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METHOD OF TREATING LIQUIDS AND METHOD OF STERILIZING INSTRUMENTS THEREWITH

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My invention relates to an improved composition of matter and to an improved method of treating liquids, such as water or aqueous solutions, for preventing the formation of rust, scale, or sludge upon containers in which they are utilized or are being treated. It also relates to an improved composition of matter for use with water or other liquids in sterilizing surgical instruments and to an improved method of sterilizing such instruments.

In sterilizing surgical instruments, it is the practice to either utilize the hot sterilization method in which the instruments are boiled in water or to utilize the cold sterilization method in which the instruments are placed in alcohol, in an aqueous solution of alcohol, or in an aqueous solution of quaternary ammonium salts. When water or an aqueous solution is utilized as the sterilizing agent, impurities in the water, such as magnesium, calcium, iron, and silicon, precipitate out as insoluble compounds, thereby forming a scale or sludge-like coating upon the walls of the sterilizer and upon the instruments being sterilized which is difficult to remove, and this is particularly true if silicon is present because when silicon compounds precipitate as silica or an insoluble silicate in a finely divided state, they form a binding agent for the other compounds.

Alcohols of the monohydric type, such as methyl, ethyl, propyl, or isopropyl alcohol, are also unsatisfactory as a liquid for sterilizing surgical instruments because such alcohols corrode and pit the instruments and dull the edges of sharp instruments, such as blades or hypodermic needles. When my improved composition is utilized in combination with an alcohol of the type mentioned, or with an alcohol solution, however, it forms during sterilization a protective, wax-like coating upon the instruments which prevents pitting or dulling of the points or cutting edges of such instruments.

While my improved composition is particularly adapted to be utilized as an addition to water, alcohol, a mixture of alcohol and water, or aqueous solutions of quaternary ammonium salts for sterilizing surgical instruments, in a broader sense, it is not to be limited in that respect because it is effective in preventing the formation of scale, sludge, or rust in the treatment of water for any desired purpose. It may, for instance, be utilized to prevent the formation of scale, sludge, or rust on the interior walls of boilers and their connecting tubes, or on the inner wall of the coils of domestic water heaters or refrigerating apparatus in which water is being treated or circulated.

It is therefore an object of the present invention to provide an improved composition of matter for use in treating water, alcohol, or aqueous solutions of various types to prevent the formation of sludge, scale, or rust.

Another object of the invention is to provide an improved method of sterilizing surgical instruments to prevent the formation of rust, scale, or sludge upon the instruments and particularly upon the joints of moving parts and to provide upon the instruments and upon the

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inner wall of the sterilizer in which they are being treated a thin, wax-like film which attains a high polish when the surface of the instruments and the inner wall of the sterilizer in which they were treated is rubbed with a dry cloth, such as, for instance, in drying them.

A further object of my invention is to provide an improved method of treating water or aqueous solutions which contain water hardening agents to prevent the separation of such hardening agents in the form of scale, sludge, or rust on the inner wall of the container in which such water is being treated, or on the inner surface of coils, tubes, or other passageways in which the water is circulated.

Other objects and advantages of my invention will be apparent as the specification proceeds.

In my improved composition, I utilize a water-soluble amine that has a higher boiling point than water, and for best results, the amine should have a boiling point that is substantially in excess of the boiling point of water. For instance, the amine which is utilized may have a boiling point ranging from approximately 125° to 360° C. or higher. Amines in which an alcohol group or an ether group is substituted for one or more of the hydrogen atoms in ammonia or an amine have been found to be suitable. For instance, I may utilize an ethanolaniline in which a single ethanol group is substituted for one of the hydrogen atoms in an amine or in ammonia, such as monoethanolamine, diethylethanolaniline, diethylethanolaniline, or aminoethylethanolaniline, or an ethanolaniline in which an ethanol group is substituted for each of two hydrogen atoms in an amine or in ammonia, such as diethanolamine or methyldiethanolamine, or I may utilize an amine in which an ether group is substituted in ammonia for two of the hydrogen atoms, such as morpholine. I may also utilize water-soluble amines in which a propyl alcohol group is substituted for one or more of the hydrogen atoms in ammonia to form the amine, such as monoisopropanolamine, diisopropanolamine, or triisopropanolamine. I may also utilize a mixture of two or more of the amine compounds. For instance, I may utilize the commercial grade of triethanolamine which contains from approximately 80% to 90% of triethanolamine, from approximately 2% to 5% but usually less than 2½% of monoethanolamine, and from 11% to 20% but usually less than 15% of diethanolamine. It will be noted the amines mentioned contain at least two but not more than nine carbon atoms. When the amine is in the solid state at normal temperatures, it may be melted or dissolved in water before being utilized.

