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(54) Title: REDUCED POUR POINT SURFACTANTS

(57) Abrégé/Abstract:
Reduced pour point ethylene oxide-propylene oxide block copolymer surfactants, pour point depressants for reducing the pour point of such surfactants, and a process for preparing such surfactants, wherein the reduced pour point is achieved without adversely affecting the properties or structure of the parent ethylene oxide-propylene oxide block copolymer surfactant or contributing to the formation of a hazy product. According to the present invention, the pour point of ethylene oxide-propylene oxide block copolymer surfactants may be reduced by mixing a parent ethylene oxide-propylene oxide block copolymer surfactant with a pour point depressant comprising a low molecular weight glycol, water, and a dialkyl sulfosuccinate.

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(54) Title: REDUCED POUR POINT SURFACTANTS

(57) Abstract: Reduced pour point ethylene oxide-propylene oxide block copolymer surfactants, pour point depressants for reducing the pour point of such surfactants, and a process for preparing such surfactants, wherein the reduced pour point is achieved without adversely affecting the properties or structure of the parent ethylene oxide-propylene oxide block copolymer surfactant or contributing to the formation of a hazy product. According to the present invention, the pour point of ethylene oxide-propylene oxide block copolymer surfactants may be reduced by mixing a parent ethylene oxide-propylene oxide block copolymer surfactant with a pour point depressant comprising a low molecular weight glycol, water, and a dialkyl sulfosuccinate.

REDUCED POUR POINT SURFACTANTS

Technical Field

This invention relates to surfactants, and, more particularly, to reduced pour point ethylene oxide-propylene oxide block copolymer surfactants, pour point depressants for reducing the pour point of such surfactants, and a process for preparing such reduced pour point surfactants.

Background of the Invention

The pour point of a compound is defined as the lowest temperature at which the compound will flow when a test container containing the compound is inverted. The pour point of a compound may need to be lowered or raised for numerous reasons. For example, the pour point of a solid compound may need to be lowered if a particular application requires that the compound be in a fluid form. Alternatively, the pour point of a fluid compound may need to be lowered if the compound is to be used for low temperature applications that require that the compound remain fluid at such reduced temperatures.

In the field of surfactants, ethylene oxide-propylene oxide block copolymer surfactants with more than about thirty percent ethylene oxide tend to be solids or pastes at room temperature. Unfortunately, several of the applications for these surfactants require that such surfactants be in a liquid form. Due to the obvious inconvenience associated with liquefying such surfactants, numerous methods have been developed to reduce the pour point of such surfactants. However, many of these methods either adversely alter the properties or structure of the parent surfactant or result in a hazy product. According to one conventional method, additives, commonly termed pour point depressants, are added to the surfactant to reduce the pour point of the surfactant. However, the addition of pour point depressants frequently alters the properties of the parent surfactant and/or results in the production of a hazy product.

Another conventional method involves the use of multiple blocking, wherein alternating blocks of ethylene oxide and propylene oxide are introduced into the surfactant structure to reduce the pour point of the parent surfactant. While this method may reduce the pour point of the resulting surfactant, the structure of the

parent surfactant is altered, and the resulting surfactant product frequently has different properties than the parent surfactant.

Therefore, what is needed are reduced pour point ethylene oxide-propylene oxide block copolymer surfactants, pour point depressants for reducing the pour point of such surfactants, and a process for preparing such reduced pour point surfactants, wherein the pour point of the surfactants is reduced without adversely affecting the properties or structure of the parent surfactant or contributing to the formation of a hazy product.

Summary of the Invention

The present invention, accordingly, provides for reduced pour point ethylene oxide-propylene oxide block copolymer surfactants, pour point depressants for reducing the pour point of such surfactants, and a process for preparing such surfactants, wherein the pour point of the surfactants is reduced without adversely affecting the properties or structure of the parent surfactant or contributing to the formation of a hazy product.

According to one aspect of the present invention, reduced pour point ethylene oxide-propylene oxide block copolymer surfactants are disclosed. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactants are prepared by mixing a parent ethylene oxide-propylene oxide block copolymer surfactant with a pour point depressant comprising a low molecular weight glycol, water, and a dialkyl sulfosuccinate.

