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COMPOSITION FOR CLEANING METAL

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This invention relates to a composition for cleaning metal and more particularly to a composition which is particularly adapted for the cleaning of vertical surfaces of metal.

A variety of metal cleaning compositions have heretofore been proposed. Compositions have been disclosed which include a detergent or other material for removing oil from the metal surface and an acid for dissolving oxides, sulfides and other products of corrosion from the metal surface. The problem of retaining such compositions on vertical metal surfaces in films of sufficient thickness to clean the surface has been recognized and compositions have been prepared in the form of heavy pastes by including in their formulations various thickening materials, such as, boiled starch, dextrin and various gums. Such compositions have been prepared in which bentonite, infusorial earth, tripoli and other earthy materials have been included for both their thickening effect and their mild abrasive properties. These paste compositions have had the disadvantage of being difficult to apply uniformly to a metal surface, particularly one of irregular contour, by reason of their heavy consistency and less satisfactory to apply than the more fluid compositions which flow off a vertical surface before the various products of corrosion are removed.

It is the object of this invention to provide an improved composition which is an efficient cleaner for metal surfaces and which avoids both the disadvantages of the prior fluid metal cleaning compositions and those of the heavy paste compositions when used for cleaning vertical metal surfaces.

The metal cleaning compositions in accordance with this invention comprise four essential ingredients, an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2}, a suitable surface-active agent, bentonite and water, in amounts and so proportioned to produce a thixotropic gel.

These compositions become fluid when subjected to mechanical work in applying them to a metal surface, but become gels when left at rest, due to their property of thixotropy. Unlike the heavy paste compositions heretofore prepared for the cleaning of vertical metal surfaces, these compositions can be spread in a uniform, thin film over a vertical surface to be cleaned with relatively little labor, and unlike permanently fluid cleaning compositions they do not drain from the surface, but remain thereon to do an efficient job of removing the oxides, sulfides and other products of corrosion from the metal. Further, their fluidity during application to a metal surface allows the surface-active agents and the bentonite to be fully effective in removing any oil film on the metal, even in crevices and grooves, and allow the acid contained in their composition to react with the products of corrosion on all parts of the surface, thus assuring a uniformly cleaned surface.

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These metal cleaning compositions are the result of our discovery that within limited ranges of composition a thixotropic gel is produced by the four essential ingredients of our composition. We have found that the addition of certain surface-active agents to mixtures of bentonite and water increases their viscosity or thickens them provided that too great an amount is not used. Mixtures of these three ingredients, over certain ranges of proportions exhibit the properties of a gel, but do not have the property of thixotropy. On the other hand, mixtures of an acid, water and bentonite can be prepared which are gels, but they do not exhibit the property of thixotropy. It is only when all four of the ingredients are present that thixotropic gels can be produced, only when a suitable surface active agent is used, and only then when the proportion of each of these ingredients is within a critical range.

The acid which we utilize in our composition must have an ionization constant within the range of about 1×10^{-5} to 1×10^{-2} to form a thixotropic gel. Any acid having an ionization constant within this range is suitable and the particular acid utilized will be selected on the basis of its efficiency in dissolving the products of corrosion of the particular metal or group of metals to be cleaned. Phosphoric acid, acetic acid and oxalic acid are examples of readily available acids having ionization constants within the range of 1×10^{-5} to 1×10^{-2} which are suitable for use in our compositions. Strong acids, such as sulfuric acid and hydrochloric acid are unsuited for use in our compositions, since they will not form compositions which are thixotropic gels.

Acetic and phosphoric acids can be used interchangeably, practically speaking, on a pound for pound basis. Acetic acid is less desirable than phosphoric acid in these compositions because of its odor which is objectionable to many people. Oxalic acid is of limited solubility, being soluble only to the extent of about 10% in water. However, it is solid in form and particularly useful in the preparation of compositions in accordance with this invention in the form of dry powders to which the proper amount of water is added at the point of use.

Mixtures of acids having ionization constants within the range of about 1×10^{-5} and 1×10^{-2} may be used in the compositions in accordance with our invention and are particularly desirable in compositions intended for certain specific uses. Thus, compositions containing both oxalic and phosphoric acid are highly efficient for cleaning brass.

