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DETERGENT COMPOSITION AND METHOD

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This invention relates to a detergent composition and method, and more particularly to a detergent composition having the property of controlling foaming and inhibiting gelling in commercial detergent solutions employed in the washing of bottles and the like.

In washing machines for washing bottles, pans, and the like, and particularly in dairy and baking equipment, detergent solutions are employed in the automatic or machine washers. The detergent solution normally employed is a strong caustic or highly alkaline solution. In any operation of this nature in which the articles to be washed are contaminated with saponifiable fatty matter, as is the case in dairy and bakery equipment, the fats become saponified during the washing operation to form sodium soaps by reaction with the caustic. The presence of the soap causes the solution to foam, the foam frequently occurring to such an extent as to overflow the washing machine tank. Furthermore it is the practice to continue to use the detergent solutions until they have become exhausted. During the use the soaps build up to such an extent that upon shutting down the machine for the night, the solution solidifies to a stiff gel. The difficulty of redissolving the gel is such that the solution is discarded long before it has ceased to be effective as a cleaner.

It has heretofore been suggested to use commercial anti-foaming agents, but those heretofore known have been insoluble in the solution, have only a very temporary effect, and have no effect upon the gelling of the soaps. Furthermore anti-foaming agents heretofore known, being insoluble, contaminated the articles being washed, generally by an oily film which remained on the washed article.

It has now been discovered that effective foaming control may be supplied, without the disadvantages of the previous foaming control agents, and at the same time gelling may be materially inhibited so that the detergent solution may be utilized for greatly increased periods. This control may be accomplished by the use of water soluble alkali metal salts of the alkyl esters of phosphoric acids. The preferred alkyl group is the octyl group. The preferred phosphoric acid is orthophosphoric acid. Other alkyl groups may, however, be employed such as the amyl, and the capryl, although these esters are markedly inferior to the octyl ester. The molecularly dehydrated phosphoric acids may likewise be employed, such as pyrophosphoric, metaphosphoric and polyphosphoric acids.

The compounds herein described as foaming and gelling inhibitors are also effective wetting agents and increase the cleaning efficiency of the detergent solutions.

Anti-foaming and anti-gelling control may be accomplished simply by adding a small amount of the acid octyl phosphate to a solution of any of the well known commercial alkaline detergents which include caustic soda.

As an example of the effect of the phosphates on foaming, a solution was prepared containing 3% caustic soda, 1.5% sodium carbonate, 0.025% linseed fatty acid, and the balance water. To one sample of this material 0.12% of mono-octyl orthophosphate was added and compared with an identical solution to which the phosphate had not been added. In each case four liters of the solution were placed in a 10" diameter glass cylinder and agitated by means of a circulating pump, withdrawing solution from the bottom of the cylinder and discharging into the top of the cylinder about 10" above the liquid level. A temperature of approximately 140° F. was maintained, this being approximately the temperature of commercial solutions. The solution containing the phosphate was continuously circulated for three days, during which time the foam did not rise higher than 1" above the liquid level and it was generally considerably lower than that. The solution which did not contain the octyl phosphate produced a foam which rose to a height of 10" and then overflowed the cylinder, within less than 10 minutes from the start of the circulation.

In a comparative test, using the same solution without the octyl orthophosphate, attempts were made to control the foam by the application of known foam inhibitors, for example of the tributyl phosphate type. These inhibitors broke the foam but their operation was only temporary and it was necessary to add new amounts of these inhibitors every few hours. The tributyl phosphate formed an oily film on the liquid.

In another test a solution was prepared containing 3% caustic soda and 0.05% linseed fatty acid. In the control, without the addition of the octyl phosphate, the foam rose to 10" and then overflowed the cylinder within 5 minutes. The addition of 0.08% of mono-octyl orthophosphate to the foaming solution produced a subsidence of the foam to about 1.5" within 5 minutes and no increase in the foam was observed for the duration of the test which was approximately 8 hours.

These tests were repeated with mixtures of mono and dioctyl orthophosphates, in substan-

tially the same total proportion, and the results were substantially the same.

Another aqueous test was made by employing a solution containing 3% caustic soda, 3% sodium carbonate, and 0.025% of a commercial foaming agent of the alkyl aryl sulfonate type. The foam was controlled by the addition of 0.25% sodium octyl orthophosphate so that during 36 hours of agitation the foam did not exceed 1.5" in height.

The foregoing tests were concerned only with foaming control. An additional series of tests on gelling control or inhibition are indicative of the value of the materials for that purpose.

For example a butterfat soap composition was prepared by melting 116.5 grams of butter and adding 32 grams of a 50% caustic soda solution. The mixture was heated and agitated for several hours until a thick soap paste formed. The mixture was continuously stirred and cooled and as cooling progressed the soap congealed in the form of granules including all of the products of the saponification reaction. The solution of this composition in a normal caustic detergent is, so far as has been ascertained, equivalent to the saponification which takes place in the washing of milk containers.

Test solutions of the soap paste so prepared were made by dissolving the paste in duplicate proportions of a 3% caustic soda solution which was maintained at 140° F. In each test one of the portions was used as a blank. In the other portion 0.5% of mono octyl sodium orthophosphate was added to the solution.

The solutions were allowed to cool overnight at room temperature and their gelling characteristics noted. In the control solutions gelling occurred at butter soap concentrations of less than 0.025%, and at a concentration of 0.10% a semi-solid gel set up. This gel became solid at concentrations of 0.25%.

In the other set of samples containing mono octyl sodium orthophosphate no gelling was noted below 0.25% butter soap concentration and a solid gel did not occur until a concentration of 0.5% butter soap was reached. Furthermore an uninhibited solution containing 0.25% butter soap, which had set up to a solid gel, did not clear up on reheating even for several hours, whereas the solid gel in the inhibited solution redissolved easily to a clear solution upon heating.

