COMPOSITION FOR SIMULTANEOUSLY LAUNDERING AND SOFTENING FABRICS

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No Drawing. Filed Sept. 19, 1963, Ser. No. 310,136

3 Claims. (Cl. 252—8.75)

The object of this invention is to provide a composition for simultaneously laundering and softening fabrics. It is a further object of this invention to provide composition whereby cationic softeners can be applied to fabrics at the same time that the goods are being laundered with anionic detergents. It is still another object of this invention to provide a method whereby the housewife can launder goods while, at the same time, applying there to a cationic softener. It is a still further object of this invention to provide a process by which textile fabrics or fibers may be finished with cationic softeners while simultaneously applying anionic wetting agents or other anionic surfac- 

tants to the fabric or fibers. It is well known to the art to apply to laundered goods a quaternary ammonium salt as a cationic softener of the type

\[
R^+ \underset{R'}{\underset{\text{X}}{\text{R}}}
\]

wherein \( R \) and \( R' \) represent alkyl radicals having 14 to 20 carbon atoms, \( R' \) is a methyl radical, \( R'' \) is a methyl, ethyl or an ethoxylated radical (\( \text{CH}_2=\text{CH}_2\)O)n, where \( n \) is an integer of at least one, and \( X \) is a chloride, bromine, sulfate, methosulfate and ethosulfate anion, by dissolving such a softener in the final rinse water. Similar materials have also been used by textile mills as softeners applied in the final rinse. In the preceding formula, \( R \) and \( R' \) represent an alkyl radical or mixture of alkyl radicals having from 14 to 20 carbon atoms usually derived from tallow. Quaternary ammonium compounds of this type are sold in substantial volume and are used in the application set forth above, more particularly in the last rinse in house- 
hold laundering operations. They impart to the treated goods a pleasant, soft hand and have found much favor with housewives.

The preferred alkyl radical, \( R \), in these compounds is usually a mixture containing about 60 to 80% of stearyl and about 20 to 40% of cetyl radicals and is ordinarily derived from tallow, preferably by hydrogenation or by by hydrogenation of its derivatives used as intermediates in the production of the quaternary ammonium comp- 
ounds. Softeners of this type being high molecular weight compounds of cationic nature are precipitated by anionic surfactants such as ordinary soaps, alkyl aryl sulfonates, fatty alcohol sulfates, and the like. They cannot, therefore, be used as such in a detergent solution because they are precipitated thereby and deposit an insoluble precipitate on the laundered goods, which, rather than having a softening effect, actually leaves them as harsh to the feel, or even more so, than if the softener had not been applied.

We have now found the surprising fact that when ca- 
tionic softeners of the foregoing type are combined with 
a stabilizer, which is a selected quaternary ammonium compound containing only one alkyl radical having from 8 to 20 carbon atoms in the alkyl chain, hereinafter referred to as monoalkyl quaternary ammonium salts, they can be dissolved in aqueous solutions of anionic detergents to yield stable dispersions showing little or no tendency to precipitate. Furthermore, when goods are laundered with such solutions, they are not only 
effectively washed by the anionic detergent, but they are also softened by the cationic softener of the type herein- 
above delineated. The monoalkyl quaternary ammonium compound of itself may possess little or no softening prop- 
er. The optimum characteristics of good softening and 
good compatibility with anionic detergents are exhibited by ratios of dialky- 

The monoalkyl quaternary ammonium salts which 
may be used as a stabilizer in conjunction with the dialky quaternary ammonium softener compounds previously de- 
cribed conform, in general, to the following structure:

\[
R^+ \underset{R'}{\underset{\text{X}}{\text{R}}}
\]

wherein \( R \) is selected from the group consisting of an alkyl or alkanolalkyl radical containing from 8 to 22 car- 
bon atoms, an alkyl benzyl phenoxo ethyl radical in which the alkyl radical contains from 8 to 9 carbon atoms and in which the phenyl radical may be substituted by a methyl group; \( R' \) and \( R'' \) are selected from the group consisting of methyl, ethyl, propyl, and isopropyl radicals and radicals which, in combination with the nitrogen atom of the above formula, form a monovalent, heterocyclic ring system in- 
cluding pyridine, pyrrole, and morpholine; \( R' \) is se- 
lected from the group consisting of methyl, ethyl, propyl, and isopropyl radicals and a benzyl group or substituted benzyl group including monochlorobenzyl, dichlorobenzyl, 

It has generally been supposed that surface-active cationic materials are universally precipitated by surface- 
active anionic materials. This is, indeed, the case when dialky dimethyl ammonium hydroxide, dialky dimethyl ammonium methosulfate, and dialky ethoxylated hy- 
doxyethyl methyl ammonium chloride solutions are added, alone, to conventional anionic detergent solutions such as aqueous solutions of soap, alkyl benzene sulfos- 
ates, aliphatic hydrocarbon sulfonates, sulfonated oils, sulfonated esters such as sulfonated butyl oleate or sul- 
fonated castor oil, alkyl sulfates, dialkyldiesters of alpha sulfo succinic acid, and the like, which are described in 
Schwartz, "Surface Active Agents," 1949, New York, Interscience Publishers, Inc., pages 25—141. We have found 
that such precipitation is inhibited or completely pre- 
vented when the dialky quaternary is combined with the
monoaikyl quaternary ammonium compounds above enumerated in the proportions hereinabove set forth. Concentration of dialky1 quaternary ammonium salts usually supplied to formulators for dilution with water to 3 to 6% active aqueous solutions which are sold in this dilute form to the housewife usually contain about 75% of dialky1 dimethyl quaternary ammonium compound. The balance is water, together with a suitable water-soluble organic solvent such as isopropanol. We prefer to prepare approximately 75% active concentrates of a blend of dialky1 and monoaikyl quaternary which can be readily cut to a 3 to 6% active solution, if desired, that can be used by the housewife, laundry, or textile mill by direct addition to the washing solution containing anionic detergent.

In current practice, it is customary for the housewife to add a measured amount of cationic softener of the dialky1 dimethyl ammonium salt type to the final rinse water used in a home washing machine so that the amount of softener applied to the fabric by exhaustion from the final rinse will usually be within the range of 200 to 1000 parts per million of dry clothes, preferably about 750 parts per million. The process of this invention represents a major advance in household laundering procedures because laundering and softening can both be performed at the same time. Thus, the housewife preferably adds the softener comprising both dialky1 and monoaikyl quaternary salts directly to the soap or other detergent solution and launders and rinses in the conventional manner. Similarly, in mill operations, softening can be carried out in the final scouring operation without interposition of an additional softening step before final drying of the goods.

It should be understood that the concentrated softeners employed in our invention may, if desired, contain a water-miscible organic solvent such as ethanol or isopropanol.

The compatibility of blends of dialky1 quaternaries and monoaikyl quaternaries with various anionic surfactants is illustrated in Table 1, using a 0.225% active content of cationic.

<table>
<thead>
<tr>
<th>Cationic</th>
<th>Anionic</th>
<th>Ratio of Anion to Cationic by Weight of 100% Active Material</th>
<th>Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>TMMSCA</td>
<td>Dodexyl benzene sulphonate</td>
<td>1.98</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMSC/5/TMMG</td>
<td>Dodexyl benzene sulphonate</td>
<td>1.38</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG</td>
<td>Dodexyl benzene sulphonate</td>
<td>1.38</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG/TMCG</td>
<td>Dodexyl benzene sulphonate</td>
<td>0.67</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG/TMCG/CPC</td>
<td>Dodexyl benzene sulphonate</td>
<td>0.67</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG</td>
<td>Soda ash</td>
<td>0.69</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG</td>
<td>Sodium salt of coconut fatty acid</td>
<td>0.69</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG</td>
<td>Sodium salt of coconut fatty acid</td>
<td>1.3</td>
<td>Precipitate.</td>
</tr>
<tr>
<td>TMMG</td>
<td>Sodium salt of coconut fatty acid</td>
<td>1.3</td>
<td>Precipitate.</td>
</tr>
</tbody>
</table>

