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(54) **Liquid surface active compositions.**

(57) This invention relates to a process for preparing a liquid surface active composition having a 1,4-dioxane content of less than 10 ppm relative to alcohol ethoxysulfate which process comprises: a) partially sulfating an alcohol ethoxylate at an SO₃/alcohol ethoxylate mole ratio of less than 0.99 to form a mixture of a sulfuric acid ester of said alcohol ethoxylate and alcohol ethoxylate and b) combining said mixture with a concentrated neutralizing agent in an amount sufficient to neutralize said sulfuric acid ester, and an amount of alcohol ethoxylate and water sufficient to yield a final composition having from 15 percent by weight to 99 percent by weight of an alcohol ethoxylate, from 1 percent by weight to 80 percent by weight of a salt of an alcohol ethoxysulfate, and from .01 percent by weight to 15 percent by weight water, wherein said alcohol ethoxylate and alcohol ethoxysulfate components comprise at least 85 percent by weight of said composition, and wherein said composition is substantially free of any organic solvent.

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LIQUID SURFACE ACTIVE COMPOSITIONS

This invention relates to liquid surface active compositions comprising a mixture of alcohol ethoxylates and alcohol ethoxysulfates which have high active matter content and contain low levels of 1,4-dioxane.

The manufacture and use of synthetic laundry detergents containing mixtures of nonionic and anionic surfactants have been documented in the patent literature.

5 Liquid surfactant compositions are well known in the field of laundry detergents and, whether for domestic or industrial applications, practically all of the available formulations are solutions of one or more surface active materials (surfactants) in water, together with an organic solvent if necessary. Such formulations usually contain only about 10 wt% to 45 wt% active matter.

10 There are certain problems involved in the use of relatively dilute formulations such as the difficulty and high cost of transporting the formulation from its point of manufacture to its point of sale. Since most of the formulation's bulk is water, it would be very advantageous from the standpoint of shipping costs to prepare more concentrated formulations.

By providing good detergency, water hardness tolerance and foamability, alcohol ethoxysulfates are finding increasing use in household laundry powders and liquids as part of mixed active surfactant systems. 15 However, a drawback to the use of alcohol ethoxysulfates in detergent formulations is the formation of 1,4-dioxane, an undesirable side-product during SO_3 sulfation of alcohol ethoxylates to produce alcohol ethoxysulfate. Despite conflicting evaluations of its level of toxicity, 1,4-dioxane has become progressively linked to carcinogenic activity, thus leading to a need to define acceptable levels of 1,4-dioxane and to develop a method for lowering the level of 1,4-dioxane in alcohol ethoxysulfate to an acceptable level or 20 eliminating it altogether. Various studies have shown that dioxane levels in aqueous alcohol ethoxysulfate solutions can be reduced by sulfating at less than the stoichiometric ratio of SO_3 to alcohol ethoxylate feed. Researchers have speculated that at these milder reaction conditions, less SO_3 is available for complexation to the ethoxylate chain, an interaction which can lead to chain cleavage and dioxane formation. However, with this technique, an unwanted increase in unsulfated alcohol ethoxylate is obtained in the final sulfator 25 product. Because the high active matter liquid systems of the instant invention contain alcohol ethoxylate, however, the presence of large amounts of unsulfated alcohol ethoxylate in the acid mixture is acceptable and desirable. In addition, the use of milder reaction conditions can lead to reductions in other unwanted products such as sodium sulfate and colored impurities.

An additional drawback to the use of alcohol ethoxysulfates in aqueous formulations is their strong gel 30 forming tendencies at concentrations greater than 30%. Flowable solutions can be prepared by incorporating approximately 14% ethanol into 60% active matter solutions of alcohol ethoxysulfates. This relatively high active matter solution lowers shipping costs, but the presence of ethanol in alcohol ethoxysulfate solutions prevents their use in spray-dried or dry-blended laundry powders where the flammability and combustibility of ethanol are a significant processing hazard. In addition, excessive water and ethanol 35 prohibit the formation of a free-flowing powder when surfactant concentrates are blended with water-soluble detergent powder particles.

