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3,849,486

PROCESS OF CONVERTING SULTONES TO HYDROXYALKYLSULFONATES

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10 Claims

ABSTRACT OF THE DISCLOSURE

It is disclosed that sultones are converted to salts of hydroxy alkyl sulfonic acids by reaction in an anhydrous system with an excess of base.

FIELD OF THE INVENTION

This invention relates to the preparation of hydroxy alkyl sulfonic acid salts and of selected mixtures thereof with alkene sulfonic acid salts.

BACKGROUND

For the most part, the prior art conversion of sultones into sulfonic acid salts has been conducted in one or more steps under a wide variety of conditions emphasizing high temperatures because of the difficulty of hydrolysis of sultones. Some of the prior art involves more or less critically timed complex step sequences with strong reagents. Examples of known operations are given in U.S. Pats. 2,061,617; 2,187,244; 3,642,881; and 3,496,225.

Much of the prior art emphasis in connection with the sulfonation of α -olefins to produce olefin sulfonate salts is centered about aqueous caustic hydrolysis treatment of SO_3 sulfonation effluent acid-mix containing about 25–60 percent sultones, the balance being mostly sulfonic acids. When such an "acid-mix" is subjected to basic hydrolysis with aqueous NaOH, it is usually considered that there is produced the mixtures described in U.S. Pat. 3,332,880 as containing about 30–70 percent alkene sulfonic acid salts, about 20–70 percent hydroxy alkyl sulfonic acid salts and about 2–15 percent disulfonate salts. Much of the prior art favors sulfonation procedures using uncomplexed SO_3 since these procedures are considered to be conducive to the formation of preferred 3-hydroxy alkane sulfonic acid salts rather than generally less desired 2-hydroxy alkane sulfonic acid salts.

Olefin sulfonation processes are known to co-produce disulfonates and higher order polysulfonates in appreciable quantities. For example, compositions of U.S. 3,332,880 are indicated as containing about 2–15 percent disulfonates. In some instances disulfonates are undesired in liquid detergent compositions because of their highly polar nature. Usually one can minimize the production of disulfonates to some extent by controlling the mol ratio of SO_3 to olefin used in the sulfonation step. Where the SO_3 :olefin ratio is about 1:1 or less, the amount of disulfonates is generally less than it is with higher SO_3 :olefin ratios. On the other hand, SO_3 :olefin ratios of about 1:1 and lower result in the failure of some olefin molecules to be sulfonated. Generally, the known prior art practice accepts about 10 percent disulfonates as a reasonable compromise with "free oil" content (unsulfonated olefin or paraffins) in the sulfonation product and prefers SO_3 to olefin mol ratios of from about 1.05:1 to about 1.25:1.

SUMMARY OF THE INVENTION

In accordance with the present invention, a process is provided whereby sultones are converted virtually completely to hydroxy alkyl sulfonic acid salts. High purity of product and high yield are attained.

Surprisingly, this result is attained by performing the aforesaid conversion in a substantially anhydrous system

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using an excess of a strong base and moderate temperatures. Preferably, the process is performed in the presence of an inert non-aqueous diluent that is readily removed when its presence is no longer desired. Avoidance of excessively high temperatures usually is desirable to minimize undesired side reactions such as conversion of the sultones to alkene sulfonic acid salts.

Accordingly, the present invention provides a process for converting sultones into hydroxy alkyl sulfonic acid salts which comprises reacting a sultone with an excess of anhydrous base at a temperature of from about 75 to about 250° C. Preferred sultones have from about 6 to about 40 carbon atoms per molecule. Preferably the temperature is from about 100 to about 200° C., especially from about 125 to about 175° C. and the reaction is in an anhydrous system. Preferably, the base is an alkali metal hydroxide or an alkaline earth metal hydroxide, particularly the former. Typical bases include calcium hydroxide and magnesium hydroxide. Particularly preferred bases are sodium hydroxide and potassium hydroxide, singly or in admixture with each other or with other bases. Sodium hydroxide is generally preferred because of low cost, availability and excellent properties of the resultant sodium compositions.

