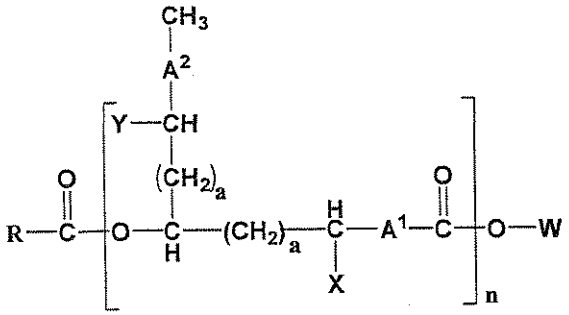
MIXED SALTS OF SULFONATED ESTOLIDES AND OTHER DERIVATIVES OF FATTY ACIDS, AND METHODS OF MAKING THEM

BACKGROUND OF THE INVENTION

[01] The present technology, in general, relates to sulfo-estolides. More particularly, the present technology relates to phase-stable compositions comprising mixed salts of sulfo-estolides, and methods of making phase-stable sulfo-estolide compositions comprising mixed salts of sulfo-estolides.

BRIEF SUMMARY OF THE INVENTION

[01a] In one aspect, there is provided a composition comprising a mixture of sodium and potassium salts of sulfo-estolides, which have the following Formula:



wherein n is an integer from 1-30;

one of X and Y is SO_3-Z, the other of X and Y is H, and X and Y are independently assigned in each repeating unit;

A^1 and A^2 are linear or branched, saturated or unsaturated, substituted or un-substituted, alkyl diradicals wherein the total number of carbons for each repeating unit is independent and in the range of C_8 to C_{22};

a is 0, 1, or 2, and is independently assigned in each repeating unit;

R is linear or branched, saturated or unsaturated, substituted or un-substituted hydrocarbon wherein the total number of carbon atoms is from 1 to 24;

W is a sodium or potassium cation, H, or an alkyl or substituted alkyl group; and

Z is a sodium or potassium cation;

wherein the potassium salt is present in the mixture in

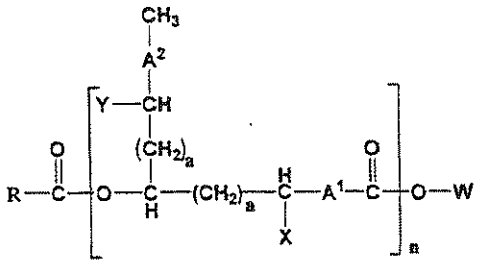
a weight fraction of about 0.1 to about 0.8 based on the total weight of the potassium and sodium salts in the mixture;

the composition has a pH value of 6 to 8.5;

the mixture of sodium and potassium sulfo-estolide salts is present in the composition in a concentration of at least 50% by weight actives; and

wherein the composition is a clear, homogeneous liquid product.

[02] In one example~~at least one aspect~~, the present technology provides a composition comprising a mixture of sodium and potassium salts of sulfo-estolides, which have the following Formula:



wherein n is an integer from 1-30; one of X and Y is SO_3-Z, the other of X and Y is H, and X and Y are independently assigned in each repeating unit; A^1 and A^2 are linear or branched, saturated or unsaturated, substituted or un-substituted, alkyl diradicals wherein the total number of carbons for each repeating unit is independent and in the range of C_8 to C_{22}; a is 0, 1, or 2, and is independently assigned in each repeating unit; R is linear or branched, saturated or unsaturated, substituted or un-substituted hydrocarbon wherein the total number of carbon atoms is from 1 to 24; W is a sodium or potassium cation, H, or an alkyl or substituted alkyl group; and Z is a sodium or potassium cation; wherein the sodium and potassium salts are present in the mixture in amounts sufficient to obtain a composition that is a clear, homogeneous liquid product.

[02a] In another aspect, there is provided a process for preparing a phase-stable sulfo-estolide composition comprising the steps of:

(a) providing at least one sulfonated intermediate made by sulfonating at least one unsaturated fatty carboxylic acid having 8 to 24 carbon atoms;

(b) reacting the sulfonated intermediate with a chain termination agent having 4 to 24 carbon atoms to form at least one sulfo-estolide;

(c) neutralizing the at least one sulfo-estolide by adding to the at least one sulfo-estolide a caustic agent selected from the group consisting of KOH, NaOH and mixtures thereof to obtain a neutralized sulfo-estolide salt;

(d) bleaching the neutralized sulfo-estolide salt with hydrogen peroxide at a pH level in the range of about 4.5 to about 7.5; and