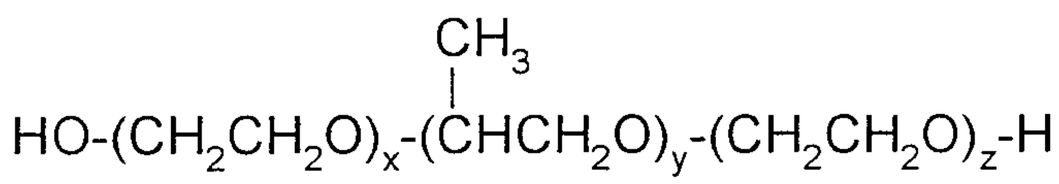
According to another aspect of the present invention, a process for preparing reduced pour point ethylene oxide-propylene oxide block copolymer surfactants is disclosed. According to this process, a parent ethylene oxide-propylene oxide block copolymer surfactant is blended with a pour point depressant comprising a low molecular weight glycol, water, and a dialkyl sulfosuccinate.

According to yet another aspect of the present invention, pour point depressants for reducing the pour point of ethylene oxide-propylene oxide block copolymer surfactants are disclosed. The pour point depressants comprise a low molecular weight glycol, water, and a dialkyl sulfosuccinate.

Detailed Description of the Preferred Embodiment

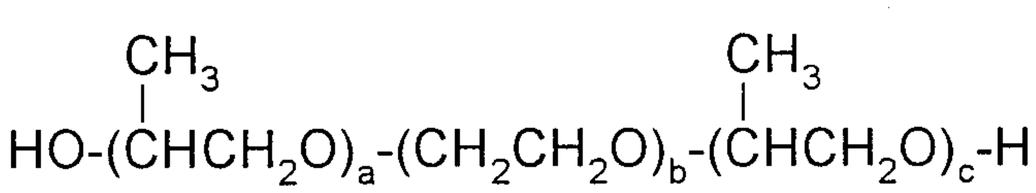
The present invention is primarily directed towards ethylene oxide-propylene oxide block copolymer surfactants that are waxy solids or pastes at room temperature. Typically, such ethylene oxide-propylene oxide block copolymer surfactants have an ethylene oxide content greater than about thirty percent, and the melting point of these surfactants increases as the degree of ethoxylation increases. The term "ethylene oxide-propylene oxide block copolymer surfactants" is meant to encompass block copolymers with the following general structure:

(I)



where x, y, and z each represent an integer, or

(II)



where a, b, and c each represent an integer.

Such ethylene oxide-propylene oxide block copolymer surfactants are useful in a variety of applications, and are frequently used as additives in agricultural formulations, pigment dispersants, grinding aids, industrial cleaners, metal-working lubricants, rinsing agents, etc. However, the use of ethylene oxide-propylene oxide block copolymer surfactants in many of these applications has been hindered by the fact that such surfactants are typically waxy solids or pastes at room temperature. Accordingly, before such surfactants can be used, they must be liquefied (*i.e.* by heating), or the pour point of such surfactants must be depressed by some means (*i.e.* through multiple blocking or through the addition of pour point depressants).

According to the present invention, the pour point of ethylene oxide-propylene oxide block copolymer surfactants may be reduced through the addition of pour point depressants comprising a mixture of a low molecular weight glycol, a dialkyl sulfosuccinate, and water. Preferably, the low molecular weight glycol comprises propylene glycol, ethylene glycol, diethylene glycol, or mixtures thereof (all commercially available from the Huntsman Corporation, Houston, Texas). Preferably, the dialkyl sulfosuccinate comprises a C4-C12 dialkyl sulfosuccinate. The dialkyl sulfosuccinate may be blended with water and a lower molecular weight alkylene glycol, such as propylene glycol, to help promote incorporation of the dialkyl sulfosuccinate into the resulting surfactant product. More preferably, the sulfosuccinate comprises dioctyl sodium sulfosuccinate, blended with about 16% water and 11% propylene glycol (commercially available from the Huntsman Corporation, Ontario, Canada, under the trade name SURFONIC® DOS-75 PG).

The pour point depressants of the present invention are capable of reducing the pour point of ethylene oxide-propylene oxide block copolymer surfactants by at least 40°C. Typically, under such conditions, less than about 85% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a parent surfactant, at least about 5% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises water, at least about 5% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a low molecular weight glycol, and at least about 5% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a dialkyl sulfosuccinate. Preferably, from about 55% to about 80% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a parent surfactant, from about 5% to about 15% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises water, from about 5% to about 15% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a low molecular weight glycol, and from about 5% to about 20% of the resulting reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a dialkyl sulfosuccinate.