1. Anionic in the form of its sodium salt.
2. TMMSC is dialky1 dimethyl ammonium methosulfate where the alkyl group is the mixture, primarily C8-C10, present in hydrogenated tallows.
3. TMSC is alkyl dimethyl benzyl ammonium chloride, where the alkyl radical is as defined under note 2.
4. TMMG is dialky1 dimethyl ammonium chloride, where the alkyl group is as defined under note 2.
5. CPC is cetyl pyridinium chloride.

In the above compatibility tests, the anionic/cationic ratios given are approximately 50% above the minimum values necessary to give compatibility. For those anionic/cationic mixtures which were found to be compatible, increase in the anionic/cationic ratio above the figures given in the table always led to compatibility, while reduction of the anionic/cationic ratios to half of the given figures generally resulted in incompatibility. In all the cases given above, however, the minimum compatible anionic/cationic ratios are well below the ratios which would be required for use in home laundering or in textile finishing. Thus, in home laundering, where the use of a 14% active powdered anionic detergent is in the range of 8 ounces per 10 pounds of goods, and the softener is used at a concentration of approximately 0.07% on the weight of goods, the anionic/cationic ratio required in the washing solution would be approximately 10.0, which is well above the minimum anionic/cationic ratios required for the selected compatible anionic/cationic mixtures stated above.

In the practice of this invention, we prefer to use an anionic/cationic ratio, based on the weights of active ingredient of each agent, of 1.5 to 20.0. Generally, the higher values of this range of the ratio are utilized in home laundering applications, while the lower values of this range are utilized in textile finishing operations.

The method of simultaneously laundering and softening fabrics according to this invention is illustrated by the following example.

**Example 1**

A five-pound load of soiled Terry towels was placed in a Westinghouse Commercial Lavender. Four ounces of "Tide," a commercially available household detergent containing both alkyl aryl sulfonate and sodium alkyl sulfate sold by the Procter & Gamble Company, was added to the charge and the machine was turned to the "Hot" position to start the addition of water. Softener solution was then added through the external opening provided for addition of liquids, at a level of 750 parts active softener per million of tallow. The goods were then laundered in the conventional manner, a single cycle consisting of a wash, three rinses, and a spin. Four complete cycles were performed in each test, detergent and softener both being applied in the same wash bath except in the case of controls. After the final rinse, the towels were tumble dried and evaluated for cleanliness, yellowing, softness, and absorbency.
twelve persons, each one making several evaluations of each sample and averaging the results. Discoloration was observed visually.

Absorbernancy was determined by conditioning 1" x 6" strips at 70° F. and 55% relative humidity, weighting one end and hanging them with the weighted end down so as to immerse them to a depth of one inch in a 0.25% aqueous solution of FD & C Red #2, and measuring the height to which the dye solution rose by wicking action after two minutes. Results are shown in Table II.

TABLE II

<table>
<thead>
<tr>
<th>Softener</th>
<th>Location Added</th>
<th>Softness Rating 1</th>
<th>Discoloration</th>
<th>Wicking, in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Last rinse</td>
<td>4.8</td>
<td>None</td>
<td>2.0</td>
</tr>
<tr>
<td>2T2MMS</td>
<td>Last rinse</td>
<td>5.0</td>
<td>Noticeable yellowing</td>
<td>0.0</td>
</tr>
<tr>
<td>Same</td>
<td>Soaping</td>
<td>5.8</td>
<td>None</td>
<td>1.3</td>
</tr>
<tr>
<td>2T2MMS: T2MCI (3:1)</td>
<td>Last rinse</td>
<td>5.0</td>
<td>Noticeable yellowing</td>
<td>0.0</td>
</tr>
<tr>
<td>Same</td>
<td>Seoaging</td>
<td>5.0</td>
<td>None</td>
<td>1.3</td>
</tr>
</tbody>
</table>

1 shows greatest softness.