Other water soluble alkali metal salts of alkyl phosphate esters, particularly those containing more than four carbon atoms in the alkyl group are partially effective as foam inhibitors but are not as effective commercially as the octyl esters.

In general the ester salts of pyro and polyphosphoric acids, such as the octyl salts are satisfactory inhibitors but are not quite as stable as the orthophosphate ester. For example, 5 grams of dioctyl sodium pyrophosphate were added to 4 liters of a foaming solution containing 3% caustic soda, 3% sodium carbonate and 0.05% linseed fatty acid. The foam, which had reached a height of 12" before addition of the pyrophosphate ester salt broke to a trace after adding the compound but after one hour had risen to 2". A second addition of 5 grams of the dioctyl sodium pyrophosphate stabilized the foam at a height of 1.5 to 2.5" during an 8-hour test period at 140° F. In commercial practice it is preferred to introduce the foaming and gelling inhibitor into the initial detergent composition. A fused mixture of caustic soda and acid octyl phosphate in the desired proportions to give an anti-foaming and anti-gelling solution, when dissolved in water to yield a caustic concentration of 0.25% to 10%, provides a suitable commercial mixture, but is somewhat tacky and hygroscopic. The preferred commercial composition is non-hygroscopic and granular and may be prepared by mixing acid octyl phosphate with soda ash. For example 10 to 50 parts of mono octyl orthophosphate in paste form may be thoroughly admixed with 90 to 50 parts of soda ash to give a dry granular product. This product may then be dissolved in water with other alkaline agents such as caustic soda.

In all cases the acid ester may be employed or the ester salt. When the acid ester is employed it is neutralized by the soda ash or caustic alkali.

In most detergent operations, both foam and gel control are essential, but in some cases where little or no saponifiable matter is present, foam control alone is important. Concentrations of the octyl type inhibitor as low as 0.05% are effective for foam control in most alkali solutions. For gel control, concentrations of at least 0.25% are desirable. In either case concentrations above 1.0% do not increase the effectiveness of control either of foaming or gelling but the higher concentrations are not detrimental.

While the caustic soda concentration in the detergent solutions may range from 0.25% to 10%, it is preferred to use a 1% to 4% concentration of caustic soda for most commercial washing operations.

The use of sodium carbonate with the octyl sodium phosphate in caustic soda solutions increases the efficiency of foam control, improves the wetting power and the cleaning efficiency of the solution. The amount of octyl sodium phosphate required for effective foam control in a solution containing 3% NaOH and 3% Na_2CO_3 is only about half of that required where the sodium carbonate is absent. Ordinarily the amount of soda ash employed is from 2 to 10 times the amount of octyl sodium phosphate, inasmuch as a satisfactory commercial preparation of dry non-hygroscopic character can be prepared from mixtures of these two components within that range. The soda ash-octyl sodium phosphate composition may be used alone as a detergent composition but the caustic soda increases the effectiveness of the foam control.

The foregoing detailed description has been given for clearness of understanding only, and no unnecessary limitations should be understood therefrom.

What we claim as new, and desire to secure by Letters Patent, is:

1. An anti-foaming and anti-gelling detergent solution for use in automatic washing equipment for bottles, pans and the like, comprising water, from 0.25% to 10% by weight of the solution of caustic soda, and from 0.05% to approximately 1% by weight of a water soluble sodium salt of an octyl ester of a phosphoric acid as a foaming and gelling inhibitor.

2. A product as set forth in claim 1, in which the ester is dioctyl sodium pyrophosphate.

3. An alkaline detergent composition for use in automatic washing equipment for bottles, pans and the like, comprising a mixture of 10 to 50 parts by weight of mono octyl orthophosphate and 90 to 50 parts by weight of soda ash.

4. An anti-foaming and anti-gelling detergent

solution for use in automatic washing equipment for bottles, pans, and the like, comprising water, from 0.25% to 10% by weight of the solution of caustic soda, from 0.1% to 10% by weight of sodium carbonate, and from 0.05% to approximately 1% by weight of a water soluble sodium salt of an octyl ester of a phosphoric acid as a forming and gelling inhibitor.

5. A product as set forth in claim 4, in which the ester is mono octyl sodium orthophosphate.

6. An alkaline detergent composition for use in automatic washing equipment for bottles, pans, and the like, comprising a fused mixture of caustic soda and acid octyl phosphate in proportions to provide an anti-foaming and anti-gelling solution when dissolved in water to yield a caustic concentration of 0.25% to 10% by weight.

7. The method of cleaning bottles, pans and the like in automatic washing equipment which comprises washing such an article in a 0.25% to 10% caustic alkali solution to which has been added an amount of water soluble alkali metal salt of an alkyl ester of a phosphoric acid in sufficient quantity to inhibit foaming and gelling of saponified matter as it forms in the washing operation, the proportion of ester being from 0.05% to approximately 1% by weight of the solution.

8. The method as set forth in claim 7 in which the ester is an octyl ester.

9. The method as set forth in claim 7 in which the ester is an octyl ester of orthophosphoric acid.

10. A solution as set forth in claim 1 in which the proportion of caustic soda is from 1% to 4% and the ester is approximately 0.25%.

11. A solution as set forth in claim 4 in which the caustic soda is from 1% to 4%, the octyl ester is approximately 0.25% and the sodium carbonate is approximately 3%.

12. A solution as set forth in claim 1 in which the caustic soda is from 1% to 4%.

13. A solution as set forth in claim 4 in which the caustic soda is from 1% to 4%.

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