

SANITIZING COMPOSITION AND METHOD

FIELD OF THE INVENTION

5 The present invention is generally directed to compositions and methods for sanitizing articles and specifically to compositions and methods for sanitizing using fatty acids and antimicrobial agents.

BACKGROUND OF THE INVENTION

10 Final rinse sanitizers are used by food processors, beverage producers, dairy processors, fermented products, and the pharmaceutical industry, among others, to kill bacteria found on equipment. This has always been of primary importance to ensue a bacteria-free environment on
15 the processing equipment to reduce the chance of contamination of food or pharmaceutical items being distributed to the general public.

 Common sanitizers used in this process range in types and effectiveness. Sanitizers using chlorine compounds
20 have been the standard in the industry; however, such sanitizers have a number of drawbacks. Chlorine-based sanitizers can be corrosive to equipment, decompose at high temperatures, be adversely affected by organic soil loads, and impart undesirable flavors to food or pharmaceutical
25 items at high temperatures. Sanitizers using iodine compounds can have many, if not all, of the same drawbacks as chlorine-based sanitizers as well as the additional drawback of staining the item being sanitized. Sanitizers using peroxyacetic acid have become widely used in food
30 processing but are falling out of favor due to their corrosiveness on metal articles, such as stainless steel and gasket material. Peroxyacetic acid-based sanitizers are considered by many to be one of the most hazardous sanitizers on the market. Sanitizers using quaternary
35 ammonium compounds have found only limited use due to their inability to kill certain types of bacteria. Such sanitizers are very active against gram positives, yeast,

and molds but have limited effectiveness in killing gram negative bacteria. The sanitizers are relatively high foaming, thereby causing many problems in CIP Equipment. Sanitizers using chlorine dioxide require an activation step and long dwell time after activation before chlorine dioxide becomes an effective bactericide. Sanitizers using dodecylbenzene, sulfonic acid, or other similar compounds produce excessive foam or produce off-odors, causing CIP problems and/or off-flavors.

SUMMARY OF THE INVENTION

Objectives of the present invention include providing a sanitizer that is highly efficacious in killing a wide variety of bacteria including both gram positive and negative bacteria, has a relatively low degree of corrosiveness to metals, is stable at relatively high temperatures, is not impacted by organic soil loads, imparts no flavor to the sanitized item, does not stain the sanitized item, is relatively nonhazardous, is relatively low foaming or nonfoaming, requires no activation or dwell time after activation to be effective in killing bacteria, has effective killing power, leaves surfaces film-free, and/or produces no off-odors after sanitization is completed.

These and other objectives are addressed by the sanitizing composition of the present invention. In one embodiment, a liquid sanitizing composition is provided that includes:

(a) no more than about 14.0 wt.% (and more preferably no more than about 11.5 wt.%) of at least one of a sulfonated compound selected from the group consisting of a fatty acid and esters and salts thereof;

(b) a solubilizing agent for the sulfonated compound; and

(c) an antimicrobial agent.

To provide an effective environment for the killing of bacteria, the liquid sanitizing composition has a pH of no more than about 3.0.

5 The sanitizer is not only highly efficacious in killing bacteria but also can be relatively low foaming, noncorrosive, stable at relatively high temperatures, unaffected by organic soil loads, flavor neutral, nonstaining, and nonhazardous to users. The sanitizer can also have effective killing power, leave surfaces film-free, and yield few, if any, off-odors.

10 The sulfonated fatty acid is preferably selected from the group consisting of sulfonated oleic acids, sulfonated linoleic acids, sulfonated myristic acids, and mixtures thereof. The sulfonated fatty acid preferably has a concentration in the sanitizing composition of no more than about 11.5 grams/liter.

15 The antimicrobial agent can be any of a variety of bactericides, including phosphoric acid, citric acid, lactic acid, hydrochloric acid, hydroxyacetic acid, acetic acid, and esters and salts and mixtures thereof, with phosphoric acid, citric acid, and lactic acid being most preferred. The antimicrobial agent has a preferred concentration in the sanitizing composition ranging from about 0.4 to about 400 grams/liter. The preferred antimicrobial agents require no activation step or swell time to make the agent an effective bactericide.