Bentonite, another of the essential ingredients of our composition, is a natural clay of the Pacific Coast States and is sodium montmorillonite. Of the many types of clay available, bentonite is the only one we have been able to locate which is suitable for use in the compositions in accordance with this invention. The standard bentonites are suitable for this use. However, we have found that a specially ground and screened, fine, granular bentonite such as, for example, may be prepared by the procedure described in U. S. Patent No. 2,036,617 to Bechtner and Hirschmann is particularly suitable for use in these compositions. This particular type of bentonite is not only advantageous in the rapidity with which it can be dispersed but also, in many cases, in that as much as 25% less is required than of the standard bentonites.

To be suitable for use in the compositions in accordance with this invention, the surface-active agent must be water-soluble and must not react with the acid contained in the composition. Further, it must retain its surface activity in an acidic aqueous medium and must have the synergistic property of increasing the apparent viscosity of a mixture of bentonite and water. Non-ionic and the cationic surface-active agents are, in general, useful in our compositions.

The anionic surface-active agents are, generally, not particularly suited for use in our compositions. Of that class, the ordinary fatty acid soaps are entirely excluded from use in our compositions since they are reactive with the acid present. Further, the anionic surface-active agents cannot be used when a corrosion inhibitor is included in the composition, since corrosion inhibitors are themselves cationic in nature and therefore reactive with anionic surface-active agents.

Although certain of the anionic surface-active agents may be suitable for use in our compositions which do not contain a corrosion inhibitor, those which we have studied, including sodium keryl benzene sulfonate, in which the keryl group has an average molecular weight equivalent to the dodecyl group, sold under the trade-name of Nacconol NRSF and sodium lauryl sulfate, sold under the name of Duponal ME, show only a very slight synergistic effect on the viscosity of a mixture of bentonite and water and have the objectionable property of causing air to be entrapped in the compositions to the extent of increasing its apparent volume by as much as one hundred per cent.

The surface-active agent which we utilize may be a single chemical compound or it may be one of the mixtures of compounds of closely related chemical structures characteristic of many of the commercially available surface-active agents. Further, we may use mixtures of two or more of the commercially available surface-active agents, which include two or more different compounds or groups of closely related compounds.

The degree of surface activity of the surface-active agent or mixture of surface-active agents which we utilize in our compositions need not be great. All surface-active agents of the non-ionic and cationic classes meeting the qualifications of non-reactivity with the acid present and surface activity in an aqueous acidic medium, tested in our investigation within the critical range of amounts set forth hereinafter, gave a gel-type product having thixotropic properties and smooth consistency, which showed no tendency to syneresis. The latter property is an important one, since syneresis will allow the aqueous solution of acid, surface-active agent and any other ingredients contained therein to drain out of the gel when deposited on a vertical surface and have the dual effect of decreasing the effectiveness of its action and of making the residual gel consisting principally of bentonite more difficult to remove from the surface.

The variety of surface-active agents useful in the compositions in accordance with this invention is so large that for the sake of brevity, we desire to supplement this disclosure by reference to the discussion of the indicated classes appearing in the treatise entitled "Surface Active Agents" by Anthony M. Schwartz and James W. Perry, published 1949 by Interscience Publishers Inc., New York, and to the review article entitled "Synthetic detergents" by John W. McCutcheon appearing page 811, volume 61, No. 5, of "Chemical Industries," dated November 1947, published by Maclean-Hunter Publishing Corporation, New York. However, a few of the typical products falling onto the various classes which are suitable for our purpose will be discussed.