A softness rating of 3 or less indicates good softening. Hence, it is apparent that addition of the 3:1 blend of dialkyl quaternary ammonium salt and monoalkyl quaternary ammonium salt during the soapin process gave substantially improved softening over the control wash run without softener, whereas addition of the dialkyl quaternary ammonium salt, only, during the soapin process essentially impaired softness as compared with the control. Furthermore, the addition of the 3:1 blend during washing resulted in washed goods having no discoloration and exhibiting good absorbency, a measure of the utility of the towel in drying operations, as compared with use of the same blend in the last rinse. In the later case, although softness was somewhat better, the goods were discolored by the cationic and the wicking was impaired.

Example 2

Another series of tests was run in the same manner as in Example 1 using 3:1 blends of dialkyl dimethyl ammonium methosulfate and cetyl pyridinium chloride, the same dialkyl quaternary and alkyl dimethyl benzyl ammonium chloride, and dialkyl dimethyl ammonium chloride and alkyl dimethyl benzyl ammonium chloride. Table III shows the results of evaluation.

TABLE III

<table>
<thead>
<tr>
<th>Softener</th>
<th>Location Added</th>
<th>Softness Rating</th>
<th>Discoloration</th>
<th>Wicking, in.</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>Soaping</td>
<td>4.7</td>
<td>None</td>
<td>2.0</td>
</tr>
<tr>
<td>2T2MCI</td>
<td>Soaping</td>
<td>5.8</td>
<td>Noticeable yellowing</td>
<td>0.0</td>
</tr>
<tr>
<td>Same</td>
<td>Soaping</td>
<td>1.0</td>
<td>None</td>
<td>1.7</td>
</tr>
<tr>
<td>2T2MMS: T2MCI (3:1)</td>
<td>Soaping</td>
<td>1.3</td>
<td>Noticeable yellowing</td>
<td>0.0</td>
</tr>
<tr>
<td>Same</td>
<td>Seoaging</td>
<td>1.2</td>
<td>None</td>
<td>1.2</td>
</tr>
<tr>
<td>2T2MMS: T2MCI (3:1)</td>
<td>Seoaging</td>
<td>2.0</td>
<td>Noticeable yellowing</td>
<td>0.0</td>
</tr>
<tr>
<td>Same</td>
<td>Seoaging</td>
<td>2.0</td>
<td>None</td>
<td>1.4</td>
</tr>
</tbody>
</table>

It is apparent from this series of tests that all three combinations of dialkyl quaternaries and monoalkyl quaternaries gave markedly improved softening over the blank, whereas the color of the laundered fabric and the wicking was better, in each case, than when the dialkyl quaternary alone or the dialkyl quaternary in combination with the monoalkyl quaternary was used in the final rinse.

Example 3

In order to determine the effective range of ratios of dialkyl quaternary to monoalkyl quaternary when added to the detergent wash, dialkyl dimethyl ammonium methosulfate was combined in varying amounts with alkyl di-

It is thus apparent that within the range of 85:15 to 60:40 of dialkyl quaternary to monoalkyl quaternary, there is marked softening of the goods when the softener is applied during the washing cycle.

It will be apparent that, while we have shown the marked utility of this invention in household laundering operations, similar advantages accrue to the textile mill or finishing plant by applying the process of this invention and thus decreasing costs by elimination of the separate, additional step of finishing the goods by applying a cationic softener in the absence of detergent.

