

**Surfactant Thickened Systems Comprising Microfibrous Cellulose
and Methods of Making Same**

BACKGROUND OF THE INVENTION

- 5 **[0001]** Surfactant-based products such as body washes, shampoos, bubble bath, dish soap, automatic dishwashing detergents, laundry detergents, automotive detergents, toilet cleaners, surfactant concentrates, fire-fighting foaming agents, among others, are often thickened by utilizing high concentration of surfactants, by combining viscosity synergistic surfactants, or by combining the surfactants with small amounts of salts, such as sodium salts.
- 10 These formulations result in high viscosity products that appear rich and smooth but they are limited in that they do not provide sufficient low shear viscosity to allow for suspension of particles. Such particulates might include aesthetic agents (decorative beads, pearlescents, air bubbles, fragrance beads, etc.) or active ingredients (insoluble enzymes, encapsulated actives such as moisturizers, zeolites, exfoliating agents (e.g. alpha hydroxyl and/or glycolic acids or
- 15 polyethylene beads), vitamins (e.g. vitamin E)) etc. or both.
- [0002]** Conventional thickeners and suspension aids such as xanthan gum, carboxymethyl cellulose (CMC), hydroxyethylcellulose (HEC), hydroxypropylmethylcellulose (HPMC), and many types of polyacrylates do not function well with high surfactant levels or in surfactant-thickened systems and often lead to a loss of transparency due to clouding, gelling,
- 20 and/or phase separation or lack sufficient suspension properties. For example, xanthan gum imparts excellent suspension properties in certain body wash formulations with low surfactant-thickening but the gum often loses its suspension ability in systems with high surfactant thickening, usually resulting in a hazy, irregular appearance, and a grainy or lumpy texture. Cellulosic products (CMC, HEC, HPMC, etc.), as another example of conventional thickeners,
- 25 provide unreliable suspension and have significant limitations with respect to surfactant compatibilities. Acrylates systems are common, however, these systems do not always achieve a sufficient clarity level, require high concentrations of polymer, and are not considered natural. Salts are often capable of increasing high shear viscosity in surfactant-thickened systems but do not impart long-term suspension ability.
- 30 **[0003]** There is presently a desire in the consumer products industry to provide for transparent surfactant-thickened systems with particulates suspended therein, as well as a suspension aid for high surfactant systems where many alternative thickeners will not function.

[0004] It has been discovered that microfibrinous cellulose (MFC), bacterially derived or otherwise, can be used to provide suspension of particulates in surfactant-thickened systems as well as in formulations with high surfactant concentrations. It was also discovered that the MFC may be used for this purpose with or without co-agents. When bacterially-derived microfibrinous cellulose is utilized, cellular debris can be eliminated which results in transparent solutions at typical use levels.

[0005] The microfibrinous cellulose appears unaffected by the surfactant micelle development and maintains good suspension in these systems. Microfibrinous cellulose is unique in its ability to function in these systems in large part because it is dispersed rather than solubilized, thereby achieving the desired suspension properties in formulations that would otherwise display the hazing and/or precipitation often seen using alternative solubilized polymers.

BRIEF SUMMARY OF THE INVENTION

[0006] Surfactant systems comprising microfibrinous cellulose are described. "Surfactant systems" is intended to include but is not limited to surfactant-thickened and high surfactant systems. Microfibrinous cellulose (MFC) includes MFC prepared by microbial fermentation or MFC prepared by mechanically disrupting/altering cereal, wood, or cotton-based cellulose fibers. When bacterially-derived microfibrinous cellulose is utilized, cellular debris can be eliminated which results in transparent solutions at typical use levels. The present invention utilizes surfactants to achieve a very thick (highly viscous) system at high shear rates with particulates suspended therein by using microfibrinous cellulose.