A nonionic surface active agent which is well suited for use in our compositions is a closely related group of polyoxyethylene ethers of alkyl phenols, which may be exemplified by the formula $C_{10}H_{21}C_6H_4(OC_2H_4)_{12}OH$. A commercial product of this type is marketed under the name of Triton NE. A typical method of manufacture of non-ionic surface active agents of this class is the addition of ethylene oxide to a fatty alcohol, fatty mercaptan, fatty amine, alkyl phenol, thiophenol or substituted aniline. The number of moles of ethylene oxide added varies with different commercial products. Thus different commercial products of this class are produced by the addition of 6 moles, 7.5 to 8 moles, 20 moles and 30 moles of ethylene oxide, respectively, to one mole of dodecyl phenol. Related surface-active agents are produced by the condensation of 20 moles of ethylene oxide with one mole of oleyl alcohol and by the addition of 40 moles of ethylene oxide to one mole of castor oil, with the ethylene oxide forming an ether linkage with the ricinoleic acid residue at the 12 position. The production of non-ionic surface active agents by the addition of ethylene oxide to various molecules are shown, for example, in U. S. Patents 1,970,579; 2,213,417; 2,213,477; 2,129,709 and 2,205,021.

Other non-ionic surface-active agents which have been found suitable for use in our compositions are the fatty acid esters of the polyethylene glycols as described, for example, by U. S. 2,275,494. Commercial products of this class are sold under the trade-name "Neutronyx" and under the name "Gycaid." The higher molecular weight polyethylene glycols, particularly those having a molecular weight above 1000, are themselves non-ionic surface active agents suitable for use in our compositions. We have used the product known as "Carbowax 1500" which is a blend of equal parts of a liquid polyethylene glycol having an average molecular weight of

approximately 300 and a polyethylene glycol having an average molecular weight of 1340.

Other wetting agents of the nonionic class which are suitable are the anhydrosorbitol esters of fatty acids which have been solubilized by etherifying the free hydroxyl groups with ethylene oxide, such as, polyoxyethylene sorbitan monostearate, polyoxyethylene sorbitan tristearate, polyoxyethylene sorbitan monooleate and polyoxyethylene sorbitan trioleate. The unetherified anhydrosorbital esters of fatty acids which are water dispersible, such as sorbitan monolaurate and sorbitan monooleate, may be used in my compositions.

Cationic surface active agents which I may use in my composition include, for example, lauryl pyridium chloride, cetyl pyridinium bromide, the coconut fatty alkyl dimethyl benzyl ammonium chloride, the product of the acylation of an unsymmetrical dimethyl ethylene diamine with a fatty acid chloride, such as, oleic acid chloride, having the formula $C_{17}H_{33}CONHC_2H_4N(C_2H_5)_2$, the tertiary amino alcohols, such as triethanol amine, and dibutylaminoethanol and the fatty acid esters of tertiary amino alcohols, such as, stearyltriethanolamine, oleyltriethanolamine and the stearic acid ester of dibutylaminoethanol.

The proportion in which each of the four essential ingredients is used in our composition is of critical importance. The exact range of proportions over which each of the four essential ingredients may be used has been found to be substantially the same with all the combinations of acids and surface-active agents we have studied and we have found that the bentonite must be present within the range of about 2.5% to about 8.0% by weight of the total composition. The surface-active agent must be present in amount within the range of 2.5% to about 8.0%, by weight of the bentonite used. The acid must be used within the range of 2.5% by weight to the limit of its solubility in the water present but not in excess of 70%, by weight, of the total composition. Water must be present within the range of about 21%, by weight, to about 92.5% of the total composition, to make up the remainder of the composition.

Thus, the four essential ingredients of our composition must be within the following ranges to produce a thixotropic gel:

Bentonite – About 2.5% to about 8% by weight.
Acid_____ About 5.0% to about 70% by weight.
Surface active agent____ About 0.1% to about 0.8% by weight.
Water to make 100%.

Phosphoric acid can be used over the entire range of 2.5%, by weight, to 70%, by weight, of the total composition. On the other hand the limit of solubility of oxalic acid in water is about 10%, by weight, which limits the maximum percentage in which it can be used to about 9% by weight of the total composition.