It is therefore an object of this invention to prepare surface active compositions comprising a blend of alcohol ethoxylates and alcohol ethoxysulfates with a 1,4-dioxane content of less than 10 ppm relative to alcohol ethoxysulfate, less than 15% water and substantially free of any organic solvent. In the process of 40 the present invention, an anionic surfactant, alcohol ethoxysulfate, is prepared by partial sulfation and blended with a nonionic surfactant, alcohol ethoxylate. Each of these surfactant types act as mutual hydrotropes, thereby permitting liquid concentrates containing active matter levels of at least 85%. It is a further object of this invention to provide a process for preparing concentrates which are clear, single-phase pourable liquids rather than gels at relatively low temperatures such as, for example, about 50° C or less.

45 This invention relates to a process for preparing a liquid surface active composition having a 1,4-dioxane content of less than 10 ppm relative to alcohol ethoxysulfate which process comprises: a) partially sulfating an alcohol ethoxylate at an SO_3 /alcohol ethoxylate mole ratio of less than 0.99 to form a mixture of a sulfuric acid ester of said alcohol ethoxylate and alcohol ethoxylate and b) combining said mixture with a concentrated base in an amount sufficient to neutralize said sulfuric acid ester, and an amount of alcohol 50 ethoxylate and water sufficient to yield a final composition having from 15 percent by weight to 99 percent by weight of an alcohol ethoxylate, from 1 percent by weight to 80 percent by weight of a salt of an alcohol ethoxysulfate, and from .01 percent by weight to 15 percent by weight water, wherein said alcohol ethoxylate and alcohol ethoxysulfate components comprise at least 85 percent by weight of said composition, and wherein said composition is substantially free of any organic solvent.

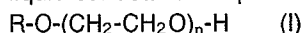
This invention also relates to liquid surface active compositions prepared according to this process.

Preferably the $\text{SO}_3/\text{alcohol}$ ethoxylate mol ratio is less than 0.90.

The composition prepared in the instant process thus comprises a) an alcohol ethoxylate component, b) an alcohol ethoxysulfate component prepared by partial sulfation of an alcohol ethoxylate and c) less than 15 percent by weight of water, with the alcohol ethoxylate and alcohol ethoxysulfate components together comprising at least 85 percent by weight of the composition. The composition is also substantially free of organic solvents, particularly low molecular weight organic solvents and more particularly, lower alcohols having from 1 to about 5 carbon atoms, particularly ethanol and methanol.

As used herein, the term "liquid" shall mean a pourable material which is neither a solid nor a gel. As used herein, "substantially free" of an organic solvent shall mean that the amount of organic solvent present, if any, is less than the amount which would substantially alter the properties of the composition. The composition typically contains less than about 3 percent by weight of organic solvent, per total weight of the composition.

The general class of nonionic surfactants or alcohol ethoxylates which are partially sulfated in the process of the instant invention and which are combined with the alcohol ethoxysulfate to form the final liquid surfactant composition is characterized by the chemical formula



wherein R is a straight-chain or branched-chain alkyl group having in the range of from 8 to 18 carbon atoms, preferably from 12 to 18 carbon atoms, or an alkylaryl group having an alkyl moiety having from 8 to 12 carbon atoms, and n represents the average number of oxyethylene groups per molecule and is in the range of from 1 to 12, preferably from 2 to 9 and more preferably from 2 to 5. The alkyl group can have a carbon chain which is straight or branched, and the ethoxylate component can be a combination of straight-chain and branched molecules. Preferably, about 85 percent of the R groups in the alcohol ethoxylates utilized in the instant invention are straight-chain. Ethoxylates within this class are conventionally prepared by the sequential addition of ethylene oxide to the corresponding alcohol (ROH) in the presence of a catalyst.

The alcohol ethoxylates utilized in the instant invention are preferably derived by ethoxylation of primary or secondary, straight-chain or branched alcohols. The most common ethoxylates in this class and the ones which are particularly useful in this invention are the primary alcohol ethoxylates, i.e., compounds of formula I in which R is an alkyl group and the $-\text{O}-(\text{CH}_2-\text{CH}_2\text{O})_n\text{-H}$ ether substituent is bound to a primary carbon of the alkyl group.

Alcohols which are suitable for ethoxylation to form the alcohol ethoxylate component of the surfactant composition as well as the alcohol ethoxylate to be partially sulfated in this invention include coconut fatty alcohols, tallow fatty alcohols, and the commercially available synthetic long-chain fatty alcohol blends, e.g., the C_{12} to C_{15} alcohol blends available as NEODOL 25 Alcohol (a registered trademark of product manufactured and sold by Shell Chemical Company), the C_{12} to C_{14} alcohol blends available as Tergitol 24L (a registered trademark of product manufactured and sold by Union Carbide Corporation), and the C_{12} to C_{13} alcohol blends available, for example, as NEODOL 23 Alcohol (Shell).