[0007] The surfactant concentration of these systems ranges from about 5% to about 99% (w/w active surfactant) wherein the specific concentration is product dependent. Body washes typically contain about 5% to about 15% (w/w) surfactant, dishwashing liquids typically contain about 20% to about 40% (w/w) surfactant (with 40% being an "ultra" concentrated product), and laundry detergents typically contain about 15% to about 50% (w/w) surfactant. Industrial surfactant concentrates (for later dilution by manufacturing or the consumer) can have surfactant levels near 100% for non-ionic surfactants, and sometimes over 50% for anionic surfactants. These concentrates can be used in the manufacture of consumer products such as bath soaps and shampoos or for applications such as fire-fighting foams where

the surfactant is diluted in use. The MFC can be added to these concentrates to provide yield stress to the concentrate or to the diluted system. The MFC is present at concentrations from about 0.05% to about 1.0%, but the concentration will depend on the desired product. For example, while about 0.06% (w/w) MFC is preferred for suspending small air bubbles in an 80% surfactant system, about 0.078% is preferred for suspending air bubbles in a 99% surfactant system, and about 0.150% (w/w) is preferred for suspending either air bubbles or beads in a system containing about 40% (w/w) surfactant. Furthermore, the concentration of MFC will be adjusted accordingly if a highly transparent system is desired. Specifically, a very transparent body wash at about 5% to about 15% (w/w active surfactant) can be achieved with a MFC level of from about 0.055 to about 0.25% (w/w active surfactant).

[0008] Particulates to be suspended could include aesthetic agents (decorative beads, pearlescents, air bubbles, fragrance beads, etc.) or active ingredients (insoluble enzymes, encapsulated actives such as moisturizers, zeolites, exfoliating agents (e.g. alpha hydroxyl and/or glycolic acids or polyethylene beads), vitamins (e.g. vitamin E) etc. or both. Other suitable particulates would be apparent to one of skill in the art.

[0009] The invention is also directed to the use of co-agents and/or co-processing agents such as CMC, xanthan, and/or guar gum with the microfibrinous cellulose in the surfactant systems described herein. Microfibrinous cellulose blends are microfibrinous cellulose products which contain co-agents. Two blends are described MFC, xanthan gum, and CMC in a ratio of 6:3:1, and MFC, guar gum, and CMC in a ratio of 3:1:1. These blends allow MFC to be prepared as a dry product which can be "activated" with high shear or high extensional mixing into water or other water-based solutions. "Activation" occurs when the MFC blends are added to water and the co-agents/co-processing agents are hydrated. After the hydration of the co-agents/co-processing agents, high shear is generally then needed to effectively disperse the microfibrinous cellulose fibers to produce a three-dimensional functional network that exhibits a true yield point. Unexpectedly, the co-agent and/or co-processing agents CMC, xanthan, and/or guar gum present in these microfibrinous cellulose blends appear to remain solubilized (after activation in water) in many high surfactant formulations despite their general lack of compatibility in the high surfactant systems, most likely due to the low use level of these polymers in these formulations with MFC.

[00010] The invention is further directed to methods of making the surfactant systems described, with or without co-agents and/or co-processing agents.

BRIEF DESCRIPTION OF THE SEVERAL VIEWS OF THE DRAWINGS

[00011] The foregoing summary will be better understood when read in conjunction with
5 the Detailed Description of the Invention.

DETAILED DESCRIPTION OF THE INVENTION

[00012] Solutions containing high levels of surfactant were prepared using microfibrinous
10 cellulose with and without co-agents. The pH of the systems described herein range from about
2 to about 12.

EXAMPLE 1

15 [00013] A thickened solution containing 80% non-ionic surfactant was prepared with
0.1% microfibrinous cellulose blend (MFC/xanthan/CMC 6:3:1 blend). A concentrate was first
prepared containing 0.5% microfibrinous cellulose blend (MFC/xanthan/CMC 6:3:1 blend) in
deionized water. 40 g of this solution was introduced into a 250 ml beaker and then 160g of
undiluted Triton® X-100 (~100% active Octoxynol-9 from Union Carbide) was added slowly
20 with mixing at 600 rpm using a jiffy mixing blade. The resulting solution exhibited good
clarity upon visual inspection and possessed the ability to suspend polyethelyne beads, gelatin
encapsulates, gellan gum beads, and air bubbles. The yield value was 0.33 Pa (as measured
with a Brookfield® Yield Rheometer) at a pH of 5.3.