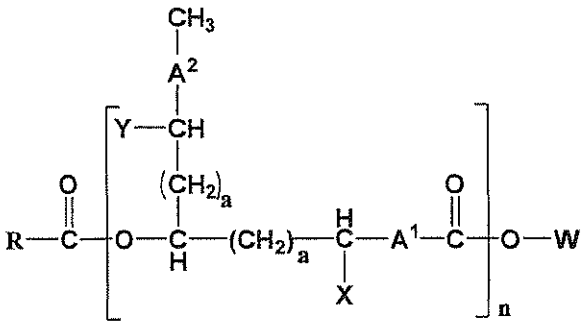
(e) adding additional KOH, NaOH or mixtures thereof before, during or after the bleaching step in an amount sufficient to obtain a mixture of potassium and sodium sulfo-estolide salts that results in a phase-stable sulfo-estolide composition that is clear and homogeneous; provided that when the caustic agent for neutralization is KOH, then NaOH or a mixture of NaOH and KOH is added to the sulfo-estolide salt before, during or after the bleaching step to obtain the sulfo-estolide salt mixture, and further provided that when the caustic agent for neutralization is NaOH, then KOH or a mixture of KOH and NaOH is added to the sulfo-estolide salt before, during or after the bleaching step to obtain the sulfo-estolide salt mixture.

[03] In another exampleaspeet, the present technology provides a process for preparing a phase-stable sulfo-estolide composition comprising the steps of: providing at least one sulfonated intermediate made by sulfonating at least one unsaturated fatty carboxylic acid having 8 to 24

carbon atoms; reacting the sulfonated intermediate with a chain termination agent having 4 to 24 carbon atoms to form at least one sulfo-estolide; neutralizing the at least one sulfo-estolide by adding to the at least one sulfo-estolide a caustic agent selected from the group consisting of KOH, NaOH and mixtures thereof to obtain a neutralized sulfo-estolide salt; bleaching the neutralized sulfo-estolide salt with hydrogen peroxide at a pH level in the range of about 4.5 to about 7.5; and adding additional KOH, NaOH or mixtures thereof before, during or after the bleaching step in an amount sufficient to obtain a mixture of potassium and sodium sulfo-estolide salts that results in a phase-stable sulfo-estolide composition that is clear and homogeneous.

[03a] In another aspect, there is provided a laundry detergent composition, comprising: about 2% to about 90% by weight of a mixture of sodium and potassium salts of sulfo-estolides having the following Formula 1:

Formula 1



wherein n is an integer from 1-30;

one of X and Y is SO3-Z, the other of X and Y is H, and X and Y are independently assigned in each repeating unit;

A1 and A2 are linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl diradicals wherein the total number of carbons for each repeating unit is independent and in the range of C_8 to C_{22};

a is 0, 1, or 2, and is independently assigned in each repeating unit;

R is a linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl radical with from 1 to 24 carbon atoms;

W is a sodium or potassium cation, H, or an alkyl or substituted alkyl group;

Z is a sodium or potassium cation;

about 2% to about 40% by weight of at least one nonionic surfactant;

0% to about 35% by weight of at least one alcohol ether sulfate;

0% to about 6% by weight of lauryl dimethlyamine oxide;

0% to about 10% by weight of oleamide diethanolamine;

0% to about 6% by weight of $C_{12}EO_3$;

0% to about 10% by weight of coconut fatty acid;

0% to about 3% by weight of borax pentahydrate;

0% to about 6% by weight of propylene glycol;

0% to about 10% by weight of sodium citrate;

0% to about 6% by weight of triethanolamine;

0% to about 6% by weight of monoethanolamine;

0% to about 1% by weight of at least one fluorescent whitening agent;

0% to about 1.5% by weight of at least one anti-redeposition agent;

0% to about 2% by weight of at least one thickener;

0% to about 20% by weight of at least one thinner;

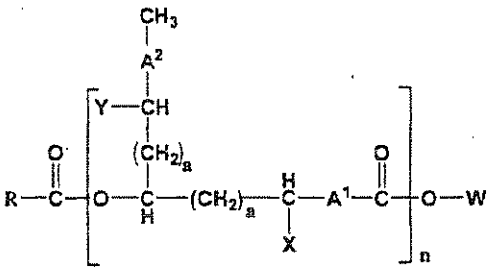
0% to about 2% by weight of at least one protease;

0% to about 2% by weight of at least one amylase; and

0% to about 2% by weight of at least one cellulase.

[04] Also disclosed is~~nother aspect of the present technology provides~~ a laundry detergent composition, comprising: about 2% to about 90% by weight of a mixture of sodium and potassium salts of sulfo-estolides having the following Formula 1:

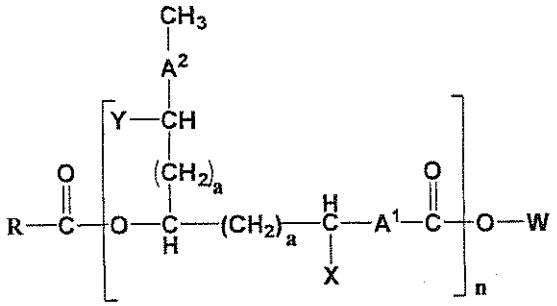
Formula 1



wherein n is an integer from 1-30; one of X and Y is SO3-Z, the other of X and Y is H, and X and Y are independently assigned in each repeating unit; A1 and A2 are linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl diradicals wherein the total number of carbons for each repeating unit is independent and in the range of C_8 to C_{22}; a is 0, 1, or 2, and is independently assigned in each repeating unit; R is a linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl radical with from 1 to 24 carbon atoms; W is a sodium or potassium cation, H, or an alkyl or substituted alkyl group; Z is a sodium or potassium cation; about 2% to about 40% by weight of at least one nonionic surfactant; 0% to about 35% by weight of at least one alcohol ether sulfate; 0% to about 6% by weight of lauryl dimethlyamine oxide; 0% to about 10% by weight of oleamide diethanolamine; 0% to about 6% by weight of $C_{12}EO_3$; 0% to about 10% by weight of coconut fatty acid; 0% to about 3% by weight of borax pentahydrate; 0% to about 6% by weight of propylene glycol; 0% to about 10% by weight of sodium citrate; 0% to about 6%

by weight of triethanolamine; 0% to about 6% by weight of monoethanolamine; 0% to about 1% by weight of at least one fluorescent whitening agent; 0% to about 1.5% by weight of at least one anti-redeposition agent; 0% to about 2% by weight of at least one thickener; 0% to about 20% by weight of at least one thinner; 0% to about 2% by weight of at least one protease; 0% to about 2% by weight of at least one amylase; and 0% to about 2% by weight of at least one cellulase.

[04a] In yet another aspect, there is provided a laundry detergent composition, comprising: about 2% to about 90% by weight of a mixture of sodium and potassium salts of sulfo-estolides having the following Formula 1:



wherein n is an integer from 1-30;

one of X and Y is SO3-Z, the other of X and Y is H, and X and Y are independently assigned in each repeating unit;

A1 and A2 are linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl diradicals wherein the total number of carbons for each repeating unit is independent and in the range of C_8 to C_{22};

a is 0, 1, or 2, and is independently assigned in each repeating unit;

R is a linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl radical with from 1 to 24 carbon atoms;

W is a sodium or potassium cation, H, or an alkyl or substituted alkyl group;

Z is a sodium or potassium cation;

about 2% to about 40% by weight of at least one nonionic surfactant;

0% to about 35% by weight of at least one or more alcohol ether sulfate;

0% to about 6% by weight of lauryl dimethlyamine oxide;

0% to about 13% by weight of $C_{12}EO_3$;

0% to about 10% by weight of coconut fatty acid;

0% to about 10% by weight of sodium metasilicate;

0% to about 10% by weight of sodium carbonate;

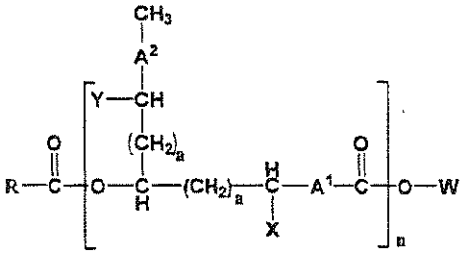
0% to about 1% by weight of at least one fluorescent whitening agent;

0% to about 1.5% by weight of at least one anti-redeposition agent;

0% to about 2% by weight of at least one thickener; and

0% to about 20% by weight of at least one thinner.

[05] Moreover, another exampleaspeet of the present technology provides a laundry detergent composition, comprising: about 2% to about 90% by weight of a mixture of sodium and potassium salts of sulfo-estolides having the following Formula 1:



wherein n is an integer from 1-30; one of X and Y is SO3-Z, the other of X and Y is H, and X and Y are independently assigned in each repeating unit; A1 and A2 are linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl diradicals wherein the total number of carbons for each repeating unit is independent and in the range of C_8 to C_{22}; a is 0, 1, or 2, and is independently assigned in each repeating unit; R is a linear or branched, saturated or unsaturated, substituted or unsubstituted alkyl radical with from 1 to 24 carbon atoms; W is a sodium or potassium cation, H, or an alkyl or substituted alkyl group; Z is a sodium or potassium cation; about 2% to about 40% by weight of at least one nonionic surfactant; 0% to about 35% by weight of at least one or more alcohol ether sulfate; 0% to about 6% by weight of lauryl dimethlyamine oxide; 0% to about 13% by weight of $C_{12}EO_3$; 0% to about 10% by weight of coconut fatty acid; 0% to about 10% by weight of sodium metasilicate; 0% to about 10% by weight of sodium carbonate; 0% to about 1% by weight of at least one fluorescent whitening agent; 0% to about 1.5% by weight of at least one anti-redeposition agent; 0% to about 2% by weight of at least one thickener; and 0% to about 20% by weight of at least one thinner.

[06] Another exampleaspeet of the present technology provides a composition comprising a mixture of salts of sulfo-estolides, which have the following Formula: