C_{12}) unsaturated fatty portions. Metathesis chemistry provides an opportunity to generate precursors having shorter chains and mostly *trans*- isomers, which could impart improved performance when the precursors are converted to downstream compositions (e.g., in surfactants).

Sulfation of alcohols produces alcohol sulfates, which have an C-O-SO_3X group, where X is typically an alkali metal or ammonium ion from a subsequent neutralization step. Sulfonation of unsaturated hydrocarbons gives sulfonates, which have a C-SO_3X group. When an unsaturated alcohol is the starting material, the unsaturated sulfate can be produced under some conditions (see, e.g., WO91/13057). With other reagents, alcohol sulfation and carbon-carbon double bond sulfonation may compete, with most of the reaction product resulting from sulfation, although the nature of the sulfonated by-products is generally not well understood (see, e.g., U.S. Pat. No. 5,446,188). Because of the competing side reactions, unsaturated alcohols are usually avoided when the goal is to make an alcohol sulfate or ether sulfate.

SUMMARY OF THE INVENTION

The present disclosure relates to sulfate and sulfonate derivatives made by one or more of alkoxylating, sulfating, sulfonating, and sulfitating monounsaturated fatty alcohol compositions. In one embodiment, the present disclosure relates to a sulfate and sulfonate derivative made by one or more of alkoxylating, sulfating, sulfonating, and sulfitating a monounsaturated fatty alcohol composition, wherein the fatty alcohol compositions are obtained by reducing a metathesis-derived monounsaturated alkyl ester. Of particular interest are the sulfate and ether sulfate derivatives. Microscopy studies indicate that the unsaturated sodium sulfates in particular have a lamellar phase that should enable formulation at high actives levels.

In an aspect, the present disclosure relates to a sulfate composition comprising: (a) from 40 to 60 wt.% of a monounsaturated fatty primary alcohol sulfate; and (b) from 40 to 60 wt.% of a secondary hydroxyalkyl fatty primary alcohol sulfate, wherein (a) and (b) derive from a C_{11}-C_{17} monounsaturated alcohol. In another aspect, the present disclosure relates to a mixture comprising water and from 1 to 80 wt.%, based on the amount of mixture, of the composition as disclosed above.

In another aspect, the present disclosure relates to a composition comprising a metathesis-derived monounsaturated fatty alcohol alkali metal sulfate having at least one lamellar phase at an actives level within the range of 65-80% actives.

In another ~~aspect~~embodiment, the present disclosure relates to a process for making an internally monounsaturated fatty alcohol sulfate, the process comprising reacting a terminally monounsaturated fatty alcohol, preferably a metathesis-derived terminally monounsaturated fatty alcohol, with sulfur trioxide in a falling-film reactor, followed by neutralization.

The derivatives and sulfate compositions are valuable for many end-use applications, including, for example, agricultural dispersants, water-soluble herbicides, anionic emulsifiers for agricultural use, hard surface cleaners, light-duty liquid detergents, personal cleansers, gas well foamers for oilfield applications, laundry detergents, enhanced oil recovery compositions, latex paints, and specialty foams.

In an aspect, there is provided a dispersant for agricultural compositions comprising the composition as disclosed above.

In an aspect, there is provided a water-soluble herbicide composition comprising the composition as disclosed above.

In an aspect, there is provided an anionic emulsifier for agricultural compositions comprising the composition as disclosed above.

In an aspect, there is provided an aqueous hard-surface cleaner comprising the composition as disclosed above.

In an aspect, there is provided a personal cleanser comprising the composition as disclosed above.

In an aspect, there is provided a foamer, foam additive, or dispersant for use in gypsum, concrete, or fire-fighting applications comprising the composition as disclosed above.

In an aspect, there is provided a gas well foamer for use in oilfield applications comprising the composition as disclosed above.

In an aspect, there is provided a light-duty liquid detergent comprising the composition as disclosed above, wherein the composition derives from a C_{14}-C_{17} monounsaturated alcohol.

In an aspect, there is provided a laundry detergent comprising the composition as disclosed above.

In an aspect, there is provided a surfactant composition for use in enhanced oil recovery, comprising the composition as disclosed above.