Suitable alcohol ethoxylates can be prepared by adding to the alcohol or mixture of alcohols to be ethoxylated a calculated amount, e.g., from 0.1 percent by weight to 0.6 percent by weight of a strong base, typically an alkali metal or alkaline earth metal hydroxide such as sodium hydroxide or potassium hydroxide, which serves as a catalyst for ethoxylation. The resulting mixture is dried, as by vapor phase removal of any water present, and an amount of ethylene oxide calculated to provide from 1 mole to 12 moles of ethylene oxide per mole of alcohol is then introduced and the resulting mixture is allowed to react until the ethylene oxide is consumed, the course of the reaction being followed by the decrease in reaction pressure.

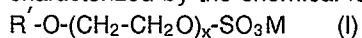
Specific nonionic detergent active compounds which can be used in the present invention as the feedstock for the partial sulfation step or as the alcohol ethoxylate component of the surfactant composition include ethoxylated fatty alcohols.

A preferred class of nonionic ethoxylates is represented by the condensation product of a fatty alcohol having from 12 to 15 carbon atoms and from 2 to 9 moles of ethylene oxide per mole of fatty alcohol. Suitable species of this class of ethoxylates include: the condensation product of one mole of a C_{12} - C_{15} oxo-alcohol and 7 moles of ethylene oxide; the condensation product of one mole of a narrow cut C_{14} - C_{15} oxo-alcohol and 7 or 9 moles of ethylene oxide; the condensation product of one mole of a narrow cut C_{12} - C_{13} fatty oxo-alcohol and 6.5 moles of ethylene oxide. The fatty oxo-alcohols, while primarily linear, can have, depending upon the processing conditions and raw material olefins, a certain degree of branching. A degree of branching in the range from 15% to 50% by weight is frequently found in commercially available oxo-alcohols.

In the process of the instant invention, an alcohol ethoxylate as described above is sulfated under

conditions to maintain a predetermined proportion of sulfated alcohol ethoxylate in the product. The alcohol ethoxylate is thus only partially sulfated and a mixture of a sulfuric acid ester of the alcohol ethoxylate and alcohol ethoxylate is formed. The partial sulfation in the instant invention is carried out utilizing liquid or gaseous SO_3 as a sulfating agent in a molar ratio of SO_3 to alcohol ethoxylate in the range of from 0.50 to 0.99, preferably 0.60 to 0.95 and more preferably from 0.60 to 0.90, in order to achieve a final liquid surfactant composition containing less than about 10 ppm 1,4-dioxane relative to alcohol ethoxysulfate. The partial sulfation reaction may be carried out employing either batch or continuous operations, and the specific reaction times and temperatures may be varied depending upon the reaction system utilized. Suitable partial sulfation agents include sulfur trioxide (SO_3), chlorosulfonic acid (ClSO_3H) and sulfamic acid ($\text{NH}_2\text{SO}_3\text{H}$), with sulfur trioxide being preferred. A typical partial sulfation procedure utilizing sulfur trioxide includes contacting liquid alcohol ethoxylate and gaseous sulfur trioxide at a molar ratio of SO_3 to alcohol ethoxylate in the range of from about 0.60 to about 0.90 at about atmospheric pressure in the reaction zone of a falling film sulfator cooled by water at a temperature in the range of from about 25°C to about 70°C to yield a mixture of the sulfuric acid ester of alcohol ethoxylate and unsulfated alcohol ethoxylate.

The alcohol ethoxysulfates produced by the partial sulfation in step a) of the instant process are characterized by the chemical formula



wherein R' is a straight-chain or branched-chain alkyl group having in the range of from 8 to 18 carbon atoms, preferably from 12 to 18 carbon atoms, or an alkylaryl group having an alkyl moiety having from 8 to 12 carbon atoms, x represents the average number of oxyethylene groups per molecule and is in the range of from 1 to 12, preferably from 5 to 12 and more preferably from 7 to 12 and M is a cation selected from an alkali metal ion, an ammonium ion, and mixtures thereof. R' is preferably substantially straight-chain alkyl, that is, at least 50 percent, preferably 85 percent, of the alkyl R' groups in the instant composition are straight-chain.

