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3,660,286

LIQUID WASH CYCLE SOFTENER

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5 Claims

ABSTRACT OF THE DISCLOSURE

Fabric softening compositions containing a mixture of branched and straight chain di-higher alkyl and straight chain di-lower alkyl quaternary ammonium compounds with alkyl amine oxides have been found useful in the wash cycle of conventional household or industrial washing machines to impart softening to fabrics in the presence of either anionic or nonionic detergents or both.

This invention relates to novel textile-treating compositions, and more particularly to compositions useful for softening fabrics during the wash cycle in an automatic washing machine.

At the present time quaternary ammonium fabric-softener products on the market have a tendency to gel, particularly if subjected to freezing temperatures, for example in transit, remaining in gel or semi-gel form when thawed. The fabric softening products containing these cationic quaternary ammonium softeners now available to the housewife are either incompatible with the common anionic detergents, or cause yellowing of fabrics when used with nonionic detergents in the wash cycle. Thus the present fabric-softening products sold for home use perform well when used in the rinse operation but cannot be used in the same wash solution with an anionic detergent because of the recognized mutual antagonistic action between anionic and cationic compounds, which presents a problem in that such action destroys or substantially reduces both the fabric softening power of the cationic and the detergent power of the anionic. If one or the other is used in large excess of the stoichiometric amount still either the fabric softening or the detergency is destroyed.

In some homes and in some coin-operated laundry establishments may be found automatic washing machines having a delayed-release device into which a rinse-cycle fabric softener may be added at the same time as the detergent at or before the beginning of the washing machine's operation, and which will not release the fabric softener until the final rinse cycle. Most machines, however, are not equipped with this device, forcing the housewife to make special note of the timing of the rinse cycle and to make a separate trip to the washing machine to add at the appropriate time, a rinse-cycle softener. Accordingly it is an object of the present invention to provide a more useful textile softening composition.

It is a further object of the invention to provide a liquid fabric softening composition which is phase-stable, non-gelling, and non-yellowing to fabrics when used in the presence of nonionic detergents.

It is a still further object of the invention to provide a textile-treating composition having good fabric softening characteristics without seriously lessening detergency

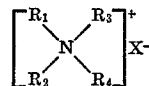
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or sudsing when used in the wash in the presence of anionic or nonionic detergents.

The invention also has for an object the formulation of a fabric softening composition which imparts less water repellency to fabrics than do present day laundry softeners, thus not appreciably affecting the re-wet properties of the cloth. Further objects of the invention will become manifest hereinafter as the description proceeds.

It has now been discovered that these objects can be achieved by a fabric softener composition comprising a mixture of quaternary ammonium compounds and an amine oxide having the molecular structures and characteristics set forth hereinbelow. The product of the present invention then, being effective as a fabric softener in the wash cycle with both anionic and nonionic detergents, enables the housewife to add the fabric softener at the beginning of the washing operation regardless of the type of automatic machine or type of detergent used.

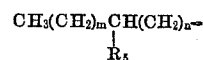
The first essential component of the fabric conditioning products of the present invention is a mixture of quaternary ammonium compounds having branched and straight chain higher alkyl groups which may be represented by the following general formula:



wherein

R_1 and R_2 are independently selected from the group consisting of:

Radical I:



and

Radical II: $CH_3(CH_2)_y-$

and mixtures thereof, where

$m=3$ through 11 inclusive,

$n=1$ through 6 inclusive,

$m+n=9$ through 12 inclusive,

$y=11$ through 17 inclusive, and

Radical I comprises between about 5% and about 25% by weight of the total of R_1 and R_2 , and Radical II comprises between about 40% and about 60% by weight of carbon chains where y is 11 through 14 inclusive, with the remainder being carbon chains where y is 15 through 17 inclusive.

R_3 and R_4 are independently selected from the group consisting of methyl, ethyl, propyl, and isopropyl radicals, R_5 is methyl or ethyl, and X is an anion selected from the group consisting of chloride, bromide, iodide, methosulfate and ethosulfate, which imparts water dispersibility to the quaternary.