Obviously, it may not always be desirable to reduce the pour point of an ethylene oxide-propylene oxide block copolymer surfactant to the extremes provided by the present invention. Accordingly, the composition of the pour point depressant (*i.e.* the relative ratio of dialkyl sulfosuccinate : low molecular weight glycol : water) and the relative amount of the pour point depressant that is mixed with the ethylene oxide-propylene oxide block copolymer surfactant may be adjusted so that the pour point of the resulting surfactant is lowered only to the desired temperature.

In a similar manner, the composition of the pour point depressant and the relative amount of the pour point depressant that is mixed with an ethylene oxide-propylene oxide block copolymer surfactant may also be adjusted to compensate for the unique properties of the particular ethylene oxide-propylene oxide block copolymer surfactant being blended with the pour point depressant, the proposed use of the reduced pour point surfactant, etc.

The addition of the pour point depressants of the present invention to ethylene oxide-propylene oxide block copolymer surfactants does not alter the properties or structure of the parent surfactant. Further, the addition of the pour point depressants of the present invention to ethylene oxide-propylene oxide block copolymer surfactants does not result in a hazy product.

It is understood that variations may be made in the foregoing with departing from the scope of the invention. For example, although the pour point depressants of the present invention are primarily discussed as being incorporated into ethylene oxide-propylene oxide block copolymer surfactants that are waxy solids or pastes at room temperature, it is understood that the pour point depressants of the present invention could potentially be used with ethylene oxide-propylene oxide block copolymers that are not solids or pastes at room temperature. For example, the pour point depressants of the present invention could potentially be used to reduce the pour point of fluid ethylene oxide-propylene oxide block copolymer surfactants that are to be used in low temperature applications.

The following examples are illustrative of the present invention, and are not intended to limit the scope of the invention in any way.

Example 1

SURFONIC® POA P-104 (manufactured by the Huntsman Corporation, Houston, Texas), water, propylene glycol, and SURFONIC® DOS-75 PG were mixed together in the ratios detailed in Table 1. The clarity and pour point of the resulting products were determined visually, and are detailed in Table 1.

Table 1

	% SURFONIC® POA P-104[1]	% water	% propylene glycol	% SURFONIC® DOS-75 PG	clarity @ pour point	pour point (°C)
1	70.00	10.00	0.00	20.00	hazy	0
2	75.00	10.00	0.00	15.00	hazy	5
3	70.00	15.00	5.00	10.00	clear	20
4	70.00	10.00	10.00	10.00	clear	5
5	70.00	10.00	5.00	15.00	hazy	0
6	71.25	11.25	6.25	11.25	clear	15
7	75.00	10.00	0.00	15.00	hazy	5
8	76.25	11.25	1.25	11.25	hazy	25
9	71.25	11.25	1.25	16.25	hazy	5
10	70.00	15.00	0.00	15.00	hazy	15
11	70.00	20.00	0.00	10.00	clear	25
12	75.00	10.00	5.00	10.00	clear	25
13	71.25	16.25	1.25	11.25	clear	25
14	70.00	20.00	0.00	10.00	clear	20
15	80.00	10.00	0.00	10.00	hazy	25
16	70.00	10.00	10.00	10.00	clear	5
17	70.00	10.00	0.00	20.00	hazy	0
18	75.00	15.00	0.00	10.00	clear	25
19	80.00	10.00	0.00	10.00	hazy	25
20	72.50	12.50	2.50	12.50	hazy	20

[1] SURFONIC® POA P-104 is a 3,250 molecular weight EO_x-PO_y-EO_z block copolymer with a 40% ethylene oxide content.

Table 1 demonstrates that the addition of propylene glycol generally has a favorable effect on the clarity of the resulting surfactant blend. Further, the addition of dioctyl sodium sulfosuccinate (SURFONIC® DOS-75 PG) generally has a favorable effect on reducing the pour point of the resulting surfactant blend.

Example 2

A mixture of 70% SURFONIC® POA P-104 and 20% SURFONIC® DOS-75 PG was mixed with water and propylene glycol in the ratios detailed in Table 2. The clarity and pour point of the resulting products were determined visually, and are detailed in Table 2.

Table 2

	% water	% propylene glycol	clarity @ pour point	pour point (°C)
1	10.00	0.00	hazy	0
2	10.00	0.00	hazy	0
3	10.00	0.00	hazy	0
4	0.00	10.00	clear	0
5	7.50	2.50	hazy	15
6	0.00	10.00	clear	0
7	2.50	7.50	hazy	5
8	5.00	5.00	hazy	0

Table 2 shows that the clarity of the resulting surfactant blend improves with the addition of propylene glycol, when the amount of the parent surfactant and dioctyl sodium sulfosuccinate are held constant.