Triethanolamine, either in its pure state or in any one of its commercial forms, has been found to be particularly suitable for use in my composition because it is a liquid at normal temperature, is completely soluble in water, and has a boiling point of 360° C.

The amine compound is utilized in combination with an ether of a dihydric alcohol, such as an ethylene or diethylene glycol monoalkyl ether in which the alkyl radical may contain from one to four carbon atoms, such as ethylene glycol monomethyl, monoethyl, or monobutyl ether, or diethylene glycol monomethyl, monoethyl, or monobutyl ether. The glycol monoalkyl ethers mentioned are also completely soluble in water and have a boiling point which is substantially higher than that of water. They may, for instance, have a boiling point ranging from approximately 125° to 230° C. The diethylene glycol monoalkyl ethers have a boiling point substantially in excess of the ethylene glycol monoalkyl ethers and are therefore more desirable for use in water that is being boiled or heated to a comparatively high temperature.

There is also present in my improved composition sodium nitrite in proportions sufficient to prevent the

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formation of rust when the composition is added in a small amount to water or to an aqueous solution.

In preparing my improved composition, the amine and the ether of the dihydric alcohol may be present in approximately the following proportions relative to each other:

Example 1

	Percent by volume
Amine compound	10 to 90
Ether of dihydric alcohol	90 to 10

and the sodium nitrite may be present in an amount ranging from approximately 20 to 40 grains per gallon of the composition or liquid which is to be treated. A sufficient amount of water is also present to dissolve the sodium nitrite.

When a small amount of the composition is added to water or an aqueous solution, the amine compound should be present in an amount sufficient to combine with water-hardening agents that are present in the water and to deposit upon the inner wall of the container or sterilizer and upon instruments being sterilized therein a wax-like film. On the other hand, the ether of the dihydric alcohol causes a dispersion of the amine and the hardening agent in the water or aqueous solution and determines to a certain extent the nature of the film that is formed, such as its hardness. Because the wax-like film that is formed should be comparatively thin, the amount of the amine should not be present in excessive amounts relative to the ether of the dihydric alcohol. A more desirable range of the amine and the ether relative to each other is as follows:

Example 2

	Percent by volume
Amine compound	25 to 75
Alkyl ether of ethylene or diethylene glycol	25 to 75

the sodium nitrite being present in an amount ranging from approximately 20 to 40 grains per gallon of the composition which is to be treated and sufficient water being present to dissolve the sodium nitrite.

There may also be added to the composition disclosed in Examples 1 and 2 a sufficient amount of a substance to minimize or eliminate the odor. For instance, terpeniol may be present in amounts ranging from approximately $\frac{1}{4}$ ounce to $\frac{3}{4}$ ounce to each quart of the composition.

The composition of the wax-like film that is formed upon the inner wall of the container and on the inner wall of passages in which water is being circulated and upon instruments being sterilized is not definitely known. It is helpful, however, when surgical instruments are being treated in the usual sterilizer because it prevents the formation of rust or scale upon the instruments. It also prevents pitting and dulling of instruments which are sterilized with alcohol or an aqueous alcohol solution. From extended research, I have found that when triethanolamine, either in the pure or in its commercial form in which some monoethanolamine and diethanolamine are present, is utilized as the amine in combination with diethylene glycol monomethyl ether, the wax-like film that is formed upon the sterilizer is comparatively thin and that upon removal of the instruments from the sterilizing bath and the solution from the sterilizer, both the instruments and the inner wall of the sterilizer may be wiped with a dry cloth to form a bright polish.

The following is a specific example of a composition that I have found to be especially suitable for use in sterilizing surgical instruments:

Example 3

	Percent by volume
Triethanolamine	25
Diethylene glycol monomethyl ether	50
Saturated aqueous solution of sodium nitrite	25

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to which may be added 2 ounces of terpeniol to each gallon of the composition.

As previously stated, my improved composition may be utilized as an addition to water which is being converted into steam in the usual steam boilers and their connecting tubes or in water being heated in domestic water heaters, or water, or an aqueous solution which is being passed through coils for refrigerating apparatus, and has particular application in the sterilization of surgical instruments in water, alcohol, aqueous-alcoholic solutions, or aqueous solutions of quaternary ammonium salts. Quaternary ammonium salts and their use in the sterilization of surgical instruments is well known in the art and numerous examples of such salts have been given in the literature. See, for instance, vol. 68, pages 753 to 759 of the American Chemical Society Journal.