The branched-chain quaternary, which results when Radical I is substituted in the general formula above, is normally present in proportions of from about 5% to 25% by weight of the quaternary mixture and preferably from about 10% to 15% by weight. The remaining quaternaries of the mixture will include straight chain higher alkyl radicals wherein about 40% to 60% by weight have chain lengths between 12 and 15 carbon atoms long, and about 40% to 60% by weight have chain lengths between 16 to 18 carbon atoms long, preferably 45% to 55% and 43% to 53% by weight, respectively.

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The second essential component is a tertiary amine oxide compound characterized as follows:



wherein R_6 is a higher alkyl radical having from about 16 to about 22 carbon atoms, or the 2-hydroxy derivative thereof, and R_7 and R_8 are each independently methyl, ethyl, propyl, isopropyl, or hydroxyethyl radicals. The arrow designates a semi-polar bond. Amine oxides wherein R_7 and R_8 are lower alkyl groups and their method of preparation are described in Guenther U.S. Pat. No. 2,169,976. Amine oxides wherein R_7 and R_8 are hydroxyethyl and their method of preparation are described in Priestley U.S. Pat. No. 3,324,183.

Thus in its broadest aspect, the invention relates to a fabric softening composition comprising a fabric softening amount of a quaternary ammonium mixture comprising both branched and straight chain compounds, about 5% to about 25% of which are branched and have two higher alkyl chains of about 12 to about 15 carbon atoms per molecule, about 95% to about 75% of which are straight-chain quaternary ammonium compounds comprising about 40% to about 60% of said compounds having, per molecule, two straight higher alkyl chains each having about 12 to about 15 carbon atoms, and about 60% to 40% of said compounds having, per molecule, two straight alkyl chains each having about 16 to 18 carbon atoms, and a tertiary amine oxide, said quaternary ammonium compound and tertiary amine oxide being within the weight ratios of about 1:1 to 7:1 respectively.

As examples of suitable branched or mixed branched and straight chain quaternaries which may be used as components of the quaternary mixtures of the present invention there may be mentioned

N,N-di(alpha methyl undecyl)-N,N-dimethyl ammonium chloride;
N,N-di(alpha ethyl decyl)-N,N-dimethyl ammonium methosulfate;
N,N-di(alpha methyl tetradecyl)-N,N-diethyl ammonium ethosulfate;
N,N-di(alpha methyl do-decyl)-N,N-dimethyl ammonium iodide;
N,N-di(alpha propyl undecyl)-N,N-dimethyl ammonium chloride;
N-dodecyl-N-(alpha ethyl dodecyl)-N-methyl-N-propyl ammonium iodide; and
N-pentadecyl-N-(alpha methyl tridecyl)-N-ethyl-N-isopropyl ammonium chloride.

Examples of useful straight-chain quaternary ammonium compounds are

N,N-di-dodecyl-N,N-dimethyl ammonium chloride;
N-di-tridecyl-N,N-diethyl ammonium bromide;
N,N-di-tetradecyl-N,N-dimethylammonium methosulfate;
N,N-di-pentadecyl-N,N-diethylammonium ethosulfate;
N,N-di-hexadecyl-N,N-dimethyl ammonium chloride;
N,N-di-octadecyl-dimethyl ammonium chloride;
N-hexadecyl-N-octadecyl-N,N-dimethylammonium chloride;
N-dodecyl-N-pentadecyl-N,N-dipropyl ammonium chloride; and
N-tridecyl-N-tetradecyl-N,N-diisopropyl ammonium chloride.

Examples of suitable amine oxides operable within the invention are dimethyl hexadecyl amine oxide, dimethyl octadecyl amine oxide, bis (2-hydroxyethyl) octadecyl amine oxide, diethyl eicosyl amine oxide, dimethyl docosyl amine oxide, bis (2-hydroxyethyl) docosyl amine

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oxide, dipropyl-2-hydroxyoctadecyl amine oxide, and diisopropyl eicosyl amine oxide.