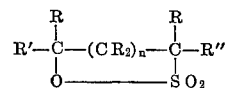
The process preferably is conducted in an inert organic solvent for the sultone. Aprotic solvents such as cyclic and acyclic olefins, paraffins or aromatic hydrocarbons are generally preferred because of their inert nature, good solvent properties, low cost and ready availability. Preferred solvents are paraffinic hydrocarbon solvents. Other preferred solvents are aromatic hydrocarbon solvents. Other preferred solvents are olefinic hydrocarbon solvents. Typical solvents are hexane, octane, nonane, decane, undecane, dodecane, tridecane, tetradecane, and olefins of similar numbers of carbon atoms per molecule. Other typical solvents are toluene, xylene, and Decalin.

In a preferred aspect, the process of the invention uses sodium hydroxide and the reaction is conducted in an inert hydrocarbon solvent for the sultone.

An acid mix formed by sulfonating an olefin or an olefin mixture with SO_3 provides a preferred source of sultones for use in the present process. The sultones may be recovered from such an acid-mix by crystallization from a hydrocarbon solvent, or by such alternate methods as solvent extraction. This provides a suitably concentrated sultone starting material for the present process. By reacting such sultones with excess anhydrous base according to the present process, products are obtained having a high percentage content of hydroxy alkyl sulfonic acid salts, virtually 100 percent. The conversion is virtually quantitative.

In addition to the foregoing, one may obtain more or less pure sultones or mixtures containing pure individual or mixed sultones in other ways. For example, processes that produce sultones are described in U.S. Pats. 2,094,451; 2,187,244; 2,850,507; 3,117,133; 3,146,242; 3,164,608; 3,164,609; 3,200,127; 3,205,237; 3,332,880; 3,376,336; 3,524,864; 3,579,537 and in Canadian Patent 894,830, and in the references cited in said patents; all of which, like other reference material cited herein, are herewith incorporated herein by reference.

Sultones useful in the process of the present invention are of the general formula:



wherein R, R' and R'' are hydrogen or alkyl and n is a whole number integer of 0, 1, 2 or 3. In such sultones generally at least one of the R groups, such as R' and R'' is a hydrocarbon group such as alkyl, alkenyl, aralkyl, alkaryl and is unsubstituted or has only hydroxy or sul-

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fonate ($-\text{SO}_3-$) substitution. In addition, two or more of the R groups also may be linked together in cyclic carbon chain structures and molecules may contain more than one ($-\text{SO}_3-$) structure. Such sultones are well known to those skilled in the art as evidenced by the patents cited herein.

In preferred sultones having from about 6 to about 40 carbon atoms per molecule, n is 1 or 2, R and R' are hydrogen and R' is alkyl of from about 2 to about 37 carbon atoms. More preferred sultones have from about 10 to about 24 carbon atoms per molecule and R' has from about 6 to about 21 carbon atoms. In particularly preferred sultones having from about 12 to about 20 carbon atoms per molecule, R' has from about 8 to about 17 carbon atoms. Such sultones in which $n=1$ are especially preferred.

Particularly useful sultone mixtures contain molecules whose carbon chain units contain predominantly the following numbers of carbon atoms: 12 and 14; 12, 14 and 16; 14 and 16; 14, 16 and 18; 16 and 18; 16, 18 and 20; 11, 12, 13, 14, and 15; 12, 13 and 14; 11, 13 and 15; 15, 16, 17 and 18; 15, 17 and 19 and 17, 19 and 21, and the like. These different compositions result in the production of sulfonate salts having desired surfactant properties in various water hardnesses, at different temperatures and for cleaning various materials in liquid formulations as well as in solid formulations.

The carbon skeleton structures of preferred sultones are saturated and are straight chain or branched chain, cyclic or aromatic or combinations of such structures, and which are pure or in mixtures. Thus mixtures obtained by converting sultones to sulfonic acid salts in accordance with the teachings of the present invention can contain entirely straight or branched or cyclic carbon chain units or other structures or combinations in various proportions. In general, preferred sultones used for the process contain from about 50 to about 100 percent of molecules having open chain carbon skeleton.

The positions of linkage to the carbon chain in starting sultones can be at various combinations of terminal and internal carbon atoms or at internal carbon atoms. Usually mixtures contain various isomers, but structures in which the S of the sultone is linked to a terminal carbon predominate.