Following partial sulfation of the alcohol ethoxylate in step a), the sulfuric acid ester of the alcohol ethoxylate formed during partial sulfation exits from the falling film column and is combined in step b) with a neutralizing agent sufficient to neutralize the sulfuric acid ester, and an amount of alcohol ethoxylate and water. The alcohol ethoxylate which is combined with the alcohol ethoxysulfate can be the unsulfated alcohol ethoxylate product from the partial sulfation step, an additional alcohol ethoxylate which may or may not contain the same number of oxyethylene units per molecule as the alcohol ethoxylate which is partially sulfated, or a combination of the two.

In a preferred embodiment, the alcohol ethoxylate which is partially sulfated in step a) to form the alcohol ethoxysulfate component of the liquid surfactant composition has a higher average number of oxyethylene units per molecule than the alcohol ethoxylate which is combined with the alcohol ethoxysulfate in step b).

The amount of alcohol ethoxysulfate which is present in the final surfactant composition is in the range of from 1 percent by weight to 80 percent by weight, preferably from 25 percent by weight to 75 percent by weight, and more preferably from 40 percent by weight to 60 percent by weight.

The amount of alcohol ethoxylate which is present in the final composition of the present invention is in the range of from 15 percent by weight to 99 percent by weight, preferably from 25 percent by weight to 75 percent by weight, and more preferably from 40 percent by weight to 60 percent by weight.

The weight ratio of alcohol ethoxylate to alcohol ethoxysulfate in the composition prepared by the process in the instant invention can vary widely with weight ratios in the range of from 99:1 to 1:6, from 5:1 to 1:5, from 4:1 to 1:4 and from 3:1 to 1:3. The weight ratio of alcohol ethoxylate to alcohol ethoxysulfate is preferably in the range of from 4:1 to 1:4, preferably from 3:1 to 1:3, and more preferably from 2:1 to 1:2.

The amount of water utilized in the composition is less than 15 percent by weight of the composition, preferably less than 10 percent by weight, more preferably less than 7 percent by weight, and most preferably, less than 5 percent by weight. The amount of water can be controlled most efficiently when an anhydrous base, such as for example, triethanolamine or monoethanolamine, is used as the neutralizing agent in step b) of the process. However through drying or through addition of water, the amount of water can also be controlled in systems prepared with alkali metal neutralizing agents such as, for example, sodium and potassium hydroxide.

The combining in step b) of the sulfuric acid ester of the alcohol ethoxylate prepared by the partial sulfation in step a) with the neutralizing agent, alcohol ethoxylate and water can be accomplished by mixing the components together in any manner. It is generally preferred, however, that the unneutralized alcohol ethoxysulfate product of step a) (i.e., the organic sulfuric acid ester/unreacted alcohol ethoxylate mixture resulting from the partial sulfation reaction) be added to a well-stirred mixture of alcohol ethoxylate and a concentrated base such as, for example, aqueous 50% sodium hydroxide. Other suitable bases include

potassium hydroxide, ammonium hydroxide, triethanolamine and monoethanolamine.

Typically, the liquid compositions prepared according to the process in the instant invention have a surface active material content, i.e. the percentage of alcohol ethoxylate plus the percentage of alcohol ethoxysulfate, of at least 85 percent by weight, preferably at least 90 percent by weight, and more preferably, at least 95 percent by weight of said composition. The compositions are also substantially free, typically less than 3 percent by weight, of organic solvents, preferably alcoholic solvents and more preferably, lower alcoholic solvents having from 1 to 5 carbon atoms.

The liquid surfactant compositions prepared in the invention can be utilized in a variety of detergent applications. The liquid surfactant compositions can be blended at relatively low temperatures, about 60° C or less, with solid detergent materials such as, for example, sodium carbonate, in order to form mixed active dry detergent powders. The liquid surfactant composition can also be added to water to form liquid detergents having lower active matter concentrations.

The invention will be described below by the following examples which are provided for purposes of illustration and are not to be construed as limiting the invention.

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Illustrative Embodiments

Preparation of Surfactant Compositions

Surfactant Composition A

An alcohol ethoxylate with a C₁₂-C₁₃ alkyl group and containing an average of 6.5 moles ethylene oxide/mole alcohol (commercially available as NEODOL 23-6.5 alcohol ethoxylate) was sulfated by reaction with gaseous SO₃ in a lab-scale falling-film reactor to form an alcohol ethoxysulfate. The SO₃/ethoxylate mole ratio was 0.64, and the reactor temperature was 65° C. The acid product was prepared at a rate of 13 g/min and was directly neutralized in a pre-mixed solution containing 42 g aqueous 50% sodium hydroxide and 67 g of an alcohol ethoxylate with a C₁₂-C₁₃ alkyl group and containing an average of 6.5 moles ethylene oxide/mole alcohol. The surfactant mixture was kept well-stirred through the use of a magnetic stirring plate. No gel formation was observed throughout the process. Approximately 420 g of acid product from the sulfator were added until pH 8 was obtained as measured by moistened pH paper.