Example 3

70% SURFONIC® POA P-104, 20% SURFONIC® DOS-75 PG, and 10% water were blended with 10% of each of the additives listed in Table 3. The clarity

and pour point of each resulting mixture were determined visually, and are detailed in Table 3.

Table 3

	Additive	clarity @ pour point	pour point (°C)
1	propylene glycol[1]	clear	10
2	dipropylene glycol[1]	hazy	0
3	ethylene glycol[1]	clear	20
4	diethylene glycol[1]	clear	20
5	SURFONIC® L12-3[1]	hazy	0
6	SURFONIC® L10-3[1]	hazy	0
7	SURFONIC® L108-85/5[1]	hazy	0
8	SURFONIC® L24-2[1]	hazy	0
9	SURFONIC® L24-3[1]	hazy	0
10	SURFONIC® L24-4[1]	hazy	0
11	SURFONIC® L12-6[1]	hazy	0
12	EPAL® 108/85[2]	hazy	0
13	2-ethyl hexanol[3]	hazy	0
14	propylene carbonate[1]	hazy	0
15	butylene carbonate[1]	hazy	0
16	butyl carbitol[4]	hazy	0
17	DOWANOL TPM®[5]	hazy	0

[1] manufactured by the Huntsman Corporation, Houston, Texas

[2] manufactured by Amoco Chemicals, Chicago, Illinois

[3] manufactured by the Ashland Chemical Company, Columbus, Ohio

[4] manufactured by Union Carbide, Danbury, Connecticut

[5] manufactured by Dow Chemical Company, Midland, Michigan

Table 3 demonstrates that very few additives produce a resulting product with a favorable clarity. Noticeably, the lower molecular weight glycols

(*i.e.* propylene glycol, ethylene glycol, diethylene glycol) are the only additives that appear to promote a clear product.

Example 4

SURFONIC® POA P-104 was mixed with an additive mix in the ratios detailed in Table 4. The additive mix comprised a 1:1:1 mixture of SURFONIC® DOS-75 PG, propylene glycol, and water. The clarity and pour point of each resulting product were determined visually, and are detailed in Table 4.

Table 4

	% SURFONIC® POA P-104	% additive mix	minimum clear temp. (°C)	clarity @ pour point	pour point (°C)
1	100	0		hazy	45
2	90	10	15	hazy	10
3	85	15	10	hazy	5
4	80	20	5	hazy	5
5	75	25	0	clear	0
6	70	30	0	clear	0
7	65	35	0	clear	<0
8	60	40	<-10	clear	<-10
9	55	45	<-10	clear	<-10

Table 4 shows that the additive mix must comprise at least 25% of the blended surfactant for the resulting product to have both a reduced pour point and a favorable clarity.

Table 5 (Comparative)

	Surfactant	clarity @ pour point	pour point (°C)
1	SURFONIC® POA P-104	hazy	43

	Surfactant	**clarity @ pour point**	**pour point (°C)**
2	A product of the present invention, comprising 70% SURFONIC® POA P-104, 10% water, 10% SURFONIC® DOS-75 PG , and 10% propylene glycol	clear	0
3	Product produced by introducing alternating blocks of ethylene oxide and propylene oxide into SURFONIC® POA P-104	hazy	15
4	Product produced by alkoxylating SURFONIC® POA P-104 with a 85:15 of ethylene oxide : propylene oxide mix	hazy	15

Table 5 compares the clarity and pour point of SURFONIC® POA P-104 (#1 above) with the clarity and pour point of SURFONIC® POA P-104 that has been blended with the pour point depressants of the present invention (#2 above) and SURFONIC® POA P-104 that has been chemically altered to reduce the pour point (#3 and #4 above). The surfactant prepared according to the present invention has a dramatically lower pour point, and is the only surfactant with a favorable clarity.

Although illustrative embodiments have been shown and described, a wide range of modification, changes, and substitution is contemplated in the foregoing disclosure. In some instances, some features of the disclosed embodiments may be employed without a corresponding use of the other features. Accordingly, it is appropriate that the appended claims be construed broadly and in a manner consistent with the scope of the invention.

Claims

1. A process for preparing reduced pour point ethylene oxide-propylene oxide block copolymer surfactants, wherein a parent ethylene oxide-propylene oxide block copolymer surfactant is mixed with a pour point depressant comprising:
   a. a low molecular weight glycol;
   b. water; and
   c. a dialkyl sulfosuccinate.