The combined level of quaternary and amine oxide can vary in an aqueous medium over a wide range, for example from about 4% to about 20%. A composition may be made comprising (i) about 2 parts to about 15 parts by weight of a mixture of quaternary ammonium compounds comprising about 12% N,N-di(alpha-methyl alkyl)-N,N-dimethyl ammonium chloride, about 45% N,N-dialkyl, N,N-dimethyl ammonium chloride wherein said alkyl is an acyclic aliphatic hydrocarbon residue having about 11 to about 15 carbon atoms, about 43% N,N-dialkyl, N,N-dimethyl ammonium chloride wherein said alkyl is an acyclic aliphatic hydrocarbon residue having 16 to 18 carbon atoms and (ii) about 1 part to about 5 parts by weight of an amine oxide compound having the structure:



wherein R is a higher alkyl radical having from about 16 to about 22 carbon atoms, or a 2-hydroxy derivative thereof, R_1 and R_2 are each independently methyl, ethyl, propyl, isopropyl or hydroxyethyl radicals, the ratio by weight of said quaternary ammonium compound to said amine oxide being within the range of about 1:1 to about 7:1.

Unexpectedly, at higher ratios of quaternary to amine oxide within the aforementioned range, i.e., 1:1 to 7:1, aqueous products containing these ingredients are homogeneous single-phase compositions, and have the advantage that no hydrotropes or emulsifying agents are required to promote or stabilize homogeneity.

Ratios of quaternary to amine oxide less than about 1:1 at an 8% total level are heavy dispersions which separate into two layers or become undesirably thick after several freeze-thaw cycles. Even at the 1:1 ratio the product tends to gel, but the gel may be broken by shaking.

The fabric softening combinations of the present invention are normally used as aqueous solutions or dispersions. The combination of quaternary mixtures and amine oxide operable within this invention may also be prepared in solid form for addition as a separate product to a wash solution containing an anionic or nonionic detergent, or for mechanical mixing with a detergent composition in particulate form.

The aforesaid combinations are particularly useful when incorporated in liquid detergents for the reasons set forth hereinafter. Accordingly all that is necessary to obtain the benefits of the invention is to add a quaternary compound mixture and one or more of the amine oxides described herein to the wash water or to the detergent prior to addition to the wash water. This can, if desired, be done by the housewife, but it is recognized that there is great convenience to the housewife to have the quaternary/amine oxide combination packaged with the detergent, whether in solid or in liquid form. Because of the present-day popularity of liquid detergents, the quaternary/amine oxide combinations of the invention are particularly valuable, since they are suited to detergent compositions in liquid form due to the discovery that liquid detergent compositions comprising said combinations within a certain range of weight ratios have acceptable physical stability.

The formulating of combinations of the quaternary and amine oxide into liquid compositions acceptable to the consumer is not without difficulties. Desirably, the level of these components in a liquid composition designed for laundry use is sufficiently high so that the housewife need not use large volumes of the liquid composition in a wash, although lower percentage levels of the quaternary and amine oxide may be used if the larger usage volumes are not a problem.

As an example of the difficulties involved in the preparation of aqueous quaternary/amine oxide compositions having acceptably high concentrations, it was found that there is a critical range of quaternary amine oxide ratios which must be adhered to in order to achieve phase stability. This is made evident by the data in Table I.

It is readily seen that the products of this invention have excellent phase stability under alternate freeze-thaw conditions without the need to incorporate a stabilizing additive. The products remain liquid and pourable when subjected to the freeze-thaw test described herein, in contrast to the commercial household emulsion-type distearyl dimethyl ammonium chloride compositions, for which freeze-thaw instability has been encountered in the field as a major problem.

When tests for fabric softening, sudsing, viscosity, and freeze-thaw stability are referred to in this specification they are performed according to the following descriptions.

FABRIC-SOFTENING TEST

0.83 gram of product and 1.37 grams of a commercial anionic based detergent are added to 1 liter of city water (approximately 90–100 p.p.m. hardness as CaCO_3) in a Terg-O-Tometer cup. For a description of the Terg-O-Tometer see Sanders and Lambert JAOCS 127, May 1950, 153–159. Five pieces of terry cloth 5 x 3 inches are added and washed at 120° F. for 15 minutes, then given two 3-minute rinses at room temperature in city water. The cloth is dried. A second, third and fourth set of washing, softening, rinsing and drying steps are performed as described above. After the fourth set, the cloths are graded for degree of softness by a panel of 10 women who are proficient in judging cloth softness. A cloth considered to be "very soft" is assigned grade 1, and a cloth that has not been softened by the treatment is graded 5, and is considered to be "very harsh." Intermediate softness is graded by assigning intermediate numbers.

