A further object of the compositions and methods is a treatment option providing acceptable material compatibility that supports good cleaning performance without a hazy, streaky, or tacky residue on the treated surface.

A further object of the compositions and methods is a treatment option having a use solution pH that does not require the use of personal protective equipment (PPE).

A still further object of the compositions and methods is to provide efficacy against biofilms.

Other objects, advantages and features of the present invention will become apparent from the following specification taken in conjunction with the accompanying drawings.

BRIEF SUMMARY OF THE INVENTION

An advantage of the compositions and methods is that antimicrobial compositions provide dilutable, non-flammable, no-rinse efficacy against microbial pathogens, including viruses such as Norovirus, while providing surface compatible formulations that do not leave hazy, streaky, or tacky residues on treated surfaces. It is a further advantage of the compositions and methods that use solution pH do not require a user to employ PPE. As still further benefits, the compositions are suitable for use as hard surface antimicrobial compositions, including ware wash applications, 3rd sink sanitizers, food contact and non-food contact applications, biofilm treatment compositions, among others, including those which are an alternative to quaternary ammonium compounds.

In one aspect, there is provided an antimicrobial composition comprising from 4 wt-% to 75 wt-% of at least one acid comprising a strong acid; at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and water, wherein the composition is a dilutable liquid concentrate having an acidic pH that is non-flammable; and wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

In another aspect, there is provided a method of using an antimicrobial composition, comprising contacting the antimicrobial composition as described herein to a surface in need of treatment; wherein the method achieves at least a 3-log microbial reduction when used against Norovirus.

In yet another aspect, there is provided a virucidal composition comprising from about 10 wt-% to about 75 wt-% of at least one strong acid; at least one weak acid; at least one

anionic surfactant comprising a linear alkyl benzene sulfonate; and water, wherein the composition is a dilutable acidic liquid concentrate that is non-flammable; and wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

In another aspect, there is provided a method of inactivating a virus, said method comprising contacting the virucidal composition as described herein to a surface in need of treatment; wherein the contacting provides antiviral inactivation efficacy from at least a 3 log reduction to complete inactivation within less 1 minute, or preferably less than 30 seconds when used against Norovirus, and wherein the method does not impart a residue on the treated surface.

In yet another aspect, there is provided a solid antimicrobial composition comprising from 4 wt-% to 70 wt-% of at least one acid comprising a strong acid; at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and at least one nonionic surfactant and/or a solidifying agent, wherein a use solution of the solid composition has an acidic pH and is non-flammable; and wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus .

In another aspect, there is provided a method of using an antimicrobial composition, comprising contacting a use solution of the solid antimicrobial composition as described herein to a surface in need of treatment; wherein the method does not require a rinse step and achieves at least a 3-log microbial reduction, when used against Norovirus.

In yet another aspect, there is provided a solid virucidal composition comprising from 4 wt-% to 70 wt-% of at least one acid comprising a strong acid; at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and at least one nonionic surfactant and/or a solidifying agent, wherein the solid composition provides a use solution that is a dilutable acidic liquid concentrate that is non-flammable; and wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

In another aspect, there is provided a method of inactivating a virus, said method comprising contacting the solid virucidal composition as described herein with an aqueous source to generate a use solution; contacting the use solution to a surface in need of viral inactivation; wherein the contacting of the surface provides antiviral inactivation efficacy from at least a 3 log reduction to complete inactivation within less 1 minute, or preferably less than 30 seconds, when used against Norovirus.

In an embodiment, a solid antimicrobial composition comprises from about 10 wt-% to about 70 wt-% of at least one acid; at least one sulfonate, sulfate and/or carboxylate anionic surfactant; and at least one nonionic surfactant and/or a solidifying agent, wherein a use solution of the solid composition has an acidic pH and is non-flammable. In a further embodiment, the anionic surfactant is a C8-C22 alkyl sulfonate and/or alpha sulfonated carboxylic acid or its ester, and the one or more acids include a strong acid, a weak acid or a combination thereof. In a further embodiment, the anionic surfactant comprises from about 0.1 wt-% to about 38 wt-% of the solid composition, the acids comprises a weak acid comprising from about 8 wt-% to about 55 wt-% and a strong acid comprising from about 2 wt-% to about 75 wt-% of the solid composition, and the solidifying agent is urea, PEG and/or a solidifying polymer.

