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DETERGENT COMPOSITION

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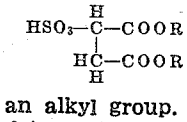
This invention relates to a new detergent composition which is specifically designed for domestic uses such as laundering, washing dishes, cleaning rugs and upholstery, washing woodwork and the like, but which is also suitable for wider uses in commercial operations requiring a substantially neutral detergent suitable for use in any hard water and resistant to the action of acids.

Objects of the invention are to produce a detergent which dissolves readily in hot or cold water, which possesses improved sudsing and foaming properties, which is stable and preferably noncaking upon storage and which is practically neutral and entirely harmless to the hands or to fabrics.

In United States Patent No. 2,028,091, dated January 14, 1936, issued in the name of A. O. Jaeger, there is described at length a class of esters of sulfodicarboxylic acids which have remarkable wetting and detergent properties in aqueous solutions when used in the form of their water-soluble salts. Although these esters produce a normal amount of foam when in aqueous solution, this foam is not stable and breaks down rapidly. One of the prime requisites of a detergent for household use is foaming power, lack of which presents a serious problem in marketing wetting and detergent compositions of the above class. I have now discovered that detergent compositions possessing a copious and stable foam and which are well-suited for domestic, laundry or industrial use are produced upon admixture of an ester of sulfodicarboxylic acid with a water-soluble salt of pyrophosphoric acid, with or without the addition of an inert water-soluble carrier material.

Any of the sulfodicarboxylic acid esters described in the specification of the patent above referred to may be used in conjunction with a water-soluble salt of pyrophosphoric acid in accordance with the present invention, but I have found that the esters, and preferably the normal esters of sulfosuccinic acid, will produce the best detergents for domestic use. These compounds have the following structural formula:



in which R is an alkyl group. For use in the preparation of detergents of the present invention the hydrogen atom of the sulfosuccinic acid group is preferably replaced by an alkali metal such as sodium, potassium or ammonium, or by an organic base such as ethanolamine, alkaloid, etc. In general, the above metals and groups are those which produce water-soluble salts of aliphatic sulfodicarboxylic acid esters.

While any of the esters of the aliphatic sulfodicarboxylic acids may be used in practicing the invention, I prefer to use the esters of aliphatic alcohols having three or more carbon atoms by reason of the improved wetting and detergent properties which these esters possess. For best results, I prefer the esters of alcohols having 5–8 carbon atoms, such as amyl alcohol, hexyl alcohol, octyl alcohol, capryl alcohol, or mixtures of these alcohols, since these compounds have the greatest wetting properties. However, other alcohols may give more desirable properties for special purposes than do the ones named, although possibly with some sacrifice of wetting power, and the invention in its broadest aspects is not limited to esters of alcohols giving the greatest possible wetting powers.

Preferably tetrasodium pyrophosphate is used in conjunction with the above esters, but the invention is not limited to the use of this compound. On the contrary, any water-soluble salt of pyrophosphoric acid may be used, such as the potassium salts, the ammonium salts and the like. These pyrophosphates, when used alone, possess a fair degree of detergent power but produce no foam on shaking in aqueous solution. Therefore the results obtained when they are mixed with esters of sulfodicarboxylic acids, and particularly with the neutral esters of alcohols of 5–8 carbon atoms, are entirely unpredictable from the behavior of the two agents when used separately. In fact the amount and stability of the foam produced when a suitable ester of sulfosuccinic acid is shaken in water in admixture with a water-soluble salt of pyrophosphoric acid, with or without the addition of an inert water-soluble carrier, are exceptional when the corresponding properties of the components are considered separately. The abundant foam produced when the above mixture is dissolved and shaken in either hard or soft water remains stable over long periods of time, and this compound therefore constitutes an excellent detergent for household and other uses.

When carrier materials are used, they should preferably be water-soluble. Water-soluble carriers serve as an extender of the finished sulfodicarboxylic acid ester-pyrophosphate compound and make it easier to measure the small amount necessary for detergent purposes, thereby reducing waste. To be suitable a carrier should be

stable and non-hygroscopic in order to prevent caking of the detergent upon standing.

A carrier having the above qualifications may be organic or inorganic. In the organic field I have used materials such as dextrose, corn sugar, cane sugar, urea, salts of organic acids such as tartrates, succinates, mono- and disodium phthalate and the like. In the inorganic field I have used a number of salts such as sodium chloride, potassium chloride, sodium bisulfate and the like, but I prefer to use sodium sulfate because it is neutral, inexpensive and dissolves rapidly in hot or cold water.

The ratio in which the components of the wetting, sudsing and detergent compositions of the present invention are compounded may vary between relatively wide limits, depending upon the detergent strength desired, the amount and stability of foam desired and the particular use for which they are intended. I have found that best results are obtained from mixtures containing from 5–15% of the ester, from 5–20% of the pyrophosphate and at least 50% of the carrier. When an ester is used which has high surface activity such as the esters of sulfosuccinic acid the amount of this material sufficient for efficient detergent action lies midway between the above limits, and with agents of the very highest wetting properties such as the sodium or potassium salt of dioctyl sulfosuccinate an amount of wetting agent corresponding to the lower limit of the above range may be used with satisfactory results. It is of course possible to omit the carrier or extender material entirely from the mixture, but this would make the product too concentrated for ordinary household use. For this reason, it is preferable to use one of the carrier materials outlined above in order to make the product commercially attractive. In addition to the above components, the composition may also contain soaps, saponin, abrasives or other substances designed to improve its scouring, foaming and cleaning properties.