It will be understood that the term "soft" or "softening" refers to a desirable change in sensory and/or physical characteristics of cloth brought about by treatment with a product of the instant invention. It is an object of a fabric softening treatment to give a soft and pleasing feel to fabrics which would otherwise tend to be harsh and stiff.

VISCOSITY

This property is determined with the Brookfield viscometer, LVF model, using a No. 1 spindle at 12 r.p.m. and 80° F. after allowing the product to age for 1 week at room temperature.

SUDSING

The tub of a Kenmore top-loading automatic washer, Model 70, is filled with 17 gallons of city water at 130° F., which has a hardness of 90–120 p.p.m. as CaCO_3 . Ninety-three grams of a commercial household built heavy-duty detergent are added with agitation for 1 minute. With agitation stopped, six pounds of cotton cloth are added, after which agitation is started. The volume of suds is recorded after 5 and 10 minutes running, according to the following grading system.

O—no suds

T—trace of suds

½—slight suds (a thin translucent layer just covering the surface)

1—moderate suds (opaque multilayer completely covering surface)

2—heavy suds

3—very heavy suds

FREEZE-THAW STABILITY TEST

A liquid product contained in a capped 4-ounce wide-mouth glass bottle is stored in a freezer at a temperature of minus 10° F. for 48 hours, after which it is removed and held at room temperature for 24 hours. This cycle is repeated until 5 such cycles have been carried out.

After any or all cycles, as desired, the physical state of the product is observed.

Example I

Liquid fabric softener compositions are prepared having the following formulas:

Formula No.	Parts				Ratio quaternary to amine oxide
	Quaternary mixture	Amine oxide	NaCl	Water	
1	8.0	0.0	0.1	91.9	7:1
2	7.0	1.0	0.1	91.9	3:1
3	6.0	2.0	0.1	91.9	5:3
4	5.0	3.0	0.1	91.9	1:1
5	4.0	4.0	0.1	91.9	1:3
6	2.0	6.0	0.1	91.9	
7	0.0	8.0	0.1	91.9	

The quaternary mixture and amine oxide are the same as described hereinafter under Example II.

The compositions were tested for fabric-softening characteristics, sudsing, viscosity, and physical appearance after five freeze-thaw cycles by the procedures described elsewhere herein, with the following results.

TABLE I

Formula No.	Fabric softening, 4 washes	Sudsing	Viscosity, cps., Brookfield No. 1 spindle, 12 r.p.m. after 1 week aging	Physical state after 2 to 5 freeze-thaw cycles
1	3.0	1	500	2 phases.
2			185	Flowable and homogeneous.
3	2.4	1	350	Flowable and homogeneous.
4			560	Flowable and homogenous (thick).
5	2.4	1	1,000+	Flowable and homogenous (very thick).
6	2.5	1	(1)	2 phases.
7	1.6	1	Gel	Non-flowable gel.

¹ 2 phases.

Formulas 1, 6, and 7 are outside the scope of the invention and although they are capable of being sampled and tested in the laboratory, are undesirable for practical use because of phase separation or gelling.

Formulas 2 through 5 in Table I are representative of flowable and homogeneous products within the invention. They have excellent fabric softening properties and show the need to adhere to the critical range of quaternary: amine oxide ratios, namely between about 1:1 and about 7:1, preferably between about 5:3 and 3:1.

For balanced fabric softening and solubility characteristics the quaternaries containing the higher alkyl groups, for example those having about 12 to about 15 carbon atoms, preferably are those which conform in the structure of their higher alkyl portion to the alkyl portion of long-chain alcohols made from alpha olefins by the oxo process. Examples of such alcohols are the products sold under the trademark "Neodol" by the Shell Chemical Company.

Those alcohols are predominantly normal primary alcohols but have alkyl branching in about 20% of the molecules, the alkyl branching being normally in the alpha position and predominantly in the form of methyl radicals.

A particularly use composition comprises

(a) About 6 parts of a mixture of quaternary ammonium compounds comprising about 12% N,N-di(alpha-methyl alkyl)N,N-dimethyl ammonium chloride, about 45% N,N-dialkyl-N,N-dimethyl ammonium chloride, wherein said alkyl is an acyclic aliphatic normal hydro-

carbon residue having a monovalent charge and having about 11 to about 15 carbon atoms, about 43% N,N-dialkyl-N,N-dimethyl ammonium chloride wherein said alkyl is an acyclic, aliphatic normal hydrocarbon residue having a monovalent charge and having 16 to 18 carbon atoms,

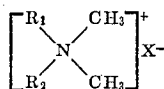
(b) About 2 parts of a dimethyl alkyl amine oxide, wherein the alkyl radical is an acyclic aliphatic hydrocarbon residue having from about 16 to about 22 carbon atoms,

(c) About 0.1 part NaCl,

(d) The balance substantially water.