The amount of the composition which is utilized in treating water, alcohol, or aqueous solutions containing alcohol or quaternary ammonium salts will of course depend upon the hardness of the water being treated. For sterilizing surgical instruments, I may, for instance, utilize from approximately one-fourth to two ounces for each gallon of water. For treating larger bodies of water, such as the feed water for boilers, I may utilize from approximately $\frac{1}{2}$ gallon to two gallons for each 260 gallons of feed water.

The following specific example will serve to illustrate and explain my invention when the composition is utilized to sterilize surgical instruments. Approximately two ounces of the composition disclosed in Example 3 were added to approximately two gallons of water which was boiled in a sterilizer in which surgical instruments were placed. After boiling the water for a period of approximately twenty minutes, it was found that the instruments were free from scale and rust, and no scale, sludge, or rust had precipitated or formed on the inner wall of the sterilizer or upon the instruments. The instruments were then withdrawn from the sterilizing liquid and it was found that a thin wax-like film had formed upon their surfaces. Upon drying the instruments with a towel, they attained a high polish. The dried instruments, including the joints and moving parts, were completely free from rust, scale, and sludge.

Upon removing the aqueous solution from the sterilizer, it was found that the inner wall of the sterilizer was free from rust, scale, and sludge, and was coated with a thin, wax-like film which attained a high polish when the inner wall of the sterilizer was wiped with a dry cloth.

In view of the thin, wax-like film that is formed upon the instruments and the inner wall of the sterilizer by my improved process, syringes, blades and hypodermic needles may be sterilized by my improved method without pitting or dulling the points or cutting blades of the instruments and this is true even though the sterilizing medium is formed completely or partially of a monohydric alcohol, such as ethyl alcohol.

What I claim is:

1. The method of treating surgical instruments in an aqueous solution containing hardening agents which comprises adding to the aqueous solution from approximately one-fourth ounce to two ounces per gallon of a composition which is soluble in the aqueous solution and then immersing the surgical instruments therein, said composition comprising a water soluble aliphatic amine having a higher boiling point than water and which contains at least two but not more than nine carbon atoms, a water soluble alkyl ether of a dihydric alcohol having a higher boiling point than water in which the alkyl group contains at least one but not more than four carbon atoms, and sodium nitrite, said amine and ether being present in the composition in proportions ranging from approximately 10% to 90% by volume of the ether to 10% to 90% by volume of the amine and the amine being present in the composition in an amount sufficient to combine with the hardening agent in the aqueous solu-

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tion and to form a film upon the instruments being treated and the ether being present in the composition in an amount sufficient to cause dispersion of the amine in the aqueous solution and to influence in the presence of the amine the physical properties of the film that is formed on the instrument, and the sodium nitrite being present in the composition in an amount to provide approximately twenty grains to forty grains for each gallon of the liquid to be treated and sufficient to prevent the formation of rust upon the instruments, and then removing and polishing the instruments after a film has been formed thereon.

2. The method of treating surgical instruments in an aqueous solution containing a monhydric alcohol and hardening agents which comprises adding to the aqueous alcohol solution from approximately one-fourth to two ounces of water soluble composition to each gallon of the aqueous solution and immersing the surgical instruments therein, said composition comprising a water soluble amine containing at least one aliphatic alcohol group and having a boiling point higher than water and which contains at least two but not more than nine carbon atoms, a water soluble alkyl ether of a dihydric alcohol having a higher boiling point than water in which the alkyl group contains at least one but not more than four carbon atoms, and sodium nitrite, said amine and ether being present in the composition in proportions ranging from approximately 75% to 25% by volume of the ether to 25% to 75% by volume of the amine, and the amine being present in the composition in an amount sufficient to combine with the hardening agents in the aqueous solution being treated and to form a film upon the instruments and the ether being present in the composition in an amount sufficient to cause dispersion of the amine in the aqueous solution and to influence in the presence of the amine the physical properties of the film that is formed on the instruments, and the sodium nitrite being present in the composition in an amount to provide from approximately twenty grains to forty grains for each gallon of the aqueous solution and sufficient to prevent the formation of rust upon the instruments, and then removing the instruments from the aqueous solution after a film has been formed thereon and polishing them.