In an aspect, there is provided a surfactant composition for use in emulsion polymerization, comprising the composition as disclosed above.

In an aspect, there is provided a sulfate derivative having the general structure: $R\text{-}CH{=}CH\text{-}(CH_2)_7\text{-}CH_2O\text{-}(AO)_n\text{-}SO_3X$ wherein R is H or C_2-C_7 alkyl, wherein when R is C_2-C_7 alkyl, the derivative has at least 1 mole % of trans-Δ^9 unsaturation; X is a mono- or divalent cation or an ammonium or substituted ammonium cation; AO is an oxyalkylene group; and n, which is the average number of oxyalkylene groups, has a value within the range of 0 to 20.

In an ~~aspect~~embodiment, there is provided a process which comprises reducing a metathesis-derived monounsaturated alkyl ester, preferably a C_{10}-C_{17} monounsaturated lower alkyl ester, to produce a monounsaturated fatty alcohol composition, and making a sulfate or sulfonate derivative by one or more of alkoxylating, sulfating, sulfonating, and sulfitating the monounsaturated fatty alcohol composition, wherein the derivative comprises: (a) an alkyl sulfate, a sulfonated alkyl sulfate, an alcohol sulfonate, a sulfated alcohol sulfonate, or a mixture thereof; or (b) an ether sulfate, a sulfonated ether sulfate, an alkoxylate sulfonate, a sulfated alkoxylate sulfonate, or a mixture thereof.

In aspects, the present disclosure provides a dispersant for agricultural compositions; a water-soluble herbicide composition; an anionic emulsifier from agricultural compositions; an aqueous hard-surface cleaner; a personal cleanser; a foamer, foam additive or dispersant for use in gypsum, concrete or fire-fighting applications; a gas well foamer for use in oilfield applications; a laundry detergent; a light-duty liquid detergent; a surfactant composition for use in enhanced oil recovery; or a surfactant composition for use in emulsion polymerization comprising the sulfate derivative as disclosed above.

Claims

1. A sulfate composition comprising:

(a) from 40 to 60 wt.% of a monounsaturated fatty primary alcohol sulfate;

and

(b) from 40 to 60 wt.% of a secondary hydroxyalkyl fatty primary alcohol sulfate, wherein (a) and (b) derive from a C_{11}-C_{17} monounsaturated alcohol.

2. The composition of claim 1 further comprising 0.1 to 20 wt.% of sulfonated products.

3. The composition of claim 1 wherein the monounsaturated alcohol is metathesis-derived.

4. The composition of claim 1 wherein (a) has the structure:

$$R\text{-}O\text{-}SO_3X$$

wherein R is a linear or branched C_8-C_{30} monounsaturated hydrocarbyl group, and X is a mono- or divalent cation or an ammonium or substituted ammonium cation.

5. The composition of claim 4 wherein R is a linear C_{11}-C_{17} monounsaturated hydrocarbyl group.

6. The composition of claim 1 wherein (a) is a mixture of cis- and trans- isomers.

7. The composition of claim 1 wherein (b) has the structure:

$$CH_3\text{-}(CH_2)_y\text{-}CHOH\text{-}(CH_2)_z\text{-}O\text{-}SO_3X$$

wherein y= 0 to 28, z= 0 to 28, y+z = 6 to 28, and X is a mono- or divalent cation or an ammonium or substituted ammonium cation.

8. The composition of claim 7 wherein y+z = 9 to 15.

~~9. The composition of claim 1 made by sulfating a monounsaturated fatty alcohol with sulfur trioxide in a falling-film reactor, followed by neutralization.~~

~~10~~9. A mixture comprising water and from 1 to 80 wt.%, based on the amount of mixture, of the composition of claim 1.

~~11~~10. A composition comprising a metathesis-derived monounsaturated fatty alcohol alkali metal sulfate having at least one lamellar phase at an actives level within the range of 65-80% actives.

~~12~~11. The composition of claim ~~11~~ 10 having an isotropic clear phase over a broader % actives range compared with that of a composition comprising a saturated analog of the monounsaturated fatty alcohol alkali metal sulfate.