More especially, a highly successful composition may be constituted as follows:

(I) About 6 parts of a mixture of quaternary ammonium compounds having the general formula



wherein about 12% of the radicals represented by R_1 and R_2 have the formula



in about 20 parts of which $m=8$, in about 30 parts of which $m=9$, in about 30 parts of which $m=10$, and in about 20 parts of which $m=11$, and wherein about 88% of the radicals represented by R_1 and R_2 have the formula



in about 10 parts of which $y=11$, in about 15 parts $y=12$, about 15 parts $y=13$, in about 10 parts $y=14$, in about 25 parts $y=15$, and in about 25 parts $y=17$.

(II) About 2 parts of stearyl dimethyl amine oxide, and

(III) The balance substantially water.

Hydrotropes may be added if desired but such compounds as sodium xylensulfonate, sodium toluenesulfonate, etc. promote separation upon aging, particularly at the higher levels of quaternary and amine oxide. This separation can be inhibited by the addition of a nonionic surfactant, generally at levels between about 0.10% to about 0.5%. Higher levels adversely affect softening properties. Suitable nonionics for this purpose are:

The Pluronics, formed by condensing propylene oxide with ethylene glycol to a molecular weight of about 600-2500 to form a base followed by condensing ethylene oxide to this base to the extent of about 20% to 90%, total molecule basis.

Alkyl phenols having about 9-12 carbon atoms in the alkyl portion (straight or branched chain) ethoxylated with 4-10 molar proportions of ethylene oxide.

Ethylene oxide condensates of the reaction product of propylene oxide and ethylenediamine, the reaction product having a molecular weight of about 2500, and the ethoxylated condensate containing about 40% to 80% ethylene oxide by weight.

Fatty alcohols having about 8 to 18 carbon atoms per molecule ethoxylated with about 5 to 30 molar proportions of ethylene oxide.

Viscosity regulators may also be optionally incorporated in the product to insure an acceptable viscosity and prevent undesirable thickening, particularly after the product has been frozen and thawed. A suitable viscosity regulator is sodium chloride at a level between about 0.05% and 0.8%, preferably about 0.075% to about 0.125%. Other suitable viscosity regulators are sodium acetate and sodium sulfate.

The expression "the balance substantially water" as used herein allows for the inclusion of unspecified optional ingredients that do not materially alter the basic and novel characteristics of the composition. For example, germicides, optical brighteners, bluing, colorants, etc. may

be incorporated into the product without disadvantage to the quaternary-amine oxide combination. However, any additives that are usually present in detergent compositions need not normally be used in a fabric softening composition intended for addition to a washing machine during the wash step.

Suitable optical brighteners that may optionally be used are sodium 4,4' - bis(2-phenylamino-4-morpholino-1,3,5-triazyl(6))diaminostilbene-2,2'-disulfonate; sodium 4,4'-bis(2,4 - diphenylamino-1,3,5-triazyl(6))diamino stilbene-2,2'-disulfonate; sodium 4,4'-bis(2-phenylamino - 4 - diethanolamino-1,3,1-triazyl(6))diamino stilbene - 2,2' - disulfonate (Calcofluor M2R); and sodium 4,4'-bis(2-phenylamino-4-morpholino-1,3,5-triazyl(6))diamino stilbene-2,2'-disulfonate (Calcofluor White RC conc.).

Suitable optional germicides are alkyl dimethyl ethylbenzyl ammonium chloride (BTC 471); 4,2',4'-trichloro-2-hydroxy diphenyl ether (Irgasan CH 3565); 4',5-dibromosalicylanilide; 3,4',5 - tribromosalicylanilide; and 2,2' - methylenbis (3,4,6 - trichlorophenol (hexachlorophene)).