2. The process of claim 1, wherein the low molecular weight glycol is selected from propylene glycol, ethylene glycol, diethylene glycol, or mixtures thereof.

3. The process of claim 1, wherein the dialkyl sulfosuccinate comprises a C4-C12 dialkyl sulfosuccinate.

4. The process of claim 1, wherein the dialkyl sulfosuccinate comprises dioctyl sodium sulfosuccinate.

5. The process of claim 1, wherein less than about 85% of the reduced pour point ethylene oxide-propylene oxide block copolymer comprises the parent ethylene oxide-propylene oxide block copolymer surfactant.

6. The process of claim 5, wherein at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the low molecular weight glycol.

7. The process of claim 6, wherein at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the dialkyl sulfosuccinate.

8. The process of claim 7, wherein at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises water.

9. The process of claim 1, wherein from about 55% to about 80% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the parent ethylene oxide-propylene oxide block copolymer surfactant.

10. The process of claim 9, wherein from about 5% to about 15% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the low molecular weight glycol.

11. The process of claim 10, wherein from about 5% to about 20% of the reduced pour point surfactant comprises the dialkyl sulfosuccinate.

12. The process of claim 11, wherein from about 5% to about 15% of the reduced pour point surfactant comprises water.

13. A reduced pour point ethylene oxide-propylene oxide block copolymer surfactant prepared by mixing a parent ethylene oxide-propylene oxide block copolymer surfactant with a pour point depressant comprising:

a. a low molecular weight glycol;

b. water; and

c. a dialkyl sulfosuccinate.

14. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 13, wherein the dialkyl sulfosuccinate comprises a C4-C12 dialkyl sulfosuccinate.

15. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 13, wherein the dialkyl sulfosuccinate comprises dioctyl sodium sulfosuccinate.

16. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 13, wherein the low molecular weight glycol is selected from propylene glycol, ethylene glycol, diethylene glycol, or mixtures thereof.

17. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 13, wherein less than 85% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the parent ethylene oxide-propylene oxide block copolymer surfactant.

18. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 17, wherein at least 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the dialkyl sulfosuccinate.

19. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 18, wherein at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises water.

20. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 19, wherein at least 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises the low molecular weight glycol.

21. A reduced pour point ethylene oxide-propylene oxide block copolymer surfactant, wherein:

a. less than about 85% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a parent ethylene oxide-propylene oxide block copolymer surfactant;

b. at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a low molecular weight glycol;

c. at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a dialkyl sulfosuccinate; and

d. at least about 5% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises water.

22. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 21, wherein the dialkyl sulfosuccinate comprises a C4-C12 dialkyl sulfosuccinate.

23. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 21, wherein the dialkyl sulfosuccinate comprises dioctyl sodium sulfosuccinate.

24. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 21, wherein the low molecular weight glycol is selected from propylene glycol, ethylene glycol, diethylene glycol, or mixtures thereof.

25. A reduced pour point ethylene oxide-propylene oxide block copolymer surfactant, wherein:

a. from about 55% to about 85% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a parent ethylene oxide-propylene oxide block copolymer surfactant;

b. from about 5% to about 15% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a low molecular weight glycol;

c. from about 5% to about 20% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises a dialkyl sulfosuccinate; and

d. from about 5% to about 15% of the reduced pour point ethylene oxide-propylene oxide block copolymer surfactant comprises water.

26. The reduced pour point ethylene oxide-propylene oxide block copolymer surfactant of claim 25, wherein the dialkyl sulfosuccinate comprises a C4-C12 dialkyl sulfosuccinate.

27. The reduced pour point surfactant of claim 25, wherein the dialkyl sulfosuccinate comprises dioctyl sodium sulfosuccinate.

28. The reduced pour point surfactant of claim 25, wherein the low molecular weight glycol is selected from propylene glycol, ethylene glycol, diethylene glycol, or mixtures thereof.

29. A pour point depressant for reducing the pour point of ethylene oxide-propylene oxide block copolymer surfactants, wherein the pour point depressant comprises:

a. a low molecular weight glycol;

b. water; and

c. a dialkyl sulfosuccinate.

30. The pour point depressant of claim 29, wherein the low molecular weight glycol is selected from propylene glycol, ethylene glycol, diethylene glycol, or mixtures thereof.

31. The pour point depressant of claim 29, wherein the dialkyl sulfosuccinate comprises a C4-C12 dialkyl sulfosuccinate.

32. The pour point depressant of claim 29, wherein the dialkyl sulfosuccinate comprises dioctyl sodium sulfosuccinate.