The final product was a clear flowable liquid at 20° C and had the analyzed composition presented in Table I.

Surfactant Composition B

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The procedure described for Surfactant Composition A above was used except that the SO₃/ethoxylate mole ratio was held at 0.83. Approximately 300 g of the acid product were neutralized in a pre-mixed solution containing 42 g aqueous 50% sodium hydroxide and 189 g NEODOL 23-6.5 alcohol ethoxylate.

The final product was a clear flowable liquid at 20° C and had the analyzed composition presented in Table I.

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Surfactant Composition C

The procedure described for Surfactant Composition A above was used except that the SO₃/ethoxylate mole ratio was held at 1.03. Approximately 240 g of the acid product were neutralized in a pre-mixed solution containing 42 g aqueous sodium hydroxide and 250 g NEODOL 23-6.5 alcohol ethoxylate. The final product was a clear flowable liquid at 20° C and had the analyzed composition given in Table I.

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As shown in Table I, much lower 1,4-dioxane levels were found in Surfactant Compositions A and B as compared to the level found in Surfactant Composition C indicating a clear advantage of sulfating at less than the stoichiometric ratio of SO₃ and alcohol ethoxylate. Also, inert sodium sulfate formation was reduced by a factor of four by reducing the SO₃/alcohol ethoxylate molar ratio from 1.03 to 0.64.

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Chromatographic analyses of the unsulfated alcohol ethoxylate exiting the sulfator were performed to determine the compositions of the alcohol ethoxysulfate and alcohol ethoxylate components of the Surfactant Compositions. Despite the wide range of sulfation conditions employed, only a slight shift in the average EO-level of the two components was found as shown in Table II. As a result, the detergent properties of the three compositions would be expected to be nearly identical.

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Similarly, the physical properties of Surfactant Compositions A, B, and C were found to be quite comparable. All three were single-phase pumpable liquids of relatively low viscosity despite containing at

least 50% alcohol ethoxysulfate and greater than 95% total surfactant. Viscosity data over a wide range of temperatures and shear rates are given in Table III. For comparison, an aqueous solution containing 48% of the same 6.5-EO alcohol ethoxysulfate was a non-flowing gel exhibiting a viscosity greater than 40 Pa.s at 50 °C.

TABLE I

ANALYSES OF SURFACTANT COMPOSITIONS						
Surfactant Composition	SO ₃ /Ethoxylate Mole Ratio	Percent Weight Alcohol Ethoxysulfate	Percent Weight Alcohol Ethoxylate	Percent Weight H ₂ O	Percent Weight Na ₂ SO ₄	ppm 1,4-Dioxane ^{a)}
A	0.64	53	44	4.5	0.23	1
B	0.83	50	47	4.7	0.55	4
C	1.03	50	45	4.6	0.89	231

a) Basis Alcohol Ethoxysulfate

TABLE II

AVERAGE EO-LEVELS OF ALCOHOL ETHOXYLATE AND ALCOHOL ETHOXYLSULFATE COMPONENTS				
Surfactant Composition	SO ₃ /Ethoxylate Mole Ratio	AVG. EO-LEVEL		
		Unsulfated ^{a)} Sulfator Product	Alcohol ^{b)} Ethoxysulfate	Alcohol ^{b)} Ethoxylate
A	0.64	6.9	6.2	6.8
B	0.83	7.1	6.3	6.6
C	1.03	7.3	6.5	6.5

a) Measured by gas and liquid chromatography.

b) From mass-balance calculation.