Suitable optional colorants are 1,4-bis(2-ethylhexylamino)anthraquinone (Aviation Oil Blue); Acid Blue 80; C.I. 61585 (Polar Brilliant Blue RAW); Basic Violet 10, C.I. No. 45170 (D & C Red No. 19—Rhodamine B); and C.I. Pigment Green 74260, a chlorinated copper phthalocyanine (Heliogen Green W powder).

The colorants, when used, are desirably present at levels between about 0.003% and 0.2%, depending upon the depth of tinting desired. For example, Polar Brilliant Blue RAW may be used in amounts from about 0.003% to about 0.02%, and generally at a level of about 0.006%. Hastings Sky Blue OB may be present between about 0.05% and 0.2%, usually about 0.1%.

Example II

As an example of a liquid product within the scope of this invention there is prepared the following composition:

(a) 6 parts by weight of a quaternary ammonium chloride mixture comprising about 12% N,N-di(alpha methyl alkyl)-N,N-dimethyl ammonium chloride, about 45% N,N-dialkyl - N,N - dimethyl ammonium chloride, wherein the alkyl groups are composed of about 20% $C_{12}H_{25}$ —, about 30% $C_{13}H_{27}$ —, about 30% $C_{14}H_{29}$ —, and about 20% $C_{15}H_{31}$ —, and about 43% N,N-dialkyl-N,N-dimethyl ammonium chloride wherein the alkyl groups are composed of about 55% $C_{16}H_{33}$ — and about 45% $C_{18}H_{37}$ —,

(b) 2 parts by weight of stearyl dimethyl amine oxide,

(c) 0.1 part NaCl,

(d) 91.85 parts water.

The composition is prepared in the following manner.

The quaternary ammonium compound is mixed in a vessel with the amine oxide component to form a premix. In another vessel is placed the water and NaCl, followed by the premix, with continuous stirring. The product is a pourable, homogeneous, opaque liquid having excellent fabric softening properties.

Example III

The following composition is prepared in accordance with the procedure of Example II, to form a liquid fabric softening product:

(a) 7 parts by weight of a quaternary ammonium chloride mixture comprising about 12% N,N-di(alpha methyl undecyl)-N,N-dimethyl ammonium chloride, about 45% N,N - ditetradecyl - N,N - dimethyl ammonium chloride, and about 43% N,N-dioctadecyl-N,N-dimethyl ammonium chloride,

(b) 1 part by weight of stearyl dimethyl amine oxide, and

(c) 92 parts water.

The product is a thick, pourable, homogeneous liquid having excellent fabric softening properties.

Example IV

The following composition is a liquid form of the products according to the invention.

	Parts by weight	
N,N-di(alpha-methyl tridecyl)-N,N-dimethyl ammonium chloride -----	1.2	5
N,N-didodecyl-N,N-diethyl ammonium chloride --	4.8	
N,N - dihexadecyl-N,N-dimethyl ammonium chloride -----	4.5	10
Stearyl dimethyl amine oxide -----	1.5	
K ₄ P ₂ O ₇ -----	0.1	
Colorant -----	0.1	
Hexachlorophene -----	0.2	
Water -----	87.6	15
	100.0	

This product is a moderately thick pourable liquid.

Example V

A mixed dry granular composition is comprised as follows:

	Parts by weight	
N,N-di(alpha-methyl tetradecyl)-N-ethyl-N-methyl ammonium ethosulfate -----	8.0	25
N,N-dipentadecyl - N,N - dimethyl ammonium bromide -----	32.0	
N,N-distearyl-N,N-dimethyl ammonium chloride -	30.0	30
Eicosyl dimethyl amine oxide -----	30.0	
	100.0	

This product when used in the washing machine with a nonionic detergent composition imparts good fabric softening to clothing.

Example VI

A liquid detergent product having the following composition is formulated in accordance with the procedure set forth in Example II.

	Parts by weight	
N,N - di(alpha - methyl undecyl)-N,N-dimethyl ammonium chloride -----	0.6	
N,N - dipentadecyl - N,N - dimethyl ammonium chloride -----	2.3	45
N,N - dioctadecyl - N,N - dimethyl ammonium chloride -----	2.1	
Bis(2-hydroxyethyl)arachidyl amine oxide -----	3.0	
Water -----	92.0	50
	100.0	

This product has good fabric softening properties.