While we have specified a variety of surface-active agents suitable for use in our compositions it is impossible to cover the entire field of such compounds which already number in the thousands, with additional ones being added continually. However, the suitability of any particular surface active agent can be readily determined by a simple test. Further, we have set forth the ranges of proportions over which the four essential ingredients of our composition have been found to give thixotropic gels. However, it can be expected that the exact limits of the ranges, particularly those for the bentonite and the surface-active agent, may vary somewhat with certain combinations of acids and surface-active agents. In any case, it is desirable to determine specific proportions for any combination used by testing the effect of varying amounts of the surface-active agent on the apparent viscosity of the composition. Both the test of a surface-active agent for suitability in our composition and the determination of the optimum proportions of the ingredients of our composition will be illustrated with the following formula:

	Lbs.
Bentonite	6.9
Phosphoric acid	19.3
Water	73.8

The addition of, for example, 0.15 lb. of the surface-active agent comprising a mixture of polyoxyethylene alkyl phenols sold under the name of Triton NE will appreciably thicken the mixture. The mixture exhibits thixotropic characteristics. Increased amounts of the Triton NE increases the thickening up to about 0.50 lb. at which the thickening reaches a maximum. Further additions have the effect of progressively thinning the mixture, so that when 1.25 lb. has been added the mixture is as thin as when no surface-active agent was present. Had this surface-active agent not exhibited a synergistic thickening of the mixture, and the resulting thickened mixture shown thixotropic properties, it would not be suitable for use in our compositions.

The exact amount of surface-active agent required to obtain maximum thickening varies with different agents and, in general, it is not desirable to utilize the amount which gives the exact maximum thickening, since the resulting manufacturing process becomes critical and difficult to control. We prefer to utilize slightly less of the surface-active agent than the amount required for maximum thickening.

In formulating the compositions in accordance with this invention it is desirable to correlate the amount of surface-active agent used with the amount of bentonite present, in addition to staying within the critical ranges of proportions. Thus, in a composition containing 5.2% by weight of bentonite we have found that 0.2%, by weight, of Triton NE gives a thixotropic gel of satisfactory consistency. The same consistency can be maintained with a reduction in the amount of bentonite used, by increasing the percentage of Triton NE added to the composition.

In addition to the four essential ingredients which comprise the improved metal cleaning composition in accordance with this invention, it may contain other materials, such as corrosion inhibitors, oils and abrasive materials. Corrosion inhibitors which we may use are, for example, aliphatic amines or quaternary ammonium compounds. For example, monoethanolamine, diethanolamine, triethanolamine, lauryl amine, and homologous compounds are suitable. Preferably, however, we use lauryl pyridinium chloride as the corrosion inhibitor in our composition.

The corrosion inhibitors are cationic surface-active agents. However, the amount required to inhibit corrosion is much less than that required to produce a thixotropic gel with bentonite and an acid. For the purpose of inhibiting corrosion about 0.025%, by weight, to about 0.25%, by

weight, of a corrosion inhibitor is used. When one or more corrosion inhibitors are included in our composition the surface-active agent used as an essential ingredient must be cationic or a small amount of a cationic agent must be used with a nonionic surface-active agent. A corrosion inhibitor in our composition markedly lowers the activity of the acid on a metal surface while the composition is in contact with it and passifies the surface of the cleaned metal to give it a marked resistance to reoxidizing or retarnishing.

A suitable oil, such as a light mineral oil, may be included in our composition to leave a residual oil film on the metal surface which is cleaned. Such a residual oil on the cleaned metal surface retards the subsequent corrosion of the surface. An amount of oil within the range of about 0.1% by weight to about 1.0% by weight will be found suitable for providing such a residual oil film.

Bentonite itself is a mild abrasive and polishing agent and is effective in removing oil and grease from metal surfaces, but the percentage which we can use is limited as already noted. However, we may include other abrasives in our composition and vary the particular ones chosen according to the condition and nature of the metal surface to be cleaned. The abrasive added may be varied from the mildly abrasive polishing agents, such as, infusorial earth and the finely divided iron oxide known as rouge, through coarser abrasives, such as, tripoli, powdered feldspar and the coarse grades of rouge, to the harsh abrasives, such as, pumice, powdered silica and Carborundum. The compositions containing the harsher abrasives do not polish the metal surface being cleaned and are used in compositions in accordance with this invention which are intended for cleaning heavily corroded metal surfaces.

The abrasives, other than bentonite, may be included in amount up to about 40% by weight, of the total composition. These abrasives cannot be used as substitutes for the bentonite in our composition, since they have no gel-forming properties. They are inert in the composition and are carried by the bentonite gel.