Furthermore, the compatibility with anionic surfactants of mixtures of dialkyl quaternaries with monoalkyl quaternaries described above provides a novel process for the processing of textile materials so as to confer upon them an extremely soft handle with concomitant high degree of water absorbency. The desirably soft handle imparted to textile fabrics by cationic softeners, which are cationic surfactants of various structures containing one or more long alkyl groups of 16 to 22 carbon atoms, cannot be duplicated by the use of anionic or nonionic types of softening agents. Indeed, the term "cationic hand" has become a descriptive term in the textile finishing industry to describe the unique, soft, handle produced by cationic softeners.

However, treatment of textile materials with efficient cationic softeners leads to a decrease in the water absorbency of the goods, making them unsuitable for end uses such as towels and diapers. In addition, goods intended for these end uses are usually treated with an anionic wetting agent to confer high absorbency upon them, and the simultaneous application of cationic softeners with the anionic wetting agent has heretofore been impossible to carry out because of the incompatibility of the cationic softeners with the anionic wetting agent.

As examples of the novel process by which textile materials may now be finished to provide a soft hand and a high absorbency, the following illustrations are given:
Example 4

Unfinished terry cloth (Test Fabrics, Inc., Style #420) was thoroughly wet out in water and mangled under sufficient pressure to leave the goods with an 85% pick-up of water. The moist terry cloth was then treated in a three roll padded with a solution containing the following ingredients, all percentages being given by weight:

<table>
<thead>
<tr>
<th>Ingredient</th>
<th>Percent</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:1 mixture of 2T2MMS and T2MCI (75% active)</td>
<td>1.5</td>
<td>5.25</td>
</tr>
<tr>
<td>Sulfated butyl oleate (60% active)</td>
<td>3.0</td>
<td>9.0</td>
</tr>
</tbody>
</table>

Water to 100%.

After treatment in the padder, the goods were dried at 220°F. The goods had a very soft, desirable hand and gave a wicking test of 2.5 inches.

Treatment of the same terry cloth by the identical process described above, except that the treating bath contained only 0.45% of the 3:1 mixture of 2T2MMS and T2MCI (75% active), gave goods with a soft handle, but with a wicking test of only 0.4 inch.

Example 5

46 pounds of 2T2MMS, 9.5 pounds of T2MCI and 19 pounds of isopropyl alcohol were mixed in a kettle at 50°C. until a uniform blend was obtained. To this mixture were then added 18 pounds of a 50% solution in isopropyl alcohol of sodium di-(2-ethylhexyl)-sulfosuccinate and 25 pounds of the condensation product of nonyl phenol with 9.5 moles of ethylene oxide. The ingredients were mixed for a short time until a uniform blend was obtained.

A 2% by weight aqueous solution of the above blend was prepared and used to impregnate cotton terry cloth by the same procedure as described in Example 4. The resulting goods had a very soft handle and a wicking test of 1.4 inches.

We claim:

1. A composition for treating fabrics consisting essentially of a surface-active anionic agent and a compatible softening agent, said softening agent consisting essentially of (1) a softener having the structure:

```
R
```

wherein R and R' are alkyls having 14 to 20 carbon atoms, R'' is methyl, R' is a member of the group consisting of methyl and ethyl, and X is a member of the group consisting of chloride, bromide, sulfate, methosulfate and ethosulfate, and (2) a stabilizer having the structure:

```
R
```

2. A process for simultaneously laundering and softening fabrics which comprises treating fabrics with an aqueous composition as defined in claim 1.

3. A composition for simultaneously laundering and softening fabrics consisting essentially of an anionic surface-active agent and a softener composition in the amount by weight of about 1.5 to 1, about 20.0 to 1, respectively, said softener composition consisting essentially of softener agent dialkyl dimethyl ammonium methosulfate wherein the alkyl group has 14 to 20 carbon atoms derived from hydrogenated tallow and as stabilizer alkyl dimethyl benzyl ammonium chloride wherein the alkyl group has 14 to 20 carbon atoms derived from hydrogenated tallow, the amount of said softener and stabilizer ranging in the ratio by weight from about 85:15 to about 60:40.

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