What is claimed is:

1. An antimicrobial composition comprising:
from 4 wt-% to 75 wt-% of at least one acid comprising a strong acid;
at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and
water,
wherein the composition is a dilutable liquid concentrate having an acidic pH that is non-flammable; and
wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

2. The composition of claim 1, wherein the anionic surfactant further comprises a C8-C22 alkyl sulfonate, and/or alpha sulfonated carboxylic acid or its ester.

3. The composition of claim 1 or 2, further comprising from 1 wt-% to 38 wt-% of a nonionic surfactant, preferably an alkoxylated surfactant having an EO/PO block copolymer.

4. The composition of any one of claims 1-3, wherein the acid comprises from 30 wt-% to 70 wt-%, and wherein the at least one anionic surfactant comprises from 0.1 wt-% to 38 wt-%, and further comprising from 1 wt-% to 38 wt-% of at least one additional functional ingredient and the remainder comprising water.

5. The composition of claim 4, wherein the at least one acid further comprises a weak acid comprising from 10 wt-% to 50 wt-% and the strong acid comprising from 0.1 wt-% to 19 wt-%.

6. The composition of any one of claims 1-5, wherein the liquid composition is a ready to use concentration comprising from 5 ppm to 10,000 pm of the at least one acid and from 10 ppm to 6,000 ppm of the anionic surfactant, and wherein the composition has a use pH from 1.5 to 4, from 2 to 4, from 2.2 to 3.5, or from 2.5 to 3.5.

7. A method of using an antimicrobial composition, comprising:
contacting the antimicrobial composition of any one of claims 1-6 to a surface in need of treatment;
wherein the method achieves at least a 3-log microbial reduction when used against Norovirus.

8. The method of claim 7, wherein the contacting is by wiping, dipping, immersing, or spraying, wherein the application of the composition does not require use of personal protective equipment, wherein the surface is a hard surface, precleaned hard surface, a surface contaminated with Norovirus, a surface contaminated with a biofilm, and/or a human or mammalian tissue, wherein the contacting provides complete kill of the Norovirus in less than 5 minutes, less than 2 minutes, less than 1 minute, or less than 30 seconds, and wherein the contacting step is at an aqueous use temperature from 4.4°C – 71.1°C (40˚F-160˚F), or from 15.6°C - 60°C (60˚F-140˚F), or from 21.1°C - 60°C (70˚F-140˚F).

9. The method of claim 7 or 8, wherein the concentrate is diluted at a rate of from 0.94 g/L (l/8 oz./gal.) to 14.98 g/L (2 oz./gal.), from 1.87 g/L (l/4 oz./gal.) to 7.49 g/L (1 oz./gal.), or from 3.75 g/L (l/2 oz./gal.) to 7.49 g/L (1 oz./gal.) to form a use solution, and wherein the use solution a use solution pH from 1.5 to 4, from 2 to 4, from 2.2 to 3.5, or from 2.5 to 3.5, and wherein a use solution comprises from 5 ppm to 10,000 ppm of at least one acid, and from 10 ppm to 6000 ppm of at least one anionic surfactant.

10. The method of any one of claims 7-9, wherein a sensor and/or indicator is employed to measure and detect at least one of the following: solution pH at which the composition loses biocidal efficacy, concentration of anionic surfactant in the use solution, fluorescence, and/or conductivity.

11. A virucidal composition comprising:
from 4 wt-% to 75 wt-% of at least one strong acid; at least one weak acid; and
at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and
water,
wherein the composition is a dilutable acidic liquid concentrate that is non-flammable; and
wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

12. The composition of claim 11, wherein the anionic surfactant further comprises a C8-C22 alkyl sulfonate and/or alpha sulfonated carboxylic acid or its ester, and wherein the composition further comprises a nonionic surfactant.

13. The composition of claim 11 or 12, wherein a use pH of the composition is from 1.5 to 4, from 2 to 4, from 2.2 to 3.5, or from 2.5 to 3.5.

14. The composition of any one of claims 11-13, wherein the composition further comprises a weak acid comprising from 10 wt-% to 50 wt-% and the strong acid comprises from 0.1 wt-% to 19 wt-%, and the at least one anionic surfactant comprises from 0.2 wt-% to 50 wt-%.

15. A method of inactivating a virus, said method comprising:
contacting the virucidal composition of any one of claims 11-14 to a surface in need of treatment;
wherein the contacting provides antiviral inactivation efficacy from at least a 3 log reduction to complete inactivation within less 1 minute, or preferably less than 30 seconds when used against Norovirus, and wherein the method does not impart a residue on the treated surface.