25 EXAMPLE 2

[00014] A thickened solution containing 80% non-ionic surfactant was prepared with
0.1% microfibrinous cellulose blend (MFC/xanthan/CMC 6:3:1 blend). A concentrate was first
prepared containing 0.5% microfibrinous cellulose blend (MFC/xanthan/CMC 6:3:1 blend) in
30 deionized water. 40 g of this solution was put into a 250 ml beaker and 160g of undiluted
Tween® 20 (~100% active Polysorbate 20 from ICI) was added slowly with mixing at 600 rpm
using a jiffy mixing blade. The resulting solution exhibited good clarity upon visual inspection

and possessed the ability to suspend polyethelyne beads, gelatin encapsulates, gum arabic encapsulates, and air bubbles. The yield value was 0.11 Pa (as measured with a Brookfield® Yield Rheometer) at a pH of 6.0.

5 EXAMPLE 3

[00015] A thickened solution containing 99% non-ionic surfactant was prepared using a wet-cake version of microfibrinous cellulose. 0.78% wet cake was added to undiluted Triton X-100 and mixed on an Oster® blender at "liquefy" (top speed) for 5 minutes. The activity (%
10 solids) of this wet-cake form of MFC was about 16% so the active MFC level was 0.125% in the surfactant. The resulting solution exhibited good clarity upon visual inspection and possessed the ability to suspend polyethelyne beads, gelatin encapsulates, gum arabic encapsulates, and air bubbles. The solution was de-aerated under vacuum and the yield point was taken. Upon visual inspection the resulting solution exhibited good clarity with a slight
15 haze and a yield point of 14.6 Pa.

EXAMPLE 4

[00016] A thickened solution containing 99% non-ionic surfactant was prepared using
20 the wet-cake version of microfibrinous cellulose. 0.78% wet cake was added to undiluted Tween® 20 and mixed on an Oster® blender at "liquefy" (top speed) for 5 minutes. The activity (% solids) of this wet-cake form of MFC was 16% resulting in an active MFC level of 0.125% in the surfactant. The resulting solution exhibited good clarity upon visual inspection and possessed the ability to suspend polyethelyne beads, gelatin encapsulates, gum arabic
25 encapsulates, and air bubbles. The solution was de-aerated under vacuum and the yield point was determined. Upon visual inspection the resulting solution exhibited good clarity with some haze and a yield point of 17.8 Pa.

CLAIMS

1. A surfactant system comprising microfibrinous cellulose at a concentration of about
5 0.05% to about 1.0% (w/w), surfactant at about 51% to about 99% (w/w active surfactant), and
a particulate.
2. The surfactant system according to claim 1, wherein the microfibrinous cellulose is
present at about 0.06%.
- 10 3. The surfactant system according to claim 1, wherein the microfibrinous cellulose is
present at about 0.075%.
4. The surfactant system according to claim 1, wherein the microfibrinous cellulose is
15 present at about 0.125%.
5. The surfactant system according to claim 2, wherein the surfactant is present at about 80
% (w/w active surfactant).
- 20 6. The surfactant system according to claim 5, further comprising air bubbles suspended
therein.
7. The surfactant system according to claim 4, wherein the surfactant is present at about
99% (w/w active surfactant).
- 25 8. The surfactant system of claim 5 wherein the pH is from about 3 to about 11.
9. The surfactant system of claim 7 wherein the pH is from about 3 to about 11.
- 30 10. Method of preparing a surfactant system, comprising,
combining microfibrinous cellulose with water and mixing,
adding surfactant and then mixing,

adding particulates followed by mixing,
wherein the resulting system is clear and the particulates are suspended therein.

11. The method of claim 10 wherein the microfibrinous cellulose is present at a concentration
5 of about 0.05% to about 1.0% (w/w), and the surfactant is present at about 51% to about 99% (w/w active surfactant).
12. The method of claim 10 wherein the microfibrinous cellulose is present at about 0.06%.
- 10 13. The method of claim 10, wherein the microfibrinous cellulose is present at about 0.075%.
14. The method of claim 10, wherein the microfibrinous cellulose is present at about 0.125%.
- 15 15. The method of claim 10, wherein the surfactant is present at about 80% (w/w active surfactant).
16. The method of claim 11, wherein the surfactant is present at about 99% (w/w active surfactant).