, sodium normal pyrophosphate, and sodium hydroxide. The corresponding salts of other alkali-metals may be used in place of the sodium salts. The preferred alkalis are trisodium phosphate, sodium carbonate, sodium orthosilicate and sodium metasilicate. The silicates, in addition to being good alkalis, exercise an inhibitive influence on corrosion of soft metals such as aluminum cylinder heads. The preferred alkalis, as well as some of the others mentioned, act as buffering agents to prevent too great acidity or alkalinity in the water solution of the radiator cleaning composition, thereby maintaining the solution at a pH value which is most effective for preventing corrosion or for preventing the formation of scale or for causing dissolution of scale which has already been formed.

The alkali in my composition protects the metal against corrosion and acts as a saponifying, detergent and peptizing agent on any grease

or oil which may be present. It also acts as a peptizing and detergent agent on iron rust and clay and other dirt which may form mud.

Tannins, pseudo tannin, alginates and similar compounds, may be used in my composition either in place of or in addition to the alkali. As suitable tannins, I mention quebracho extract, cutch and logwood, although other tannins or similar materials may be employed. These materials are referred to herein as "tannin bodies," the term being intended to include not only the tannins, pseudo tannins or alginates, but also other compounds having similar properties. These tannin bodies, like trisodium phosphate and sodium carbonate and other buffering salts, act as buffering agents to prevent too great acidity or alkalinity in the water, and also act as dispersive agents on calcium precipitates such as calcium phosphate. The tannin bodies are capable of holding in colloidal solution a considerable amount of precipitated hardness. In addition, the tannin bodies absorb oxygen, thereby decreasing the tendency of the metal to corrode. Alkali-metal sulphites, for example, sodium sulphite, also have the property of absorbing oxygen and may be used in place of or in addition to the tannin bodies.

As a specific example of my composition, I may use 2 oz. of sodium hexametaphosphate or sodium tripolyphosphate or a mixture thereof, 1 oz. of trisodium phosphate, and $\frac{1}{2}$ oz. of sodium sulphite. As another example, I may use 2 oz. of sodium hexametaphosphate or sodium tripolyphosphate, 1 oz. of sodium carbonate, and $\frac{1}{2}$ oz. of sodium sulphite. I may use in place of the sodium sulphite in either of these examples the same amount, namely, $\frac{1}{2}$ oz., of a tannin body such as quebracho extract. A further example is 2 oz. sodium hexametaphosphate, $2\frac{1}{2}$ oz. sodium metasilicate, and 2 oz. of quebracho extract.

Although it is preferred that the composition contain an alkali, this may be omitted where the composition is to be used simply to flush out the radiator and engine jacket so as to remove the scale, as contrasted with being kept in the radiator for long periods of time in order to prevent the formation of scale. Where the composition is to remain in the radiator for long periods of time, there is a tendency for the hexametaphosphate or tripolyphosphate to revert to the orthophosphate. Enough alkali may be used in the composition to offset any undesirable acidity developed by the reversion of the hexametaphosphate or tripolyphosphate. The corrosion inhibitors may likewise be omitted where the composition is to be used merely for flushing out the radiator and will not remain in the system for a long period of time.

I may also use in my composition alkali-metal chromates or bichromates such, for example, as sodium chromate or sodium bichromate. These materials act as buffering agents to prevent too great acidity or alkalinity in the water and, in addition, have the property of forming films on iron which protect it against corrosion.

Inhibitors such as quinoline and substituted quinolines, such as quinoline ethiodide, or other coal-tar derivatives and acid sludges from the washing of petroleum and coal-tar distillation products, such as are used in the pickling of iron and steel, may also be employed in my composition, these inhibitors having the property in case too great activity develops of preventing attack on the metal, but allowing the solution to

attack and dissolve the rust. These materials are, in general, basic nitrogen compounds of high molecular weight. For simplicity, I shall use the term "nitrogen base inhibitor" to designate these inhibitors with the intent that it will include not only the aliphatic amines, such as n-tributyl, n-diamyl amine, n-triamyl amine, etc., and the aromatic amines, such as aniline, pyridine or quinoline, etc., but also the complex nitrogen base sludges formed in the acid washing of petroleum and coal-tar distillation products.

The proportions of the various ingredients may be varied widely according to the type of deposit which it is desired to dissolve or prevent. The quantities given in the examples are suitable for use in a radiator having a capacity of 5 gal. where it is desired to simply maintain the radiator clean. If, however, it is desired to dissolve a deposit which has already formed, or if the radiator has a greater capacity than that given, the amount of composition should be increased.