16. The method of claim 15, wherein the composition is further effective against a small, non-enveloped virus, a large, non-enveloped virus, and/or an enveloped virus.

17. A solid antimicrobial composition comprising:
from 4 wt-% to 70 wt-% of at least one acid comprising a strong acid;
at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and
at least one nonionic surfactant and/or a solidifying agent,
wherein a use solution of the solid composition has an acidic pH and is non-flammable; and
wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

18. The composition of claim 17, wherein the anionic surfactant further comprises a C8-C22 alkyl sulfonate and/or alpha sulfonated carboxylic acid or its ester, or wherein the one or more acids comprise lactic acid and methane sulfonic acid.

19. The composition of claim 17 or 18, wherein the nonionic surfactant is an alkoxylated surfactant having an EO/PO block copolymer, and wherein the solidifying agent is urea, PEG and/or a solidifying polymer.

20. The composition of any one of claims 17-19, wherein the anionic surfactant comprises from 0.1 wt-% to 38 wt-% of the solid composition, wherein the at least one acid comprises a weak acid comprising from 8 wt-% to 55 wt-%

and optionally further comprising from 1 wt-% to 25 wt-% of at least one additional functional ingredient.

21. A method of using an antimicrobial composition, comprising:
contacting a use solution of the solid antimicrobial composition of any one of claims 17-20 to a surface in need of treatment;
wherein the method does not require a rinse step and achieves at least a 3-log microbial reduction when used against Norovirus.

22. The method of claim 21, wherein the contacting is by wiping, dipping, immersing, or spraying, wherein the surface is a hard surface, precleaned hard surface, a surface contaminated with Norovirus, a surface contaminated with a biofilm, and/or a human or mammalian tissue, and wherein the contacting provides complete kill of the Norovirus in less than 5 minutes, less than 2 minutes, less than 1 minute, or less than 30 seconds, wherein the use solution pH is from 1.5 to 4, from 2 to 4, from 2.2 to 3.5, or from 2.5 to 3.5.

23. The method of claim 21 or 22, wherein the application of the use solution and/or handling of the solid composition does not require use of personal protective equipment and/or wherein the contacting step is at an aqueous use temperature from 4.4°C – 71.1°C (40˚F-160˚F), or from 15.6°C - 60°C (60˚F-140˚F), or from 21.1°C - 60°C (70˚F-140˚F), and wherein the use solution comprises from 50 ppm to 6000 ppm of the at least one acid, and from 10 ppm to 6000 ppm of the anionic surfactant.

24. The method of any one of claims 21-23, wherein a sensor and/or indicator is

employed to measure and detect at least one of the following: solution pH at which the composition loses biocidal efficacy, concentration of anionic surfactant in the use solution, fluorescence, and/or conductivity.

25. A solid virucidal composition comprising:
from 4 wt-% to 70 wt-% of at least one acid comprising a strong acid;
at least one anionic surfactant comprising a linear alkyl benzene sulfonate; and
at least one nonionic surfactant and/or a solidifying agent,
wherein the solid composition provides a use solution that is a dilutable acidic liquid concentrate that is non-flammable; and
wherein the composition achieves at least a 3-log microbial reduction when used against Norovirus.

26. The composition of claim 25, wherein the anionic surfactant further comprises a C8-C22 alkyl sulfonate and/or alpha sulfonated carboxylic acid or its ester, or wherein the at least one acid further comprises a weak acid and the anionic surfactant comprises from 1 wt-% to 40 wt-% of the solid composition .

27. The composition of claim 25 of 26, wherein a use pH of the composition is from 1.5 to 4, from 2 to 4, from 2.2 to 3.5, or from 2.5 to 3.5.

28. A method of inactivating a virus, said method comprising:
contacting the solid virucidal composition of any one of claims 25-27 with an aqueous source to generate a use solution;
contacting the use solution to a surface in need of viral inactivation;
wherein the contacting of the surface provides antiviral inactivation efficacy from at least a

3 log reduction to complete inactivation within less 1 minute, or preferably less than 30 seconds, when used against Norovirus.

29. The method of claim 28, wherein the composition is further effective against a small, non-enveloped virus, a large, non-enveloped virus, and/or an enveloped virus.