20 The solubilizing agent is preferably an alcohol, such as propylene glycol, ethyl alcohol, isopropyl alcohol, hexylene glycol, and mixtures thereof. The preferred concentration of the alcohol in the sanitizing composition ranges from about 0.02 to about 80 grams/liter.

25 The sanitizing composition preferably does not include deleterious compounds found in other sanitizers. By way of example, the composition is preferably substantially free

of iodine, chlorine, peroxyacetic acid, dodecylbenzene, sulfonic acid, and quaternary ammonium compounds.

5 The sanitizing composition can further include a solvent for the above-noted components. The solvent is preferably selected from the group consisting of water, hydrogen peroxide, ethoxylated alcohols, and mixtures thereof.

10 The steps used to prepare the sanitizing composition are important to the effectiveness of the composition. The method includes the steps of:

(a) contacting the sulfonated fatty acid with a solvent for the sulfonated fatty acid;

15 (b) contacting the alcohol with the solvent to form an intermediate sanitizing composition, wherein the time between contacting step (a) and contacting step (b) is preferably no more than about 20 minutes. The intermediate sanitizing composition can be contacted with the antimicrobial agent at an acidic pH. If too long a period of time passes between the additions of the sulfonated fatty acid and the alcohol, the sulfonated fatty acid can "wax out" of the solvent.

DETAILED DESCRIPTION

25 The low foaming sanitizer of the present invention preferably includes a solvent, a sulfonated fatty acid and/or esters and/or salts thereof, a solubilizing agent for the sulfonated fatty acid in the solvent, and an antimicrobial agent. The pH of the sanitizer preferably is acidic, more preferably is no more than about pH 3 and more preferably ranges from about pH 1 to about pH 2.

30 The solvent (or carrier) can be any solvent (or carrier), preferably nontoxic and nonhazardous, for the sulfonated fatty acid and the antimicrobial agent. Preferred solvents (and/or carriers) include water, hydrogen peroxide, propylene glycol, isopropyl alcohol, and

mixtures thereof with water and propylene glycol being most preferred.

The sulfonated fatty acid can be any low foaming compound having one or more sulfo groups connected to a carbon or nitrogen atom. The chain length of the sulfonated compound is preferably relatively short to permit the sulfonated compound to pass through the cell wall of the bacteria. Most preferably, the chain length is short enough to produce a molecular weight of the sulfonated compound of about 172 daltons or less. Preferred sulfonated fatty acids include sulfonated oleic acid, sulfonated linoleic acid, sulfonated myristic acid, toluene sulfonic acid, and mixtures thereof. Although the sanitizer can include esters and/or salts of sulfonated fatty acids in lieu of a sulfonated fatty acid, sulfonated fatty acids and salts thereof are most preferred.

The total concentration of the sulfonated fatty acid, fatty esters, and fatty acid salts is important to the performance of the sanitizer. The concentration (before dilution for use) is preferably no more than about 14.0 wt.% and more preferably ranges from about 6 to about 12 wt.% and most preferably from about 9 to about 11.5 wt.% or preferably no more than about 14.0 g/l and more preferably ranges from about 6 to about 12 g/l and most preferably from about 10.0 to about 11.5 g/l. The final use concentration is preferably no more than about 0.07 wt.% (i.e., no more than about 0.7 g/l) and more preferably ranges from about 0.01 to about 0.03 wt.% (i.e., ranging from about 0.01 to about 0.03 g/l). As will be appreciated, the "final use" concentration refers to the concentration of the selected component during sanitization. In some applications, the sanitizer is diluted with additional solvent or carrier (e.g., water) prior to sanitization. The common dilution ratio of the

sanitizer to the solvent or carrier is at least about 0.2% and more commonly ranges from about 0.3% to about 0.5%.