A typical acid mix containing sultone and sulfonic acid, useful for recovery of sultone starting material, is obtained by sulfonating a mixture of olefins with uncomplexed SO_3 in a mol ratio of SO_3 to olefin of from about 0.5:1 to about 2:1, said olefins containing 0 to 100 percent vinyl, and/or 0 to 100 percent internal olefins and in which vinylidene olefins may be present, said olefins having from about 6 to about 40 carbon atoms per molecule. Unreacted olefin from such sulfonation is frequently a suitable solvent both for crystallization of the starting sultone and for the subsequent reaction of the sultone with anhydrous base according to the process of the present invention. Where desired, sultones can be obtained from such an acid-mix using various processes such as crystallization solvent extraction and the like.

A mixture of sultones containing one or more components having (1) various numbers of carbon atoms per molecule, (2) various carbon skeleton structures and/or (3) various positions of SO_3 linkages to the carbon skeleton structure is generally preferred because such mixtures can be obtained readily by sulfonating mixtures of olefins available in large quantities and at low cost. Preferably such starting olefin mixtures are selected to produce product sulfonic acid salt having desired properties for the ultimate use either per se or in combination with various other sulfonate materials and adjuvant materials generally used in surface active compositions such as dishwashing or laundry detergents.

Although the conditions and materials used in sulfonation are important, the various materials and other factors involved such as temperature, pressure, propor-

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tions, diluents, reactor configuration, contact time, etc. are well known to those of skill in the art. As an example, olefins may be sulfonated with SO_3 in a falling-film reactor at a temperature of from about 0 to about 70° C., at a SO_3 /olefin mol ratio of from about 0.5:1 to about 2:1. Preferred temperatures are about 40–50° C. while the preferred SO_3 /olefin mol ratio is from about 1.0:1 to about 1.2:1. Typical batch-wise pot reactor sulfonations and conditions therefore are disclosed in U.S. Pat. 2,061,617.

Typical sultones processed in accordance with the present invention include: 3 - hydroxydecane - 1 - sulfonic acid sultone, 4 - hydroxydecane-1-sulfonic acid sultone, 3 - hydroxyundecane - 1 - sulfonic acid sultone, 4-hydroxyundecane - 1 - sulfonic acid sultone, 3-hydroxydodecane-1 - sulfonic acid sultone, 4 - hydroxydodecane-1-sulfonic acid sultone, 3 - hydroxytridecane - 1 - sulfonic acid sultone, 4 - hydroxytridecane - 1 - sulfonic acid sultone, 3 - hydroxytetradecane - 1 - sulfonic acid sultone, 4 - hydroxytetradecane - 1 - sulfonic acid sultone, 3 - hydroxypentadecane - 1 - sulfonic acid sultone, 4 - hydroxypentadecane - 1 - sulfonic acid sultone, 3 - hydroxyhexadecane-1-sulfonic acid sultone, 4 - hydroxyhexadecane - 1 - sulfonic acid sultone, 3 - hydroxyheptadecane - 1 - sulfonic acid sultone, 4 - hydroxyheptadecane - 1 - sulfonic acid sultone, 3 - hydroxyoctadecane - 1 - sulfonic acid sultone, 4 - hydroxyoctadecane - 1 - sulfonic acid sultone, 3 - hydroxynonadecane - 1 - sulfonic acid sultone, 4 - hydroxynonadecane - 1 - sulfonic acid sultone, 3 - hydroxyeicosane - 1 - sulfonic acid sultone, 4 - hydroxyeicosane-1-sulfonic acid sultone, 3 - hydroxyheneicosane - 1 - sulfonic acid sultone, 4 - hydroxyheneicosane - 1 - sulfonic acid sultone, 3 - hydroxydocosane - 1 - sulfonic acid sultone, 4 - hydroxydocosane - 1 - sulfonic acid sultone, 3-hydroxytricosane - 1 - sulfonic acid sultone, 4 - hydroxytricosane-1-sulfonic acid sultone, 3 - hydroxytetraicosane - 1 - sulfonic acid sultone.