The compositions in accordance with this invention can be prepared by thoroughly admixing the bentonite, acid, surface-active agent and water, along with an abrasive and/or corrosion inhibitor where such are included in the composition, in a suitable mixer and then filling them into suitable containers, as collapsible tubes or jars for distribution to the user.

The examples given in the following table specifically illustrate suitable formulations of the compositions in accordance with this invention:

TABLE 1

Example No.	1	2	3
	Lbs.	Lbs.	Lbs.
Bentonite	6.9	5.2	5.2
Phosphoric acid (75%)	19.3	14.5	
Phosphoric acid (85%)			14.5
Triton NE (30%)	4.5	0.2	0.2
Silica, 350-mesh		34.8	34.8
Lauryl pyridinium chloride			0.05
Water	69.3	45.3	42.25
Total	100.0	100.0	100.00

Each of the examples given in Table 1 are thixotropic gels ready for use in the cleaning of metal surfaces.

In an alternate embodiment of my invention, we prepare the compositions in accordance with this invention in the form of a dry powder, using as the essential acid, an acid which is a solid at ordinary temperatures, such as, for example, oxalic acid, and instruct the user to add to the composition the correct amount of water to form a thixotropic gel. In following this embodiment of our invention we instruct the user to thoroughly stir the correct amount of water into the composition to dissolve the solid acid and the surface-active agent contained therein and then allow it to stand overnight before use. This embodiment of our invention is illustrated by the following example:

Example 4

	Lbs.
Bentonite	5.2
Oxalic acid	5.0
Silica, 350 mesh	34.8
Amino ester of a long chain fatty acid	0.2
Total dry mix	45.2
Water added by user	54.8
Total cleaner ready for use	100.0

The fact that the compositions in accordance with this embodiment of our invention are distributed to the user in the form of a dry powder permits the use of less expensive packages than with the compositions in the form of a gel and are cheaper to ship since they do not contain the water. However, they have the disadvantage of requiring the user to carry out the mixing operation.

From the foregoing disclosure of our invention, it will be appreciated that our improved thixotropic metal cleaning compositions are made possible by unexpected synergism between some of the ingredients thereof. Within the range of proportions with which we are concerned the addition of an aqueous solution of a suitable acid to a mixture of bentonite and water has only the effect on the viscosity of the mixture which can be expected from the viscosity of the acid and of the mixture. When a suitable surface-active agent is mixed with a mixture of bentonite and water a synergistic increase in the viscosity of the mixture takes place, but the mixture has no thixotropic properties. When an acid is added to such a thickened mixture of a surface-active agent, bentonite and water, or conversely when a suitable surface-active agent is added to a mixture of bentonite, acid, and water, the mixture takes on thixotropic properties. This is definitely a second synergistic action. Neither of these synergistic actions are predictable from the properties of the materials.

This application is a continuation-in-part of our abandoned application Serial No. 673,635, filed May 31, 1946.

What we claim and desire to protect by Letters Patent is:

1. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2} in amount on an anhydrous basis within the range of about 5%, by weight, of the

composition to the limit of its solubility in the said water, but not in excess of about 70%, by weight, of the said composition; and a water-soluble synthetic organic surface-active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially linear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid, and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition.

2. A composition in the form of a thixotropic gel for cleaning metal having suspended therein an inorganic abrasive other than bentonite and consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2} in amount on an anhydrous basis within the range of about 5%, by weight, of the composition to the limit of its solubility in the said water, but not in excess of about 70%, by weight, of the said composition; and a water-soluble synthetic organic surface-active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially linear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid, and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition.

3. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2} in amount on an anhydrous basis within the range of about 5%, by weight, of the composition to the limit of its solubility in the said water, but not in excess of about 70%, by weight, of the said composition; a water-soluble synthetic organic surface-active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially liear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid, and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition; and a corrosion inhibitor in amount within the range of about 0.025%, by weight, to about 0.25%, by weight, of the composition.