The alkali-metal hexametaphosphate which I prefer to use is in the soluble sodium hexametaphosphate sometimes called "Graham's salt." The sodium hexametaphosphate is assumed to be a complex of the general formula $\text{Na}_2(\text{Na}_4\text{P}_6\text{O}_{18})$, although some authorities believe that salts of the formulas $\text{Na}_5(\text{NaP}_6\text{O}_{18})$ and $\text{Na}_4(\text{Na}_2\text{P}_6\text{O}_{18})$ may also be present. Sodium hexametaphosphate in readily soluble glassy form may be prepared by strongly heating monosodium dihydrogen orthophosphate and rapidly cooling the molten mass.

The alkali-metal tripolyphosphates are chemical compounds of the formula $\text{M}_3\text{P}_3\text{O}_{10}$ in their anhydrous form, in which M represents an alkali-metal. Sodium tripolyphosphate is the most common and important of the alkali-metal tripolyphosphates. Chemical and X-ray analyses show that sodium tripolyphosphate is a definite chemical compound which is distinct from both sodium hexametaphosphate and sodium pyrophosphate and that it is not a mixture of the two. Sodium tripolyphosphate is fusible and may be solidified by very rapidly cooling in a glassy amorphous form. Under slower cooling it solidifies in the form of crystals. The glass may be converted into crystal form by annealing. Sodium tripolyphosphate forms a crystalline hydrate of the general formula $\text{Na}_5\text{P}_3\text{O}_{16}\text{H}_2\text{O}$. Sodium tripolyphosphate is colorless, appearing white in the granulated crystalline form. When crushed it forms a free-flowing granular mass. By suitable precautions it may be produced in a mass which readily disintegrates into its constituent fine crystals. Sodium tripolyphosphate is not deliquescent and particularly in its hydrated form may be preserved indefinitely in ordinary atmospheres without caking or picking up moisture. Sodium tripolyphosphate is readily water-soluble in both its glassy and crystalline forms.

The alkali-metal metaphosphates and tripolyphosphates are "molecularly dehydrated phosphates" as such term is employed in Hall and Jackson Patent No. 1,903,041. For example, sodium metaphosphate (NaPO_3) may be considered as derived from monosodium dihydrogen orthophosphate by the removal of water of constitution. Likewise, sodium tripolyphosphate may be similarly considered as derived by molecular dehydration of a mixture of orthophosphates which is intermediate in acidity between the monosodium dihydrogen orthophosphate and the disodium monohydrogen orthophosphate. The meta-

phosphates and tripolyphosphates may be regarded as salts of condensed or molecularly dehydrated phosphoric acids which have been molecularly dehydrated to a greater extent than pyrophosphoric acid.

Sodium tripolyphosphate has several advantages over sodium hexamethaphosphate in a radiator cleaning composition. Sodium tripolyphosphate is not hygroscopic, as is sodium hexametaphosphate. Particularly in its hydrated form, sodium tripolyphosphate may be preserved indefinitely in ordinary atmospheres without caking or picking up moisture. Furthermore, it is much more stable in highly heated alkaline solutions than sodium hexametaphosphate and therefore does not revert to the orthophosphate form nearly as rapidly as the hexametaphosphate. Also, it is not necessary, in making sodium tripolyphosphate, to resort to the drastic chilling which is required in producing the glassy sodium hexametaphosphate.

While I prefer to use sodium hexametaphosphate or tripolyphosphate, the corresponding salts of the other alkali-metals such as those of potassium, lithium and ammonium may be used.

I have specifically described certain preferred embodiments of my invention. It is to be understood, however, that the invention is not limited to the preferred examples which have been given by way of illustration only, but that the

invention may be otherwise embodied or practiced within the scope of the following claims.

I claim:

1. A radiator cleaning composition containing effective amounts of an alkali-metal hexametaphosphate and a water-soluble alkali.

2. A radiator cleaning composition containing effective amounts of an alkali-metal hexametaphosphate, a water-soluble alkali, and a corrosion inhibitor of the group consisting of a tannin body, an alkali-metal sulphite, an alkali-metal chromate, and an alkali-metal bichromate.

3. A method of cleaning automobile radiators which comprises treating the surfaces having ferruginous and calcareous deposits thereon with an aqueous solution containing effective amounts of an alkali-metal hexametaphosphate and a water-soluble alkali, whereby the deposits are dissolved without material injury to the treated surfaces.

4. A method of cleaning automobile radiators which comprises treating the surfaces having ferruginous and calcareous deposits thereon with an aqueous solution containing an effective amount of an alkali-metal hexametaphosphate, a water-soluble alkali, and a corrosion inhibitor of the group consisting of a tannin body, an alkali-metal sulphite, an alkali-metal chromate, and an alkali-metal bichromate.

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