automated process is largely subjective and relies on human observations, the opportunity for an unsuitable piece of tableware to be placed in front of a customer exists.

Summary

The present disclosure addresses these challenges. The present disclosure is directed to compositions and methods for washing and/or rinsing tableware. The compositions include a sulfonated silane, preferably a zwitterionic sulfonated silane.

Advantageously, in certain embodiments, compositions of the present disclosure include components that not only remove soils and impart good aesthetics, but also make tableware easier to subsequently clean. Specifically, certain preferred compositions described herein cause soils not to stick to tableware which has been previously treated and thus reduce labor, chemical usage, and water as well insure better and more consistent aesthetic results in the dish washing process.

The present disclosure provides a method of washing and/or rinsing tableware, wherein the method includes: providing tableware; and contacting the tableware with a composition comprising a sulfonated silane. In one aspect, the present disclosure provides a method of washing and/or rinsing tableware, the method comprising: providing tableware; and contacting the tableware with a composition comprising a sulfonated silane to provide a protective layer.

In certain embodiments, the method includes providing dirty tableware, washing the dirty tableware, and optionally rinsing the tableware to provide a protective layer.

In certain embodiments, the method includes providing clean tableware and rinsing the clean tableware to provide a protective layer.

In certain embodiments of the present disclosure, a rinse-aid composition is provided. In one embodiment, the rinse-aid composition includes a sulfonated silane, a metal salt, and a surfactant. In another embodiment, the rinse-aid composition includes a sulfonated silane, a surfactant, and a solidification agent.

In certain embodiments of the present disclosure, a tableware detergent composition is provided. In one embodiment, the tableware detergent is a solid tableware detergent composition that includes a sulfonated silane, a surfactant, an alkaline source, and a solidification agent. In another aspect, the present disclosure provides a solid tableware detergent composition comprising: a sulfonated silane; a surfactant; an alkaline

source; and a solidification agent; wherein a dried coating of the composition on a substrate surface provides a protective layer.

Definitions

The term "tableware" includes dishes (e.g., plates, bowls, cups, serving dishes, etc.), cutlery (e.g., spoons, forks, knives, serving utensils), and glassware (e.g., stemware).

The terms "comprises" and variations thereof do not have a limiting meaning

The claims defining the invention are as follows:

1. A method of washing and/or rinsing tableware, the method comprising:

providing tableware; and

contacting the tableware with a composition comprising a sulfonated silane to provide a protective layer.

2. The method of claim 1 wherein the sulfonated silane comprises a zwitterionic sulfonated silane.

3. The method of claim 2 wherein the zwitterionic sulfonated silane has the following formula (Formula II):

$$(R^1O)_p\text{-}Si(Q^2)_q\text{-}W\text{-}N^+(R^2)(R^3)\text{-}(CH_2)_m\text{-}SO_3^-$$

(II)

wherein:

each R^1 is independently a hydrogen, methyl group, or ethyl group;

each Q^2 is independently selected from hydroxyl, alkyl groups containing from 1 to 4 carbon atoms and alkoxy groups containing from 1 to 4 carbon atoms;

each R^2 and R^3 is independently a saturated or unsaturated, straight chain, branched, or cyclic organic group, which may be joined together, optionally with atoms of the group W, to form a ring;

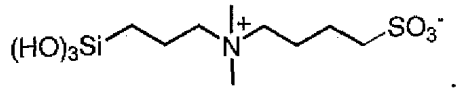
W is an organic linking group;

p and m are integers of 1 to 3;

q is 0 or 1; and

p+q=3.

4. The method of claim 3 wherein the zwitterionic sulfonated silane is



5. The method of any one of claims 1 to 4 wherein providing tableware comprises providing dirty tableware, and contacting the dirty tableware comprises washing the dirty tableware.

6. The method of claim 5 wherein contacting the dirty tableware comprises washing the dirty tableware followed by rinsing the tableware to provide a protective layer.

7. The method of any one of claims 1 to 4 wherein providing tableware comprises providing clean tableware, and contacting the tableware comprises rinsing the clean tableware to provide a protective layer.

8. The method of claim 1 wherein the composition further comprises a metal salt.

9. The method of claim 8 wherein the metal salt comprises a combination of a source of aluminum ion and a source of zinc ion.

10. The method of claim 1 wherein the composition further comprises a surfactant.

11. The method of claim 10 wherein the surfactant is a nonionic ethylene oxide containing surfactant.

12. The method of claim 1 wherein the composition further comprises a hydrophilic polymer.

13. The method of claim 12 wherein the hydrophilic polymer is a polycarboxylate.

14. The method of claim 1 wherein the composition further comprises an alkaline source.

15. The method of claim 14 wherein the alkaline source comprises a metal carbonate, an alkali metal hydroxide, or a combination thereof.

16. The method of any one of claims 1 to 15 wherein the tableware is glassware.

a sulfonated silane;

a surfactant;

an alkaline source; and

a solidification agent;

wherein a dried coating of the composition on a substrate surface provides a protective layer.

19. The composition of claim 18 wherein the dried coating of the composition on the substrate surface has a contact angle of less than 40 degrees.

20. The composition of claim 18 wherein the sulfonated silane comprises a zwitterionic sulfonated silane.

21. The composition of claim 20 wherein the zwitterionic sulfonated silane has the following formula (Formula II):

$$(R^1O)_p\text{-}Si(Q^2)_q\text{-}W\text{-}N^+(R^2)(R^3)\text{-}(CH_2)_m\text{-}SO_3^-$$

(II)

wherein:

each R^1 is independently a hydrogen, methyl group, or ethyl group;

each Q^2 is independently selected from hydroxyl, alkyl groups containing from 1 to 4 carbon atoms and alkoxy groups containing from 1 to 4 carbon atoms;

each R^2 and R^3 is independently a saturated or unsaturated, straight chain, branched, or cyclic organic group, which may be joined together, optionally with atoms of the group W, to form a ring;

W is an organic linking group;

p and m are integers of 1 to 3;

q is 0 or 1; and

p+q=3.

22. The composition of claim 21 wherein the zwitterionic sulfonated silane is