3. The method of treating surgical instruments in an aqueous solution containing hardening agents which comprises adding to the aqueous solution from approximately one-fourth to two ounces of the water soluble composition to each gallon of the aqueous solution and immersing the surgical instruments therein, said composition comprising a water soluble aliphatic amine containing at least one ethanol group and having a boiling-point higher than water and which amine contains at least two but not more than nine carbon atoms, a water soluble alkyl ether of a diethylene glycol in which the alkyl group contains at least one but not more than four carbon atoms, and sodium nitrite, said amine and ether being present in the composition in proportions ranging from approximately 75% to 25% by volume of the ether to 25% to 75% by volume of the amine and the amine being present in the composition in an amount sufficient to combine with the hardening agents in the aqueous solution and to form a film upon the instruments and the ether being present in the composition in an amount sufficient to cause dispersion of the amine in the aqueous solution and to influence in the presence of the amine the physical properties of the film that is formed on the instruments and the sodium nitrite being present in the composition in an amount to provide from approximately twenty grains to forty grains for each gallon of the aqueous solution and sufficient to prevent the formation of rust upon the instruments, removing the instruments from the aqueous solution after a film has been formed thereon, and then polishing the instruments.

4. The method of treating surgical instruments in an aqueous solution containing hardening agents which com-

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prises adding to the aqueous solution from approximately one-fourth to two ounces of the water soluble composition to each gallon of the aqueous solution and immersing the surgical instruments therein, said composition comprising a water soluble ethanol amine having a boiling point higher than water and which contains at least two but not more than nine carbon atoms, a water soluble alkyl ether of diethylene glycol in which the alkyl radical contains at least one but not more than four carbon atoms, and sodium nitrite, said amine and ether being present in the composition in proportions ranging from approximately 75% to 25% by volume of the ether to 25% to 75% by volume of the amine and the amine being present in the composition in an amount sufficient to combine with the hardening agents in the solution and to form a film upon the instruments and the ether being present in the composition in an amount sufficient to cause dispersion of the amine in the aqueous solution and to influence in the presence of the amine in the solution the physical properties of the film that is formed on the instruments and the sodium nitrite being present in the composition in an amount to provide from approximately twenty grains to forty grains of each gallon of the aqueous solution, boiling the mixture for a sufficient time to sterilize the instruments and to form a wax-like film on the instrument and then removing the instruments from the aqueous solution and polishing them.

5. The method of treating water containing hardening agents to maintain the hardening agents in solution during the heating of water in a boiler to form steam and to prevent the formation of scale and sludge on the inner wall of the boiler or passages through which the water is circulated, which comprises adding to the water from approximately one-fourth to two ounces of a water soluble composition for each gallon of water being treated, said composition comprising a water-soluble amine having a higher boiling point than water and which contains at least one aliphatic alcohol group and at least two but not more than nine carbon atoms, a water soluble alkyl ether of a dihydric alcohol in which the alkyl radical contains at least one but not more than four carbon atoms, and sodium nitrite, said amine and ether being present in the composition in proportions ranging from approximately 75% to 25% by volume of the ether to 25% to 75% by volume of the amine and the amine being present in the composition in an amount sufficient to combine with the hardening agents in the water being treated to form a film upon the walls of the boiler and the ether being present in the composition in an amount sufficient to cause dispersion of the amine in the water and to influence in the presence of the amine the physical properties of the film that is formed and the sodium nitrite being present in the composition in an amount to provide from approximately twenty grains to forty grains for each gallon of the water being treated.

6. The method of treating water containing hardening agents to maintain the hardening agents in solution during the heating of water in a boiler or water passages to form steam and to prevent the formation of scale and sludge on the inner wall of the boiler or passages through which the water is circulated which comprises adding to the water from approximately one-fourth to two ounces per gallon of the water being treated a water soluble composition, said water soluble composition comprising an amine containing at least one ethanol group which amine has a higher boiling point than water and which contains at least two but not more than nine carbon atoms, a water soluble alkyl ether of diethylene glycol in which the alkyl group contains at least one but not more than four carbon atoms, and sodium nitrite, said amine and ether being present in the composition in proportions ranging from approximately 75% to 25% by volume of the ether to 25% to 75% by volume of

the amine and the amine being present in the composition in an amount sufficient to combine with the hardening agents in the water being treated to form a film upon the walls of the boiler or the passages through which water is being circulated and the ether being present in the composition in an amount sufficient to cause dispersion of the amine in the aqueous solution being treated and to influence in the presence of the amine in the water being treated the physical properties of the film that is formed, and the sodium nitrite being present in the composition in an amount sufficient to provide from approximately twenty grains to forty grains for each gallon of water being treated and in an amount sufficient to prevent the formation of rust on the walls of the boiler and the passages through which the water is circulated.

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