The solubilizing agent can be any compound that renders the fatty acid, fatty ester, or fatty acid salt more soluble in the solvent. Preferred solubilizing agents are short chained alcohols having a molecular weight of no more than about 46 daltons. The most preferred agents include propylene glycol, ethyl alcohol, isopropyl alcohol, hexylene glycol, and mixtures thereof. The molar ratio of the solubilizing agent to the sulfonated compound preferably ranges from about 4:1 to about 2:1 and more preferably from about 3:1 to about 2.2:1. Such molar ratios yield a preferred concentration (before dilution for use) of the solubilizing agent in the sanitizer that ranges from about 10 to about 80 g/l and more preferably from about 30 to about 60 g/l or from about 1 to about 8 wt.%, more preferably from about 3.5 wt.% to about 6.5 wt.%, and most preferably from about 4.5 wt.% to about 5.5 wt.%. The final use concentration preferably ranges from about 0.02 to about 0.40 g/l (i.e., from about 0.001 to about 0.04 wt.%) and more preferably from about 0.06 to about 0.30 g/l (i.e., from about 0.001 to about 0.03 wt.%).

The antimicrobial agent can be any of a variety of bactericides. Preferred bactericides include phosphoric acid, citric acid, lactic acid, hydrochloric acid, hydroxyacetic acid, acetic acid, and esters and salts thereof, with food grade bactericides such as phosphoric acid, citric acid, and lactic acid and esters and salts thereof being most preferred. While not wishing to be bound by any theory, it is believed that the antimicrobial agent and fatty compound operate synergistically to cause bacterial death. The fatty compound is believed to penetrate and cause swelling of the cell wall. The antimicrobial agent is able to pass through the swollen

cell wall, thereby causing rupturing of the cell wall and death of the bacteria.

The final use concentration of the antimicrobial agent is important to the efficacy of the sanitizer. Preferably, the molar ratio between the sulfonated compound and the antimicrobial agent ranges from about 1:1 to about 3:1 and more preferably from about 1.5:1 to about 2:1, which yields a preferred concentration (before dilution for use) ranging from about 20 to about 40 wt.% (or from about 200 to about 400 g/l) and a more preferred concentration ranging from about 25 to about 35 wt.% (or from about 250 to about 350 g/l). The final use concentration preferably ranges from about 0.04 to about 0.2 wt.% (or from about 0.40 to about 2 g/l) and more preferably from about 0.05 to about 0.18 wt.% (or from about 0.5 to about 1.75 g/l).

The timing of the steps to prepare the sanitizer are important to the effectiveness of the sanitizer in killing microbes. The various components can be added to the solvent in any sequence (e.g., the sulfonated compound can be added before or after or at the same time as the solubilizing agent) so long as the sulfonated compound and the solubilizing agent are added in close temporal proximity to one another. Preferably, the sulfonated compound and the solubilizing agent are added within about 20 minutes of one another, more preferably within about 10 minutes, and most preferably within about 5 minutes. If too long a period of time elapses between the addition of the sulfonated compound and the solubilizing agent, the sulfonated compound can "wax out" (or precipitate out) of the solvent over time. The antimicrobial agent can be added at any time during preparation of the sanitizer. The concentrated sanitizer can thereafter be diluted prior to use.

EXPERIMENT 1

An experiment was performed to determine the effectiveness of a sanitizer according to the present invention in killing bacteria. A sanitizer was prepared using the following components: (a) 25 wt.% of aqueous phosphoric acid (75 wt.% solution); (b) 5 wt.% propylene glycol; (c) 2 wt.% ethanol (100 proof); (d) 6 wt.% sulfonated oleic acid; and (e) 62 wt.% water. *Staphylococcus aureus* and *pseudomonas aeruginosa* were added to hard water in varying concentrations. A use concentration of 1 ounce of the sanitizer for 3 gallons of hard water was employed. At a bacteria concentration of 150 ppm in the hard water, the sanitizer had a 99.999% kill rate and, at a bacteria concentration of 250 ppm in the hard water, the sanitizer had a kill rate of 99.9 %.