Example VII

The following composition shows that K₄P₂O₇ can be substituted for NaCl. The product is made in accordance with the general procedure set forth in Example II.

	Parts	
The quaternary mixture of Example II -----	6.0	60
Dimethyl stearyl amine oxide -----	2.0	
K ₄ P ₂ O ₇ -----	0.1	
Water -----	91.9	65
	100.0	

This product is a homogeneous liquid having a viscosity of less than 100 cps. It has excellent fabric softening properties.

The solid forms of the compositions of this invention may be in particulate form or may be compressed or molded into any desired shape. The particulate form is preferred. A suitable solid form may contain solid diluents if desired; for example such diluents may be urea, sodium sulfate, sodium chloride, starch, colloidal clays, finely

divided silicas, sodium bicarbonate, polyphosphates such as tetrapotassium pyrophosphate, sodium tripolyphosphate, etc., sodium carbonate, sodium tetraborate, etc. Urea or sodium sulfate are preferred. Suitable solid compositions may also contain small amounts, e.g. about 4%, of a quaternary ammonium mixture having the compositions hereinbefore described, and also small amounts of the amine oxide, e.g., about 0.5%, and a diluent, e.g. about 95.5%. If desired, the solid compositions may comprise as much as about 88% of the quaternary ammonium compound, with about 12% amine oxide and no diluent. A particularly useful product comprises about 6% of the quaternary ammonium compound, about 2% of a tertiary amine oxide, and about 92% urea or sodium sulfate, as seen in Example VIII.

Example VIII

Following are two examples of granular products within the scope of the invention.

	a	b
The quaternary ammonium compound of Example II.....	6	6
Dimethyl stearyl amine oxide.....	2	2
Na ₂ SO ₄	92	
Urea.....		92
Total.....	100	100

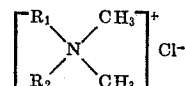
The figures are parts by weight. The products are tested in the washing machine in the presence of a commercial built anionic detergent composition and a commercial built nonionic detergent composition. Both products have good fabric softening properties and are non-yellowing.

Example IX

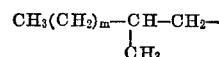
A liquid product within the invention is made having the following composition.

	Parts by weight
A mixture of quaternary ammonium compounds --	6.0
Dimethyl stearyl amine oxide -----	2.0
Water -----	92.0
	100.0

The mixture comprises quaternary ammonium compounds having the generic structure



wherein R₁ and R₂ are independently selected from Radical I:



and Radical II: CH₃(CH₂)_y—, and mixtures thereof,

m is 8 through 11, inclusive
y is 11 through 17, inclusive

and wherein

Radical I comprises about 12% of the total higher alkyl radicals in said mixture, and

about 20% of the radicals represented by Radical I are alpha-methyl undecyl, about 30% are alpha-methyl dodecyl, about 30% are alpha-methyl tridecyl, and about 20% are alpha-methyl tetradecyl, and

Radical III comprises about 88% of the total higher alkyl radicals in said mixture, and

about 10% of the radicals represented by Radical II are dodecyl, about 15% are tridecyl, about 15% are tetradecyl, about 10% are pentadecyl, about 25% are hexadecyl and about 25% are octadecyl.

A product having the above composition has excellent fabric softening properties.

Example X

A liquid product within the invention is made with the following composition.

	Parts by weight	
The quaternary ammonium mixture of Example IX -----	15.0	5
Dimethyl stearyl amine oxide -----	3.5	
Water -----	81.5	
	100.0	10

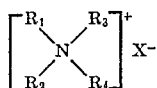
The product is physically stable and has excellent fabric softening characteristics.

The examples given herein are for the purpose of illustrating the invention which is limited only by the scope of the appended claims.