4. A dry powder adapted to form a thixotropic gel suitable for cleaning metal when intimately admixed with an amount of water within the range of about 21.0%, by weight, to about 92.5%, by weight, of the final composition, consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the final composition; an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2} which is solid at normal room temperatures in amount on an anhydrous basis within the range of about 5%, by weight, of the composition to the limit of its solubility in the said water, but not in excess of about 70%, by weight, of the said composition; and a water-soluble synthetic organic surface-active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially linear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is solid at normal room temperatures, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid, and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition.

5. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2} in amount on an anhydrous basis within the range of about 5%, by weight, of the composition to the limit of its solubility in the said water, but not in excess of about 70%, by weight, of the said composition; and a non-ionic surface-active agent in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

6. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; phosphoric acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; and a polyoxyethylene ether of an alkyl phenol within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

7. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; an acid having an ionization constant within the range of about 1×10^{-5} to about 1×10^{-2} in amount on an anhydrous basis within the range of about 5%, by weight, of the composition to the limit of its solubility in the said water, but not in excess of about 70%, by weight, of the said composition; and a catonic surface-active agent in amount within the range of about 2.5%, by weight, to about 8.0%, by

weight, of the bentonite present in the composition.

8. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; phosphoric acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; and a non-ionic surface active agent within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

9. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; phosphoric acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; and a cationic surface active agent within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

10. A composition in the form of thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; phosphoric acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; and a corrosion inhibitor within the range of about 0.025%, by weight, to about 0.25%, by weight, of the composition; and a cationic surface active agent within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

11. A dry powder adapted to form a thixotropic gel suitable for cleaning metal when intimately admixed with an amount of water within the range of about 21.0%, by weight, to about 92.5%, by weight, of the final composition, consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the final composition; oxalic acid in amount on an anhydrous basis within the range of about 5%, by weight, of the composition to the limit of its solubility in the said water, and a water-soluble synthetic organic surface-active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially linear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is solid at normal room temperatures, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid, and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition.

12. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; acetic acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70% by weight, of the composition; and a water-soluble synthetic organic surface active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially linear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition.

13. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; acetic acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70% by weight, of the composition; and a water-soluble synthetic organic surface active agent selected from the group consisting of non-ionic and cationic surface active agents and characterized by an essentially linear structure one end of which is hydrophobic and the other end of which is hydrophilic in character, which is not reactive with the said acid in aqueous solution, which retains its surface activity in the presence of the said acid and which has the characteristic of synergistically increasing the apparent viscosity of a mixture of bentonite and water, in amount within the range of about 2.5% to about 8.0%, by weight, of the bentonite present in the composition; and a corrosion inhibitor in amount within the range of about 0.025%, by weight, to about 0.25%, by weight, of the composition.

14. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; acetic acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70% by weight, of the composition; a corrosion inhibitor within the range of about 0.025%, by weight, to about 0.25%, by weight, of the composition; and a non-ionic surface active agent within the range of about 2.5%, by weight, to about 8.0% by weight, of the bentonite present in the composition.

15. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; acetic acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; lauryl pyridinium chloride within the range of about 0.025%, by weight, to about 0.25%, by weight, of the composition; and a polyoxyethylene ether of an alkyl phenol within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

16. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; phosphoric acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; a corrosion inhibitor within the range of about 0.025%, by weight, to about 0.25% by weight, of the composition; and a non-ionic surface active agent within the range of about 2.5%, by weight, to about 8.0%, by weight, of the bentonite present in the composition.

17. A composition in the form of a thixotropic gel for cleaning metal consisting essentially of bentonite in amount within the range of about 2.5%, by weight, to about 8.0%, by weight, of the composition; water within the range of about 21%, by weight, to about 92.5%, by weight, of the composition; phosphoric acid in amount on an anhydrous basis within the range of about 5%, by weight, to about 70%, by weight, of the composition; lauryl pyridinium chloride within the range of about 0.025%, by weight, to about 0.25%, by weight, of the composition; and a polyoxyethylene ether of an alkyl phenol within the range of about 2.5%, by weight, to about 8.0%, by weight of the bentonite present in the composition.

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