EXPERIMENT 2

Another experiment was performed to determine the effectiveness of a sanitizer using higher concentrations of phosphoric acid and sulfonated oleic acid in killing bacteria. A sanitizer was prepared using the following components: (a) 40 wt.% of aqueous phosphoric acid (75 wt.% solution); (b) 5 wt.% propylene glycol; (c) 2 wt.% ethanol (100 proof); (d) 14 wt.% sulfonated oleic acid; and (e) 39 wt.% water. *Staphylococcus aureus* and *pseudomonas aeruginosa* were added to separate batches of hard water at concentrations of 150 ppm and 250 ppm. A use concentration of 1 ounce of the sanitizer for 3 gallons of hard water was employed. At both concentrations, the bacteria kill rate was approximately 99.999%. After two weeks, the preparation became unstable at 100°F storage and the experiment was discontinued.

EXPERIMENT 3

Another experiment was performed to determine the effectiveness of a sanitizer using higher concentrations of phosphoric acid and sulfonated oleic acid in killing bacteria. A sanitizer was prepared using the following components: (a) 35 wt.% of aqueous phosphoric acid (75 wt.% solution); (b) 5 wt.% propylene glycol; (c) 2 wt.% ethanol (100 proof); (d) 10 wt.% sulfonated oleic acid; and (e) 48 wt.% water. *Staphylococcus aureus* and *pseudomonas aeruginosa* were added to hard water in varying concentrations. A use concentration of 1 ounce of the sanitizer for 3 gallons of hard water was employed. At bacteria concentrations of 150 and 250 ppm in the hard water, the sanitizer had a 99.999% kill rate.

EXPERIMENT 4

The following experiments were run against a standard Gram positive and Gram negative bacteria to demonstrate the synergistic effect of phosphoric acid and sulfonated oleic acid in killing such bacteria. Each organism was grown up to $2-6 \times 10^6$ organisms per cc of broth. The kill rates were run using a standard "AOATC" Weber & Black Chalange method. Specifically, one cc of bacteria is placed in 99 mls of sanitze solution (200 ppms) held in solution for 30, 60, 120 seconds. At each interval a 1 cc sample was taken and then neutralized in 9 mls of 1% sodium bicarbonate solution. One cc was then withdrawn from the neutralizing solution and plated. After 48 hrs of incubation the results were read. The sanitze solutions included 200 ppm of phosphoric acid alone, 200 ppm of sulfonated oleic acid alone, and 200 ppm each of phosphoric acid and sulfonated oleic acid. The results are presented below.

GRAM NEGATIVE			
Solution 200 ppms	30 sec	60 sec	120 sec
Phosphoric Acid	6×10^6	4×10^4	4×10^4
Sulfonated Oleic Acid	6×10^6	6×10^6	6×10^6
5 Sulfonated Oleic Acid & Phosphoric Acid (Mixture Splits)	6×10^6	2×10^2	1×10^1

SANITIZING COMPOSITION AND METHOD

GRAM POSITIVE			
Solution 200 ppms	30 sec	60 sec	120 sec
5 Phosphoric Acid	2×10^5	2×10^3	2×10^3
Sulfonated Oleic Acid	2×10^6	2×10^6	2×10^6
Sulfonated Acid and Sulfonated Oleic Acid	2×10^4	2×10^2	2×10^0

10 As can be seen from the above tables, the sanitize solutions containing either phosphoric acid alone or sulfonated oleic acid alone had significantly lower kill rates against both gram negative and gram positive bacteria than a sanitize solution containing both sulfonated oleic acid and phosphoric acid. Accordingly, the joint use of

15 sulfonated oleic acid and phosphoric acid provide surprising and unexpected synergistic results in killing bacteria.

While various embodiments of the present invention

20 have been described in detail, it is apparent that modifications and adaptations of those embodiments will occur to those skilled in the art. However, it is to be expressly understood that such modifications and adaptations are within the scope of the present invention,

25 as set forth in the following claims.

What is claimed is:

1. A liquid sanitizing composition, comprising:
 - (a) a solvent;
 - (b) no more than about 14 wt.% of a sulfonated
5 compound that is at least one of a sulfonated fatty acid and esters and salts thereof;
 - (c) a solubilizing agent for the sulfonated compound in the solvent; and
 - (d) an antimicrobial agent, wherein the liquid
10 sanitizing composition has a pH of no more than about 3.0.
2. The sanitizing composition of Claim 1, wherein the sulfonated fatty acid is selected from the group consisting of a sulfonated oleic acid, a sulfonated linoleic acid, and a sulfonated myristic acid, and mixtures
15 thereof.
3. The sanitizing composition of Claim 1, wherein the concentration of the sulfonated compound in the solvent is no more than about 11.5 g/l.
4. The sanitizing composition of Claim 1, wherein
20 the antimicrobial agent is selected from the group consisting of phosphoric acid, citric acid, lactic acid, hydrochloric acid, hydroxyacetic acid, acetic acid, and esters and salts and mixtures thereof.
5. The sanitizing composition of Claim 1, wherein
25 the concentration of the antimicrobial agent in the composition is at least about 0.4 g/l.
6. The sanitizing composition of Claim 1, wherein the composition comprises at least about 0.04 wt.% of the antimicrobial agent.
- 30 7. The sanitizing composition of Claim 1, wherein the solubilizing agent comprises an alcohol.
8. The sanitizing composition of Claim 6, wherein the alcohol is selected from the group consisting of propylene glycol, ethyl alcohol, isopropyl alcohol,
35 hexylene glycol, and mixtures thereof.



9. The sanitizing composition of Claim 6, wherein the concentration of the alcohol in the solvent ranges from about 0.02 to about 80 g/l.

10. The sanitizing composition of Claim 1, wherein the composition comprises from about 0.001 to about 8 wt.% of the solubilizing agent.

11. The sanitizing composition of Claim 1, wherein the composition is substantially free of iodine.

12. The sanitizing composition of Claim 1, wherein the composition is substantially free of chlorine.

13. The sanitizing composition of Claim 1, wherein the composition is substantially free of peroxyacetic acid.

14. The sanitizing composition of Claim 1, wherein the composition is substantially free of dodecylbenzene and sulfonic acid.

15. A sanitizing composition, comprising:

(a) no more than about 14 wt.% of a sulfonated oleic acid;

(b) a solubilizing agent selected from the group consisting of propylene glycol, ethyl alcohol, isopropyl alcohol and mixtures thereof; and

(c) an antimicrobial agent selected from the group consisting of phosphoric acid, citric acid, lactic acid, and esters and salts and mixtures thereof.

16. A method for sanitizing an object, comprising: contacting the object with an acidic, antimicrobial composition comprising no more than about 14 wt.% of a sulfonated fatty acid or ester or salt thereof, an antimicrobial agent, and an alcohol.

17. The method of Claim 16, wherein the fatty acid is sulfonated oleic acid.

18. The method of Claim 16, wherein the antimicrobial agent is selected from the group consisting of phosphoric acid, citric acid, lactic acid, and esters and salts and mixtures thereof.



19. The method of Claim 16, wherein the aqueous composition comprises from about 0.04 to about 40 wt.% of the antimicrobial agent.

20. The method of Claim 16, wherein the alcohol is
5 selected from the group consisting of propylene glycol, ethyl alcohol, isopropyl alcohol and mixtures thereof.

21. The method of Claim 16, wherein the aqueous composition comprises from about 0.001 to about 8 wt% of the alcohol.

10 22. A method for preparing a sanitizing composition, comprising:

(a) contacting a sulfonated fatty acid or ester or salt thereof with a solvent for the sulfonated fatty acid;

(b) contacting an alcohol with the solvent to form an
15 intermediate sanitizing composition, wherein the time between contacting step (a) and contacting step (b) is no more than about 20 minutes.

23. The method of Claim 13, further comprising:

(c) contacting the intermediate sanitizing
20 composition with an antimicrobial agent at an acidic pH.

24. The method of Claim 14, wherein the solvent is selected from the group consisting of water, hydrogen peroxide, ethoxylated alcohols, and mixtures thereof.

25 25. The method of Claim 14, wherein the time between the contacting step (a) and the contacting step (c) is no more than about 10 minutes.