What is claimed is:

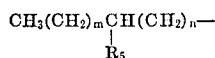
1. A non-yellowing fabric softener consisting essentially of:

- (i) a mixture of quaternary ammonium compounds having branched and straight chain higher alkyl radicals, said compounds being represented by the formula



wherein

R_1 and R_2 are independently selected from the group consisting of
Radical I:



and

Radical II: $CH_3(CH_2)_y-$

and mixtures thereof, where $m=8$ through 11 inclusive, $n=1$, $y=11$ through 17, inclusive, and Radical I comprises between about 5% and about 25% by weight of the total of R_1 and R_2 , and Radical II comprises between about 40% and about 60% by weight of carbon chains where y is 11 through 14 inclusive, with the remainder being carbon chains where y is 15 through 17, inclusive;

R_3 and R_4 are independently selected from the group consisting of methyl, ethyl, propyl, and isopropyl radicals,

R_5 is methyl or ethyl, and

X is an anion selected from the group consisting of chloride, bromide, iodide, methosulfate, and ethosulfate, which imparts water dispersibility to the quaternary; and

- (ii) a tertiary amine oxide compound having the structure



wherein R_6 is a higher alkyl radical having from about 16 to about 22 carbon atoms, or the 2-hydroxy derivative thereof; R_7 and R_8 are each independently methyl, ethyl, propyl, isopropyl, or hydroxyethyl radicals, said quaternary ammonium compound mixture and tertiary amine oxide being within the weight ratios of about 1:1 to about 7:1 respectively.

2. The fabric softening composition of claim 1 comprising about 6% by weight of the mixture of quaternary ammonium compounds, about 2% by weight of the tertiary amine oxide, and the balance substantially water, said mixture of quaternary ammonium compounds and said tertiary amine oxide having the identification set forth in claim 1.

3. A liquid fabric softening composition according to claim 1 consisting essentially of

- (i) about 6% of said mixture of quaternary ammonium compounds, wherein

Radical I comprises about 12% of the total higher alkyl radicals in said mixture, X being chloride, and wherein about 20% of the radicals represented by Radical I are alpha-methyl undecyl, about 30% are alpha-methyl dodecyl, about 30% are alpha-methyl tridecyl, and about 20% are alpha-methyl tetradecyl, and wherein

Radical II comprises about 88% of the total higher alkyl radicals in said mixture wherein

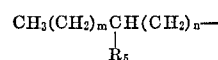
about 10% of the radicals represented by Radical II are dodecyl, about 15% are tridecyl, about 15% are tetradecyl, about 10% are pentadecyl, about 25% are hexadecyl and about 25% are octadecyl,

- (ii) about 2% of dimethyl stearyl amine oxide, and
(iii) the balance substantially water, said Radical I and Radical II having the identification set forth in claim 1.

4. A fabric-softening composition consisting essentially of

- (i) a fabric softening amount of a quaternary ammonium mixture consisting essentially of

(a) about 5% to about 25% by weight based on said mixture of branched alkyl chain compounds wherein said branched alkyl chain is represented by the formula



wherein m is 8 through 11, n is 1, and R_5 is methyl or ethyl, said branched alkyl chain compounds having two alkyl chains of about 12 to about 15 carbon atoms, and two alkyl chains each independently selected from the group consisting of methyl, ethyl, propyl, and isopropyl per molecule,

- (b) about 95% to about 75% by weight, based on said mixture, of straight alkyl chain quaternary ammonium compounds consisting essentially of about 40% to about 60% by weight of said straight-chain compounds having, per molecule, two straight alkyl chains each having about 12 to 15 carbon atoms, and about 60% to 40% by weight of said straight-chain compounds having, per molecule, two straight alkyl chains each having about 16 to 18 carbon atoms, said straight chain quaternary ammonium compounds having in addition two alkyl chains independently selected from the group consisting of methyl, ethyl, propyl, and isopropyl, and
(ii) a tertiary amine oxide compound having the structure



wherein R_6 is a higher alkyl radical having from about 16 to about 22 carbon atoms, or the 2-hydroxy derivative thereof, R_7 and R_8 are each independently methyl, ethyl, propyl, isopropyl or hydroxyethyl radicals, said quaternary ammonium mixture and tertiary amine oxide compound being within the weight ratios of about 1:1 to about 7:1, respectively.

5. A fabric softening composition in solid form according to claim 4 consisting essentially of from about 4% to about 50% of said quaternary ammonium mixture, about 0.5% to about 50% of the tertiary amine oxide of claim 4, and from 0 to about 95.5% of a solid diluent selected from the group consisting of urea, sodium sulfate, sodium chloride, starch, colloidal clays, finely divided silicas, sodium bicarbonate, tetrapotassium pyro-

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phosphate, sodium tripolyphosphate, sodium carbonate,
and sodium tetraborate.

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10 117—139.5 CQ; 252—137, 152