Typical hydroxy alkane sulfonic acids whose salts are produced from sultones in accordance with the present invention include

3-hydroxy-decane-1-sulfonic acid,
4-hydroxy-decane-1-sulfonic acid,
5-hydroxy-decane-1-sulfonic acid,
3-hydroxy-undecane-1-sulfonic acid,
4-hydroxy-undecane-1-sulfonic acid,
5-hydroxy-undecane-1-sulfonic acid,
3-hydroxy-dodecane-1-sulfonic acid,
4-hydroxy-dodecane-1-sulfonic acid,
5-hydroxy-dodecane-1-sulfonic acid,
3-hydroxy-tridecane-1-sulfonic acid,
4-hydroxy-tridecane-1-sulfonic acid,
5-hydroxy-tridecane-1-sulfonic acid,
3-hydroxy-tetradecane-1-sulfonic acid,
4-hydroxy-tetradecane-1-sulfonic acid,
5-hydroxy-tetradecane-1-sulfonic acid,
3-hydroxy-pentadecane-1-sulfonic acid,
4-hydroxy-pentadecane-1-sulfonic acid,
5-hydroxy-pentadecane-1-sulfonic acid,
3-hydroxy-hexadecane-1-sulfonic acid,
4-hydroxy-hexadecane-1-sulfonic acid,
5-hydroxy-hexadecane-1-sulfonic acid,
3-hydroxy-heptadecane-1-sulfonic acid,
4-hydroxy-heptadecane-1-sulfonic acid,
5-hydroxy-heptadecane-1-sulfonic acid,
3-hydroxy-nonadecane-1-sulfonic acid,
4-hydroxy-nonadecane-1-sulfonic acid,
5-hydroxy-nonadecane-1-sulfonic acid,
3-hydroxy-eicosane-1-sulfonic acid,
4-hydroxy-eicosane-1-sulfonic acid,
5-hydroxy-eicosane-1-sulfonic acid,
3-hydroxy-heneicosane-1-sulfonic acid,
4-hydroxy-heneicosane-1-sulfonic acid,
5-hydroxy-heneicosane-1-sulfonic acid,
3-hydroxy-docosane-1-sulfonic acid,

4-hydroxy-docosane-1-sulfonic acid,
5-hydroxy-docosane-1-sulfonic acid,
3-hydroxy-tricosane-1-sulfonic acid,
4-hydroxy-tricosane-1-sulfonic acid,
5-hydroxy-tricosane-1-sulfonic acid,
3-hydroxy-tetracosane-1-sulfonic acid,
4-hydroxy-tetracosane-1-sulfonic acid, and
5-hydroxy-tetracosane-1-sulfonic acid.

Some of the foregoing and additional sultones and sulfonic acids and other materials useful with the process of the present invention are described in terms of a starting material produced by sulfonation of various individual olefins or olefin mixtures selected from the following listing: decene-1, undecene-1, dodecene-1, tridecene-1, tetradecene-1, pentadecene-1, hexadecene-1, heptadecene-1, octadecene-1, nonadecene-1, eicosene-1, triacontene-1, 2-ethyl-hexene-1, 2-methyl undecene-1, 2-ethyl decene-1, 2-propyl undecene-1, 2-butyl decene-1, 2-pentyl decene-1, 2-hexyl octene-1, decene-2, undecene-3, dodecene-4, tridecene-2, tetradecene-5, pentadecene-7, hexadecene-6, heptadecene-8, octadecene-2, nonadecene-2, eicosene-2, tricosene-2, 3-ethyl-dodecene-2. Sultone derivatives of the vinyl and internal olefins of the foregoing listing are generally of the form 1,2-; 1,3-; 1,4-; 1,5-; 2,3-; 2,4-; 2,5-; 2,6- or the like depending upon the procedures used in sulfonation and on the starting olefin. Vinylidene olefins usually form sulfonic acids rather than sultones. Alkene sulfonic acids, hydroxy alkyl sulfonic acids and disulfonic acids are isomeric in nature depending to some extent upon the predominant form of the co-present or precursor sulfones.

The process of the present invention requires an excess of base above a 1:1 mol ratio of base to sultone (or sultone plus sulfonic acid). When the amount of excess base is small, generally about 10 percent or less, the conversions are low and losses high. Although base:sultone mol ratios up to about 25:1 are useful, ratios in excess of about 5:1 mols of base per mol of sultone are seldom necessary and are preferably avoided to minimize the problems attendant to recovery of the excess base. Thus the mol ratio of base to sultone is from about 1.2:1 to about 25:1, preferably from about 1.25:1 to about 10:1, especially from about 1.5:1 to about 5:1. These specific ratios apply to bases of monovalent alkali metals and in general are divided by a factor of 2 for bases of divalent alkaline earth metals. Furthermore, the ratios are based on sultones having an average of one sulfonate group ($-\text{SO}_3^-$) per molecule. The mixtures having an average of more than one ($-\text{SO}_3^-$) group per molecule require proportionately larger amounts of base.