Table III

Viscosities of Surfactant Compositions				
Temp (°C)	Shear Rate (s ⁻¹)	Surfactant Composition		
		A	B	C
20	0.396	1160 mPa.s	1040 mPa.s	1140 mPa.s
20	3.96	919 mPa.s	790 mPa.s	855 mPa.s
50	3.96	137 mPa.s	44 mPa.s	159 mPa.s
50	15.84	132 mPa.s	123 mPa.s	135 mPa.s
80	15.84	41 mPa.s	42 mPa.s	46 mPa.s
80	79.20	39 mPa.s	37 mPa.s	41 mPa.s

Claims

1. A process for preparing a liquid surface active composition having a 1,4-dioxane content of less than 10 ppm relative to alcohol ethoxysulfate which process comprises: a) partially sulfating an alcohol ethoxylate at an SO_3 /alcohol ethoxylate mole ratio of less than 0.99 to form a mixture of a sulfuric acid ester of said alcohol ethoxylate and alcohol ethoxylate and b) combining said mixture with a concentrated neutralizing agent in an amount sufficient to neutralize said sulfuric acid ester, and an amount of alcohol ethoxylate and water sufficient to yield a final composition having from 15 percent by weight to 99 percent by weight of an alcohol ethoxylate, from 1 percent by weight to 80 percent by weight of a salt of an alcohol ethoxysulfate, and from .01 percent by weight to 15 percent by weight water, wherein said alcohol ethoxylate and alcohol ethoxysulfate components comprise at least 85 percent by weight of said composition, and wherein said composition is substantially free of any organic solvent.
2. A process as claimed in claim 1, wherein the partially sulfating an alcohol ethoxylate is carried out at an SO_3 /alcohol ethoxylate mole ratio of less than 0.90.
3. A process as claimed in claim 1 or 2, wherein the process is carried out at a temperature in the range of from 20 °C to 80 °C.
4. A process as claimed in claim 1, wherein the SO_3 /alcohol ethoxylate mole ratio in said partial sulfation is in the range of from 0.50 to 0.99.
5. A process as claimed in one or more of the claims 1-4, wherein the SO_3 /alcohol ethoxylate mole ratio in said partial sulfation is in the range of from 0.60 to 0.90.
6. A process as claimed in one or more of the claims 1-5, wherein said alcohol ethoxysulfate in said liquid surface active composition has a formula $\text{R}'\text{-O-(CH}_2\text{CH}_2\text{O)}_x\text{-SO}_3\text{M}$, wherein R' is an alkyl group having from 8 to 18 carbon atoms or an alkylaryl group having an alkyl moiety having from 8 to 12 carbon atoms, M is a salt selected from the group consisting of an alkali metal salt, an ammonium salt and mixtures thereof, and x represents the average number of oxyethylene groups per molecule and is a number in the range of from 1 to 12.
7. A process as claimed in one or more of the claims 1-6, wherein said alcohol ethoxylate which is partially sulfated in step a) and added to said sulfuric acid ester in step b) has a formula $\text{R-O-(CH}_2\text{CH}_2\text{O)}_n\text{-H}$, wherein R is an alkyl group having from 8 to 18 carbon atoms or an alkylaryl group having an alkyl moiety in the range of from 8 to 12 carbon atoms, and n represents the average number of oxyethylene groups per molecule and is a number in the range of from 1 to 12.
8. A process as claimed in one or more of the claims 1-7, wherein said neutralizing agent is monoethanolamine, triethanolamine, sodium hydroxide or potassium hydroxide.
9. A process as claimed in any one of claims 1-8, wherein the percent by weight of alcohol ethoxysulfate in said liquid surface active composition is in excess of the percent by weight of alcohol ethoxylate.
10. A liquid surface active composition having a 1,4-dioxane content of less than 10 ppm relative to alcohol ethoxysulfate, from percent by weight to 99 percent by weight alcohol ethoxylate, from 1 percent by weight to 80 percent by weight of a salt of alcohol ethoxysulfate, and from .01 percent by weight to 15 percent by weight water, wherein said alcohol ethoxylate and alcohol ethoxysulfate comprise at least 85 percent by weight of said composition, which is obtainable by the process of a) partially sulfating an alcohol ethoxylate at an SO_3 /alcohol ethoxylate mole ratio of less than 0.99 to form a mixture of a sulfuric acid ester of said alcohol ethoxylate and alcohol ethoxylate and b) combining said mixture with a concentrated neutralizing agent in an amount sufficient to neutralize said sulfuric acid ester, and an amount of alcohol ethoxylate and water sufficient to yield a final composition having from 15 percent by weight to 99 percent by weight of an alcohol ethoxylate, from 1 percent by weight to 80 percent by weight of a salt of an alcohol ethoxysulfate, and from .01 percent by weight to 15 percent by weight water, wherein said alcohol ethoxylate and alcohol ethoxysulfate components comprise at least 85 percent by weight of said composition, and wherein said composition is substantially free of any organic solvent.

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