~~13~~12. The composition of claim ~~11~~ 10 further comprising a hydroxyalkyl alcohol sulfate and sulfonates, the composition having an isotropic clear phase at up to 50% actives.

~~14~~13. A dispersant for agricultural compositions comprising the composition of claim 1.

~~15~~14. A water-soluble herbicide composition comprising the composition of claim 1.

~~16~~15. An anionic emulsifier for agricultural compositions comprising the composition of claim 1.

~~17~~16. An aqueous hard-surface cleaner comprising the composition of claim 1.

~~18~~17. A personal cleanser comprising the composition of claim 1.

~~19~~18. A foamer, foam additive, or dispersant for use in gypsum, concrete, or fire-fighting applications comprising the composition of claim 1.

~~20~~19. A gas well foamer for use in oilfield applications comprising the composition of claim 1.

~~21~~20. A light-duty liquid detergent comprising the composition of claim 1, wherein the composition derives from a C_{14}-C_{17} monounsaturated alcohol.

~~22~~21. A laundry detergent comprising the composition of claim 1.

~~23~~22. A surfactant composition for use in enhanced oil recovery, comprising the composition of claim 1.

~~24~~23. A surfactant composition for use in emulsion polymerization, comprising the composition of claim 1.

~~25~~24. A sulfate derivative having the general structure:

$$R\text{-}CH{=}CH\text{-}(CH_2)_7\text{-}CH_2O\text{-}(AO)_n\text{-}SO_3X$$

wherein R is H or C_2-C_7 alkyl, wherein when R is C_2-C_7 alkyl, the derivative has at least 1 mole % of trans-Δ^9 unsaturation; X is a mono- or divalent cation or an ammonium or substituted ammonium cation; AO is an oxyalkylene group; and n, which is the average number of oxyalkylene groups, has a value within the range of 0 to 20.

~~26. The derivative of claim 25 wherein R is C_2-C_7 alkyl and the derivative has at least 1 mole % of trans-Δ^9 unsaturation.~~

~~27~~25. The derivative of claim ~~25~~ 24 ~~or claim 26~~ comprising a fatty alcohol ethoxylate sulfate.

~~28. A process which comprises reducing a metathesis-derived monounsaturated alkyl ester, preferably a C_{10}-C_{17} monounsaturated lower alkyl ester, to produce a monounsaturated fatty alcohol composition, and making a sulfate or sulfonate derivative by one or more of alkoxylating, sulfating, sulfonating, and sulfitating the monounsaturated fatty alcohol composition, wherein the derivative comprises: (a) an alkyl sulfate, a sulfonated alkyl sulfate, an alcohol sulfonate, a sulfated alcohol sulfonate, or a mixture thereof; or (b) an ether sulfate, a sulfonated ether sulfate, an alkoxylate sulfonate, a sulfated alkoxylate sulfonate, or a mixture thereof.~~

~~29. A process for making an internally monounsaturated fatty alcohol sulfate, the process comprising reacting a terminally monounsaturated fatty alcohol, preferably a metathesis-derived terminally monounsaturated fatty alcohol, with sulfur trioxide in a falling-film reactor, followed by neutralization.~~

~~30~~26. A dispersant for agricultural compositions; a water-soluble herbicide composition; an anionic emulsifier from agricultural compositions; an aqueous hard-surface cleaner; a personal cleanser; a foamer, foam additive or dispersant for use in gypsum, concrete or fire-fighting applications; a gas well foamer for use in oilfield applications; a laundry detergent; a light-duty liquid detergent; a surfactant composition for use in enhanced oil recovery; or a surfactant composition for use in emulsion polymerization comprising the sulfate derivative of claim ~~25~~24.

~~34~~27. A dispersant for agricultural compositions; a water-soluble herbicide composition; an anionic emulsifier from agricultural compositions; an aqueous hard-surface cleaner; a personal cleanser; a foamer, foam additive or dispersant for use in gypsum, concrete or fire-fighting applications; a gas well foamer for use in oilfield applications; a laundry detergent; a light-duty liquid detergent; a surfactant composition for use in enhanced oil recovery; or a surfactant composition for use in emulsion polymerization comprising the sulfate derivative of claim ~~27~~25.