The temperature used for the present conversion reaction, although not especially critical, is important as set forth hereinafter. The temperature must be high enough and held long enough to produce the desired reaction. In general, this requires operation above the freezing point of the sultone. On the other hand, temperatures must not be held at an excessively high value for a sufficiently long time to produce an adverse amount of side reactions. Temperatures of from about 75 to about 250° C. are useful with temperatures of from about 100 to about 200° C. being preferred because of equipment cost and other considerations. Reaction times range from a few minutes to several hours, depending to some extent upon temperature. Suitable pressures range from about 0.1 to about 100 atmospheres. In general, it is preferred to operate near or at atmospheric pressure or somewhat higher, typically from about $\frac{1}{2}$ to about 10 atmospheres pressure, to avoid costly high pressure or high vacuum equipment, and to minimize dehydration. Reaction times will naturally vary depending upon temperature, concentration, and the mol ratio of base to sultone employed. In particular, when lower mol ratios of base to sultone are employed, e.g. 1.2-2.0, longer reaction times and/or higher temperatures are desirable to ensure complete reaction.

As a general proposition, sulfonic acid salts produced by the present process have valuable surface active properties and are useful with other materials in built and in un-built detergent formulations known to those skilled in the art for sulfonic acid salts. For example, U.S. Pats. 3,332,874-3,332,880 describe combinations of certain sulfonic acid salts with alkyl glyceryl ether sulfonates, with alkyl aryl sulfonates and alkyl ether sulfates, with esters of condensates of coconut fatty alcohols and 3(N,N-dimethyl-N-alkylammonio)-2-hydroxy-propane-1-sulfonate, with amides, and with amides and alkyl glyceryl ether sulfonates. The present products are useful in such ways in various forms, such as liquid, flake, granule, tablet and bar form. When used with detergent builders and other adjuvants, conventional materials and proportions may be used as set forth for example in U.S. Pat. 3,332,880, columns 10 and 11, herein incorporated by reference. In general, the proportions of alkene sulfonic acid salts relative to hydroxy alkyl sulfonic acid salts produced by the present anhydrous process are different from those produced by aqueous processing since in the present process sultones are converted almost exclusively to hydroxy alkane sulfonic acid salts and in high yield.

The following examples indicate preferred embodiments and aspects of the present invention.

Example I

3 Grams (10.84 mmol) of the sultone of 3-hydroxy-tetradecane-1-sulfonic acid was dissolved in 10 ml. of toluene, 3 g. (75 mmol) powdered anhydrous NaOH was added and the slurry heated slowly to the boiling point (107°) with stirring and under the protection of a stream of dry nitrogen. The system was held at this temperature at reflux of 1 hour.

After cooling, the mixture was extracted three times using 25 ml. portions of ether to remove toluene and any unreacted sultone which might be present.

The dry residue remaining after removal of the ether was dissolved in 50 ml. of a 1:1 mixture of isopropanol and water and the excess NaOH neutralized and brought to a pH of about 8 by adding dilute H_2SO_4 .

10 g. of Na_2CO_3 was added to the neutralized solution. The solution separated into an aqueous phase containing inorganic salts and an organic phase containing the salt-free sulfonate. The aqueous phase was set aside.

After evaporation of the isopropanol from the organic phase, hydroxyalkane sulfonate was recovered as a white solid. The recovered product was analyzed by thin layer chromatography (TLC) using a modification of the procedure described in J.A.O.C.S. Vol. 48, December 1971, pages 790-793.

Recovery: 3.15 g. (92.3 percent of theoretical)

Purity: 98 percent by thin layer chromatography (TLC) analysis.

Example II

1 g. (3.28 mmol) of the sultone of 3-hydroxy-hexadecane-1 sulfonic acid was dissolved in 4 ml. toluene in a flask equipped with a reflux condenser. 1 g. (25 mmol) finely powdered solid NaOH was added and the mixture was heated slowly to the boiling point of toluene (108° C.) with stirring.

After one hour of refluxing and stirring, the viscous mixture was cooled down to room temperature and the toluene and unreacted sultone removed by extraction with ether.

The white, finely dispersed, solid residue resulting from the ether extraction was dissolved in 26 ml. of a 1:1 mixture of isopropanol and water and the strong caustic solution adjusted to a pH between 7 and 8 by adding dilute H_2SO_4 .

The mixture was heated to 55°. The alcohol and water phases were separated by adding 4 g. Na_2CO_3 .

The aqueous phase was discharged. The isopropanol phase was evaporated to dryness.

Recovery: $0.85=75.2$ percent (theory) of a white solid
TLC analysis: 2 percent alkene sulfonate +98 percent hydroxyalkane sulfonate.

Example III

Protected by a nitrogen blanket and with stirring, a dry mixture of 2 grams (6.56 mmol) of the sultone of 3-hydroxyhexadecane-1 sulfonic acid and 2 grams (50 mmol) powdered solid NaOH was heated slowly to 160°.

After cooling, the reaction mixture was extracted with ether to remove residual sultone. (No unreacted sultone was found.)

The residue was dissolved in a hot mixture of 25 ml. isopropanol and 25 ml. H₂O.

To this mixture was added 8 grams of Na₂CO₃. The mixture was agitated and allowed to separate into two layers.

The aqueous, salt-containing layer was discarded, the isopropanol phase allowed to settle overnight (7° C.).

Snow white crystals had separated from the solution on standing; they were separated by vacuum filtration, washed, and dried.

A second smaller portion of sulfonate was recovered from the filtrate.

Recovery	Comp. by TLC (wt. percent)	
	Alkene sulfonic acid salts	Hydroxy alkyl sulfonic acid salts
From cake=1.90 g. (80.85 percent of theory).....	0	100
From filtrate=0.45 g. (19.15 percent of theory).....	15	85

Example IV

40 mmols of the sultone of 3-hydroxydodecane-1-sulfonic acid was combined with an equal weight of anhydrous, powdered NaOH in 80 ml. dodecane, the reaction mixture brought to 140° (oil bath), and the mixture held at this temperature for 2 hours while stirring and passing a stream of dry nitrogen over the slurry.

The reaction mixture thus obtained contained the desired hydroxy alkane sulfonate, the excess NaOH, dodecane and possibly unreacted sultone. Separation schemes for this kind of mixture are based generally on the different solubility of the components in the system: H₂O/non-miscible organic solvent. Changing from the anhydrous into the aqueous system presents a problem to avoid hydrolysis of the unreacted sultone leading to erroneous results. Previous experiments had shown, however, that the sultone does not hydrolyze at low temperature and that little or no unreacted sultone is present, nevertheless, the following technique was used to avoid the interference described.

200 ml. of a mixture of MEK (methyl ethyl ketene)/hexane (2:1 by volume) was added to the cold reaction product and the slurry cooled to 0° C. The excess caustic was dissolved by adding 200 ml. of a (1:1) mixture of MEK/H₂O. Dilute H₂SO₄ was then added to the mixture until a pH around 8 was reached. After adding another 200 ml. of the MEK/H₂O mixture, the solution was warmed to room temperature and stirred vigorously for 10 minutes. On standing the phases separated. The lower aqueous layer containing the desired sultone was recovered and extracted three more times with 200 ml. portions of (2:1) MEK/hexane. The final, neutral-free aqueous solution containing only sulfonate and sulfate was evaporated to dryness. To remove the sulfate, the dry mixture of salt and sulfonate was dissolved in a hot mixture (55° C.) of isopropanol/H₂O (1:1 by volume) using 25 ml. of the solvent per gram of sulfonate/salt mixture.

Anhydrous sodium carbonate was added to the clear hot solution until the phases separated (3.5 g. carbonate per gram sulfonate). The sulfate-containing aqueous layer was discarded. The desired sulfonate was recovered from the isopropanol phase by evaporation of the solvent.

10.7 Grams of sodium-3-hydroxydodecane sulfonate free of salt and of neutrals was recovered which was 92.75 percent of theory.

Example V

Example IV was repeated using the sultone 3-hydroxy-tetradecane-1-sulfonic acid. 12.0 Grams of sodium-3-hydroxytetradecane sulfonate free of salt and neutrals was recovered which was 94.8 percent of theory. Purity by TLC was 97 percent.

Example VI

Example IV was repeated using the sultone of 3-hydroxyhexadecane-1-sulfonic acid. In this instance four runs were made each using ¼ of the materials and the product from the four runs was combined.