My detergent compositions may be prepared by simple mechanical admixture of the ingredients or by spray-drying in any known or approved spray-drying equipment. I have obtained excellent results with a standard type of spray-dryer now on the market in which the material to be dried is atomized into a vertical cylinder containing a rising vortex of hot air or hot products of combustion. Air temperatures of 600–700° F. are preferably used in this equipment and saturated solutions of the sulfodicarboxylic ester salt, pyrophosphate and inert carrier are introduced simultaneously.

My compositions are also well suited for manufacture and sale in the form of cakes or bars, similar to ordinary soap. In this form of the invention it is preferable to employ a diluent or carrier material having greater mechanical strength and less water solubility than sodium sulfate, for example pumice, hard soaps, or mixtures of these or other materials having similar characteristics.

The invention will be more specifically described in conjunction with the following specific examples, which illustrate compositions prepared in accordance therewith but to which the invention is not limited.

Example 1

5 parts by weight of sodium dioctyl sulfosuccinate are dissolved in a mixture of water, methyl or ethyl alcohol and a small amount of butyl ether of diethylene glycol to a 60% solution, constituting a clear liquid. 15 parts of tetra sodium pyrophosphate are completely dissolved in a suitable amount of water and to the solution are added 80 parts of sodium sulfate.

The pyrophosphate-sodium sulfate solution is fed into the centrifugal atomizer of a spray-drying chamber at the rate of 7½ lbs. per minute. The sodium dioctyl sulfosuccinate solution is introduced into the atomizer simultaneously at the rate of 320 cc. per minute. Both solutions are introduced at atmospheric temperature.

The inlet temperature of the hot gas should be about 600–640° F. The outlet temperature of the gas leaving the apparatus should be about 220–240° F.

Under these conditions an almost complete recovery of a spray-dried mixture is obtained in the form of a snow-white powder that is light, fluffy and dissolves instantly in hot water.

The rate of sulfosuccinate introduction may be varied within wide limits, and may be as high as 3200 cc. per minute, in which case a mixture containing 50% of the sulfosuccinate and 50% of the pyrophosphate-sodium sulfate mixture is obtained.

Instead of using the sodium salt of dioctyl sulfosuccinate, the potassium salt may be used. In this case I prefer to use tetra potassium pyrophosphate with potassium sulfate instead of sodium sulfate as the carrier.

Example 2

A mixture containing 0.05% of the sodium salt of dioctyl sulfosuccinate and 0.15% tetra sodium pyrophosphate was prepared and comparative sudsing tests of this material were run against a 0.05% solution of the sulfosuccinate alone and a 0.15% solution of the pyrophosphate alone. It will be seen from the results of these tests, as given in the following table, that the mixture of the above two compounds gave results completely different from those produced by either of the individual constituents, both in the amount of foam and the stability thereof.

Table 1

	Percent	Initial foam	Foam at end of 1 min.	Foam at end of 5 min.
		Cc.	Cc.	Cc.
Sodium dioctyl sulfosuccinate.	0.05	175	60	30
Tetra sodium pyrophosphate.	.15	No foam		
Sodium dioctyl sulfosuccinate + tetra sodium pyrophosphate.	.05 .15	250	250	250

In Table 2 there are given the results obtained when comparative tests were run on corresponding amounts of the oleic acid ester of methyl taurine, alone and in admixture with tetra sodium pyrophosphate. This methyl taurine may be taken as a standard of comparison in judging sudsing power as it produces a normal amount of foam when shaken with water, which foam is very stable.

Table 2

	Percent	Initial foam	Foam at end of 1 min.	Foam at end of 5 min.
		Cc.	Cc.	Cc.
Taurine ester	0.05	150	150	150
Taurine ester + tetra sodium pyrophosphate	.05 1.5	150	150	150

It will thus be seen from a comparison of the two tables that while the tetra sodium pyrophosphate has no foaming power by itself, its addition to sodium dioctyl sulfosuccinate increases the foaming properties of that detergent and produces a foam which is stable for suitable periods of time, a result that is surprising in view of the properties of the pyrophosphate. It will also be seen that the addition of tetra sodium pyrophosphate to the methyl taurine ester produces no difference in either the amount of foam formed nor the stability of that foam, thus indicating that the pyrophosphate is a specific foam-producer for the sulfosuccinate, while it does not necessarily produce the same results for other wetting agents.

What I claim is:

1. A wetting, sudsing and detergent agent comprising a spray-dried mixture comprising 5–15% by weight of a sulfosuccinic ester of an aliphatic alcohol having from 5–8 carbon atoms, 5–20% by weight of a water-soluble salt of pyrophosphoric acid, and at least 50% by weight of a water-soluble, non-hygroscopic carrier which is stable at spray-drying temperatures and which exhibits when in a saturated solution a pH value between 6.5 and 8.5.

2. A wetting, sudsing and detergent agent comprising a spray-dried mixture comprising 5–15% by weight of an alkali metal salt of dioctyl sulfosuccinate, 5–20% by weight of tetra sodium pyrophosphate and at least 50% by weight of sodium sulfate.

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