The recovery procedure was modified slightly at the end since the product separated from the isopropanol solution on standing so that evaporation of the solvent was not needed. After decantation, the end products were obtained by vacuum filtration and drying of the cake in air. 10.1 Grams of sodium-3-hydroxyhexadecane sulfonate free of neutrals and salt was recovered. Purity by TLC was 97 percent.

Example VII

Example IV was repeated using the sultone of 3-hydroxyoctadecane-1-sulfonic acid.

As in Example VI, the product separated from the propanol solution on standing and was recovered by decantation, vacuum filtration and air drying. 12.7 Grams of sodium-3-hydroxyoctadecane sulfonate free of salt and neutrals was recovered. This was only 85.2 percent of theory; however, in this instance the mother liquor was discharged without recovery of the residual product contained therein. Purity by TLC was 89 percent.

Example VIII

A series of runs was conducted as in Example VI at various temperatures, various reaction times and various ratios of base to sultone.

The runs were based on 3 gram quantities (9.85 mmols) of a typical sultone, the sultone of 3-hydroxyhexadecane-1-sulfonic acid. The base used was NaOH, the mol ratio of base to sultone ranged from 1.0 to 15.2. Reaction time ranged from 0.5 to 3 hours. Temperature ranged from 80 to 180° C. The reaction was conducted in anhydrous systems using dodecane as a typical solvent.

Results are tabulated. Runs 6 and 7 are included to show the results of operating outside the scope of the present invention, i.e., without an excess of anhydrous base.

Run No.	Temp., °C.	Time, hrs.	Mol Na-OH per mol sultone	Recovery sulfonate, mol percent	Composition by TLL, wt. percent**		
					A-	HA	X
NaOH:Sultone=1.9 to 15.2							
1-----	80	1	15.2	82.6	3	97	-----
2-----	100	2	3.8	93.5	3	97	-----
3-----	100	3	1.9	97.6	3	97	-----
4-----	140	2	7.6	98.8	3	97	-----
5-----	180	2	7.6	90.0	3	97	-----
NaOH:Sultone=1							
6-----	140	2	1.0	*84.8	51.5	42.5	6
7-----	140-160	.5	1.0	*88.3	44	48	8
NaOH:Sultone=1.5 to 2.3							
8-----	140	2	1.5	*96.75	5	67	23
9-----	140	2	1.8	*92.2	5	68	27
10-----	140	2	2.3	*95.6	4	74	22

*Calc. for 100 percent HA.

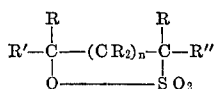
**A-, HA and X mean, respectively, alkene sulfonate, hydroxy alkyl sulfonate and unknown. The unknown probably is an intermediate of some sort associated with incomplete reaction.

What is claimed is:

1. A process for converting sultones into hydroxy alkane sulfonic acid salts in high purity and high yield which comprises

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reacting a sultone of the formula:



wherein:

R, R' and R'' are hydrogen or alkyl, n is an integer of 0, 1, 2, or 3, the total number of carbon atoms in the sultone molecule is from about 6 to about 40, with alkali metal hydroxide or alkaline earth metal hydroxide, in an anhydrous system, at a temperature of from about 75 to about 250° C., the hydroxide and sultone being used in a ratio of from about 1.1 to about 25 mols of alkali metal hydroxide, or from about 0.55 to about 12.5 mols of alkaline earth metal hydroxide, per mol of sultone.

2. The process of Claim 1 wherein the mol ratio of hydroxide to sultone is from about 1.2 to about 25 for alkali metal hydroxide or from about 0.6 to about 12.5 for alkaline earth metal hydroxide.

3. The process of Claim 1 wherein the temperature is from about 100 to about 200° C.

4. The process of Claim 1 wherein the sultones have from about 10 to about 24 carbon atoms per molecule.

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5. The process of Claim 1 conducted in the presence of an inert solvent for the sultone.

6. The process of Claim 5 wherein the solvent is a paraffinic hydrocarbon solvent.

7. The process of Claim 5 wherein the solvent is an aromatic hydrocarbon solvent.

8. The process of Claim 5 wherein the solvent is an olefinic hydrocarbon solvent.

9. The process of Claim 1 wherein the sultone is reacted with alkali metal hydroxide.

10. The process of Claim 1 wherein the alkali metal hydroxide is sodium hydroxide.

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