Abstract:
A method for quenching coke mass is disclosed. The coke mass may be quenched by providing an aqueous stream with a quench aid, and contacting the coke mass with the aqueous stream. The quench aid may have at least one fatty alcohol ethoxylated surfactant. Novel compositions comprising at least two secondary alcohol ethoxylates, which are suitable as surfactants, quenching aids, or dewatering aids in a variety of applications, are also disclosed.
FIELD OF THE INVENTION

[0001] The present invention relates to compositions for quenching or dewatering. More specifically, the compositions may be used with methods suitable for the quenching process in coke manufacturing.

BACKGROUND OF THE INVENTION

[0002] In the typical coke manufacturing process, a large mass of coal is fed into a series of ovens, called an oven battery. An oven battery may contain 20 to 100 or more ovens. The ovens are sealed and the coal is heated to about 1100 °C in the absence of oxygen. The lack of oxygen carbonizes the coal, transforming it to coke. The operation of each individual oven is a cyclic, or batch process, but batteries typically contain enough ovens to produce coke practically continuously. The length of each cycle may range from 15 to more than 30 hours, depending on a variety of factors, including the quality of the coal feed and the type of coke produced, i.e. blast furnace coke, or foundry coke. As the coal is carbonized, hot organic vapors are produced and may be recycled back to heat the oven or used elsewhere.

[0003] Once the entire mass has been carbonized, the coke mass is pushed out the sides of the oven with a ram and onto a railroad car, called a quench car. The quench car transfers the coke to a quench tower where the coke is deluged, or quenched, with water to cool the coke and keep it from burning in the presence of oxygen. The coke is sprayed with water until the coke mass cools to about 100 °C. This requires a large volume of water. After the coke mass is quenched, it is transferred to an inclined coke wharf to drain the excess water and cool the coke to a temperature that is safe to handle. The drained water is collected and may be reused to quench multiple coke batches or sent elsewhere for wastewater treatment.

[0004] In the case of water-quenched coke, water cools mostly the surface of the coke, requiring large volumes to effectively quench the coke. The large volume of water required increases the residual moisture content of water-quenched coke.
Reducing residual moisture content in coke positively impacts the energy requirement in down-stream applications.

[0005] Some alkyl phenol components are known to decrease residual moisture content in some applications, including sand and municipal solid waste. Unfortunately, some alkyl phenols, such as some alkylphenol ethoxylates, are known endocrine disrupters in mammals and are toxic to many aquatic species. The toxic alkylphenol ethoxylates include dodecylphenol, nonylphenol, and octylphenol ethoxylates. In addition, these alkylphenol ethoxylates have poor biodegradability. Consequently, many countries, including those of the European Union, Canada, Japan, Taiwan, Korea and the United States have banned alkylphenol ethoxylates or restricted its use.

BRIEF DESCRIPTION OF THE INVENTION

[0006] It was surprisingly discovered that adding fatty alcohol ethoxylated surfactants to the quench water as a "quenching aid" not only reduced the quench time, but resulted in coke with a low residual moisture content. Fatty alcohol ethoxylated surfactants may comprise primary alcohol ethoxylates or secondary alcohol ethoxylated surfactants. Fatty alcohol ethoxylates have fewer negative effects on aquatic life and are more biodegradable than alkylphenol ethoxylates.

[0007] Accordingly, compositions and methods for quenching coke mass are disclosed. Although the methods disclosed are directed to a coke quenching process, the compositions are suitable for quenching coke or dewatering solid matter and particulates in a variety of applications. Exemplary applications include dewatering of sand and municipal solid waste. The methods may comprise providing a coke mass; providing an aqueous stream with a quenching aid therein; and contacting the coke mass with the aqueous stream. The quenching aid may comprise at least one fatty alcohol ethoxylated surfactant therein.

[0008] In another embodiment, the fatty alcohol ethoxylated surfactant may comprise at least one secondary alcohol ethoxylate as in the empirical formula, Formula I:

$$C_nH_{2n}O(CH_2CH_2O)_nH$$

where n is an integer ranging from about 1 to about 20;
a is an integer ranging from 2 to 25; and
b is an integer ranging from 5 to 51.

[0009] At least one secondary alcohol ethoxylate may have the structure as shown in Formula II:

\[
\begin{align*}
  &R_1 \quad \text{O} \quad \{\text{EO}\}_n \quad \text{H} \\
  &R_2
\end{align*}
\]

where \( n \) may be an integer ranging from about 1 to about 20;
EO is ethylene oxide (i.e., \( \text{CH}_2\text{CH}_2\text{O} \)); and
\( R_1 \) and \( R_2 \) may be the same or different, and are straight \( \text{C}_i\text{C}_{15} \) alkyls or branched \( \text{C}_i\text{C}_{15} \) alkyls. Alternatively, \( n \) may range from about 1 to about 15 or from about 1 to about 10.

[0010] All secondary alcohol ethoxylated surfactants may be used in the present invention. Specific examples include, but are not limited to, polyethylene glycol trimethylnonyl ether, polyethylene glycol dodecyl ether, polyethylene glycol tetradecyl ether, and polyethylene glycol hexadecyl ether.

[0011] In another embodiment, a method is disclosed wherein the quenching aid used may have an average HLB ranging from about 8.0 to about 15.0. Alternatively, the HLB may be about 11.0 ± 1.0.

[0012] The ethoxyl chain, represented as "\( n \)" in Formulas I or II, may be long or short. In another method, the quenching aid may comprise at least one short ethoxyl chain secondary alcohol ethoxylate and at least one long ethoxyl chain secondary alcohol ethoxylate. The ethoxyl chain, \( n \), of the short ethoxyl chain secondary alcohol ethoxylate may range from about 1.0 to about 5.0. The ethoxyl chain, \( n \), of the long ethoxyl chain secondary alcohol ethoxylate may range from greater than about 5.0 to about 10.0. In yet another embodiment a method is disclosed wherein the weight ratio of the short chain to the long chain secondary alcohol ethoxylate may range from about 05:95 to about 50:50. Alternatively, the short chain
to long chain secondary alcohol ethoxylate weight ratio may range from about 20:80
to about 30:70.

[0013] In another embodiment, a method is disclosed wherein the weight ratio
of the coke mass being quenched to the aqueous stream may range from about
1.0:0.25 to about 1.0:10.0. Alternatively, the weight ratio of the coke mass to the
aqueous stream may range from about 1.0:1.0 to about 1.0:2.5.

[0014] In yet another embodiment, a method is disclosed wherein the
quenching aid may be present in an amount ranging from about 1 ppm to about 2000
ppm by volume of the aqueous stream. Alternatively, the quenching aid may be
present in an amount ranging from about 10 ppm to about 1000 ppm by volume.

[0015] Novel compositions are also disclosed. These compositions are
suitable as surfactants, quenching aids, or dewatering aids in a variety of applications.
As such, their use is not limited to the coke quenching process. In one embodiment, a
composition is disclosed wherein the composition comprises at least two secondary
alcohol ethoxylates as in Formula II:

\[
R_1 \quad O \quad \{EO\}_n \quad H
\]

\[
R_2
\]

where \(n\) may be an integer ranging from about 1 to about 20;
\(EO\) is ethylene oxide (i.e., \(\text{CH}_2\text{CH}_2\text{O}\)); and
\(R_1\) and \(R_2\) may be the same or different, and are straight \(\text{C}_1\text{C}_{25}\) alkyls or branched \(\text{C}_1\text{C}_{25}\) alkyls. Alternatively, \(n\) may range from about 1 to about 15 or from about 1 to
about 10.

[0016] All secondary alcohol ethoxylated surfactants are may be used in the
present invention. Specific examples include, but are not limited to, polyethylene
glycol trimethylnonyl ether, polyethylene glycol dodecyl ether, polyethylene glycol
tetradecyl ether, and polyethylene glycol hexadecyl ether.
[0017] In another embodiment, the composition may have an average HLB ranging from about 8.0 to about 15.0. Alternatively, the HLB may be about 11.0 ± 1.0.

[0018] In another embodiment, the composition may comprise at least one short ethoxyl chain secondary alcohol ethoxylate and at least one long ethoxyl chain secondary alcohol ethoxylate. The ethoxyl chain, n, of the short ethoxyl chain secondary alcohol ethoxylate may range from about 1.0 to about 10.0, preferably about 1.0 to about 5.0. The ethoxyl chain, n, of the long ethoxyl chain secondary alcohol ethoxylate may range from greater than about 5.0 to about 20.0, preferably about 5.0 to about 10.0. In yet another embodiment a composition is disclosed wherein the weight ratio of the short chain to the long chain secondary alcohol ethoxylate may range from about 05:95 to about 50:50. Alternatively, the short chain to long chain secondary alcohol ethoxylate weight ratio may range from about 20:80 to about 30:70.

[0019] The composition may further comprise a co-solvent. In one embodiment, the co-solvent is water.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0020] It was surprisingly discovered that adding fatty alcohol ethoxylated surfactants to the quench water as a "quenching aid" not only reduced the quench time, but resulted in coke with a low residual moisture content. Fatty alcohol ethoxylated surfactants may comprise primary alcohol ethoxylates or secondary alcohol ethoxylated surfactants. Fatty alcohol ethoxylates have fewer negative effects on aquatic life and are more biodegradable than alkylphenol ethoxylates.

[0021] Accordingly, compositions and methods for quenching coke mass are disclosed. Although the methods disclosed are directed to a coke quenching process, the compositions are suitable for quenching or dewatering solid matter and particulates in a variety of applications. Exemplary applications include dewatering of sand and municipal solid waste. The methods may comprise providing a coke mass; providing an aqueous stream with a quenching aid therein; and contacting the coke mass with the aqueous stream. The quenching aid may comprise at least one fatty alcohol ethoxylated surfactant therein.
In another embodiment, the fatty alcohol ethoxylated surfactant may comprise at least one secondary alcohol ethoxylate as in the empirical formula, Formula I:

\[ C_{1.340}(CH_2CH_2O)_nH \]  

(I)

where \( n \) is an integer ranging from about 1 to about 20; 
\( a \) is an integer ranging from 2 to 25; and 
\( b \) is an integer ranging from 5 to 51.

At least one secondary alcohol ethoxylate may have the chemical formula as in Formula II:

[Diagram]

where \( n \) may be an integer ranging from about 1 to about 20; 
EO is ethylene oxide (i.e., \( CH_2CH_2O \)); and 
\( R_1 \) and \( R_2 \) may be the same or different, and are straight \( C_{1-25} \) alkyls or branched \( C_{1-} \) \( C_{25} \) alkyls. Alternatively, \( n \) may range from about 1 to about 15 or from about 1 to about 10 or from about 1 to about 5.

In another embodiment, the total number of carbon atoms in the ethoxylated surfactant (i.e. number of carbon atoms in \( R_1 + R_2 \)) may range from about 12 to about 16 carbon atoms.

Surfactants, including secondary alcohol ethoxylated surfactants are classified by their hydrophile-lipophile balance ("HLB"). The HLB is an empirically determined value that represents the relationship between the hydrophobic and the hydrophilic portions of the surfactant molecule. The HLB value is related to the moles of ethylene oxide and the surfactant's molecular weight. The HLB may also be estimated or calculated by those skilled in the art.

All secondary alcohol ethoxylated surfactants may be used in the present invention. Specific examples include, but are not limited to, polyethylene glycol trimethylnonyl ether, polyethylene glycol dodecyl ether, polyethylene glycol tetradecyl ether, and polyethylene glycol hexadecyl ether.
[0027] It was also surprisingly discovered, however, that blends of secondary alcohol ethoxylates with an average HLB value ranging from about 8.0 to about 15.0 may further increase the quenching and dewatering abilities of the quenching aid. Accordingly, in another embodiment, a method is disclosed wherein the quenching aid may be a blend of secondary alcohol ethoxylates with an average HLB ranging from about 8.0 to about 15.0. Alternatively, the average HLB may be about 11.0 ± 1.0.

[0028] A person of ordinary skill in the art can appreciate that individual secondary alcohol ethoxylates with an HLB outside of the above ranges may be used to produce a quenching aid with an average HLB ranging from about 8.0 to about 15.0. Accordingly, the HLB of the individual secondary alcohol ethoxylates blended to make the quenching aid may vary from about 1 to about 30. Moreover, the average HLB may be adjusted by varying the ratios of the individual secondary alcohol ethoxylates. Methods for calculating the required ratios of different surfactants to yield a blend with a desired HLB are well known in the art and include, but are not limited to, the utilization of "HLB Computagraphs".

[0029] The ethoxyl chain, or moles of ethoxylation, represented as "n" in Formulas I or II may be long or short. In another method, the quenching aid may comprise at least one short ethoxyl chain secondary alcohol ethoxylate and at least one long ethoxyl chain secondary alcohol ethoxylate. The ethoxyl chain, n, of the short chain ethoxyl secondary alcohol ethoxylate may range from about 1.0 to about 10.0, preferably about 1.0 to about 5.0. The ethoxyl chain, n, of the long ethoxyl chain secondary alcohol ethoxylate may range from greater than about 5.0 to about 20.0, and preferably from greater than about 5.0 to about 10.0. The moles of ethoxylation have some effect on the HLB. Thus, in another embodiment, a method is disclosed wherein the weight ratio of the short ethoxyl chain to the long ethoxyl chain secondary alcohol ethoxylate may range from about 05:95 to about 50:50. In yet another embodiment, the weight ratio of the short ethoxyl chain to the long ethoxyl chain secondary ethoxylate may range from about 15:85 to about 35:65. Alternatively, the short ethoxyl chain to long ethoxyl chain secondary alcohol ethoxylate weight ratio may range from about 20:80 to about 30:70.
The volume of the aqueous stream required to effectively quench the coke may depend on a variety of factors, including, but not limited to, water cleanliness, the size of the coke mass, and the temperature of the coke. In another embodiment, a method is disclosed wherein the weight ratio of the coke mass being quenched to the aqueous stream may range from about 1.0:0.25 to about 1.0:10.0. Alternatively, the weight ratio of the coke mass to the aqueous stream may range from about 1.0:1.0 to about 1.0:2.5.

Just as the volume of the aqueous stream required to effectively quench the coke may vary with each application, the concentration of the quenching aid may vary with each application. In yet another embodiment, a method is disclosed wherein the quenching aid may be present in an amount ranging from about 1 ppm to about 2000 ppm by volume of the aqueous stream. Alternatively, the quenching aid may be present in an amount ranging from about 10 ppm to about 1000 ppm by volume.

Novel compositions are also disclosed. These compositions are suitable as surfactants, quenching aids, or dewatering aids in a variety of applications. As such, their use is not limited to the coke quenching process. In one embodiment, a composition is disclosed wherein the composition comprises at least two secondary alcohol ethoxylates as in Formula II:

\[
\begin{align*}
R_1 & \quad \quad O \quad \quad \{\text{EO}\}^n \quad \quad H \\
R_2
\end{align*}
\]

where \(n\) may be an integer ranging from about 1 to about 20; \(\text{EO}\) is ethylene oxide (i.e., \(\text{CH}_2\text{CH}_2\text{O}\)); and \(R_1\) and \(R_2\) may be the same or different, and are straight \(\text{C}_1\text{C}_{25}\) alkyls or branched \(\text{C}_{15}\) alkyls. Alternatively, \(n\) may range from about 1 to about 15 or from about 1 to about 10.

In another embodiment, the total number of carbon atoms in the secondary alcohol ethoxylates (i.e. number of carbon atoms in \(R_1 + R_2\)) may range from about 12 to about 16 carbon atoms. Specific examples of suitable secondary
alcohol ethoxylates include, but are not limited to, polyethylene glycol trimethylnonyl ether, polyethylene glycol dodecyl ether, polyethylene glycol tetradecyl ether, and polyethylene glycol hexadecyl ether.

[0034] In another embodiment, the composition may have an average HLB ranging from about 8.0 to about 15.0. Alternatively, the HLB may be about 11.0 ± 1.0.

[0035] In another embodiment, the composition may comprise at least one short ethoxy chain secondary alcohol ethoxylate and at least one long ethoxy chain secondary alcohol ethoxylate. The ethoxy chain, n, of the short ethoxy chain secondary alcohol ethoxylate may range from about 1.0 to about 10.0, preferably 1.0 to about 5.0. The ethoxy chain, n, of the long ethoxy chain secondary alcohol ethoxylate may range from greater than about 5.0 to about 20.0, preferably greater than about 5.0 to about 10.0. In yet another embodiment a composition is disclosed wherein the weight ratio of the short ethoxy chain to the long ethoxy chain secondary alcohol ethoxylate may range from about 05:95 to about 50:50. In yet another embodiment, the weight ratio of the short ethoxy chain to the long ethoxy chain secondary ethoxylate may range from about 15:85 to about 35:65. Alternatively, the short ethoxy chain to long ethoxy chain secondary alcohol ethoxylate weight ratio may range from about 20:80 to about 30:70.

[0036] The composition may further comprise a co-solvent to broaden the temperature ranges at which the composition remains stable. The co-solvent may range from about 0.1 wt% to about 10 wt% of a total weight of the composition. Alternatively, the co-solvent may range from about 0.5 wt% to about 5 wt%. In one embodiment, the co-solvent is a polar protic solvent. Suitable polar protic solvents include, but are not limited to, water, ethanol, methanol, n-propanol, isopropanol, and n-butanol. In yet another embodiment, the co-solvent is water.

EXAMPLES

EXAMPLE SET 1

[0037] The examples in Example Set 1 demonstrate the effectiveness of secondary alcohol ethoxylates as quenching aids to comparative quenching aids, nonyl phenol and dodecylphenol ethoxylates.
The following procedure was used in Example Set 1. A fixed quantity of crushed coke (43 g) was charged into a cylindrical alumina crucible. The charged crucible was then placed in an oven set at 400 °C and maintained for 1 hour. The charged crucible was then removed from the oven and placed in a fume hood. A thermocouple was used to measure the coke temperature at several locations within the crucible to obtain an average bulk temperature. The thermocouple was left in the bulk of the coke during quenching with water containing various quenching aids at dosage levels of 200 ppm. The time for the coke to reach 100 °C was recorded.

The results of Example Set 1 are shown in Table 1.

Table 1 - Effectiveness of Various Quenching Aids

<table>
<thead>
<tr>
<th>Quench Composition</th>
<th>Time to Reach 100 °C (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (control)</td>
<td>34</td>
</tr>
<tr>
<td><strong>Comparative Quenching Aids (15 ml at 200 ppm)</strong></td>
<td></td>
</tr>
<tr>
<td>75 wt% nonyl phenol (EO=9.5) + 25 wt% octyl phenol (EO=1)</td>
<td>23</td>
</tr>
<tr>
<td>Dodecylphenol (EO=10)</td>
<td>22</td>
</tr>
<tr>
<td><strong>Exemplary Quenching Aids (15 ml at 200 ppm)</strong></td>
<td></td>
</tr>
<tr>
<td>Secondary alcohol ethoxylate (short ethoxyl chain; EO=2)</td>
<td>11</td>
</tr>
<tr>
<td>Secondary alcohol ethoxylate (long ethoxyl chain; EO=9)</td>
<td>14</td>
</tr>
</tbody>
</table>

EXAMPLE SET 2

The examples in Example Set 2 demonstrate the quenching effectiveness of a quenching aid at various concentrations and dosages. The quenching aid comprised a blend of secondary alcohol ethoxylates. Specifically the quenching aid contained 25 wt% Tergitol 15-S-3 and 75 wt% Tergitol 15-S-7. Tergitol 15-S-3 and Tergitol 15-S-7 from Dow Chemical were used for the "short ethoxyl chain" and "long ethoxyl chain" secondary alcohol ethoxylates, respectively. The ethoxyl chain, n, of the short ethoxyl chain secondary alcohol ethoxylate was 3. The ethoxyl chain, n, of the long ethoxyl chain secondary alcohol ethoxylate was 7.
The following procedure was used in Example Set 2. A fixed quantity of crushed coke (35.5 g) was charged into a cylindrical alumina crucible and weighed. The charged crucible was then placed in an oven set at 100 °C and maintained at that temperature for 3 hours. The charged crucible was cooled to room temperature and weighed again. The weight difference before and after heating was used to calculate the initial moisture content of the coke.

The charged crucible was then placed in an oven set at 900 °C and maintained for 1 hour. The charged crucible was then placed in a fume hood. A thermocouple was used to measure the coke temperature at several locations within the crucible to obtain an average bulk temperature. The thermocouple was left in the bulk of the coke during quenching with water containing the exemplary quenching aid at different concentrations and dosages. The time for the coke to reach 100 °C was recorded. The results of Example Set 2 are shown in Table 2.

Table 2 - Quenching Effectiveness of Various Dosages and Concentrations
Quenching Aid

<table>
<thead>
<tr>
<th>Quench Composition</th>
<th>Concentration (ppm)</th>
<th>Dosage (ml)</th>
<th>Time to Reach 100 °C (seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (control)</td>
<td>N/A</td>
<td>70</td>
<td>10**</td>
</tr>
<tr>
<td></td>
<td>N/A</td>
<td>47</td>
<td>12*</td>
</tr>
<tr>
<td>Exemplary Quenching Aids</td>
<td>400</td>
<td>35</td>
<td>6*</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>47</td>
<td>6*</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>70</td>
<td>8*</td>
</tr>
<tr>
<td></td>
<td>400</td>
<td>87</td>
<td>5**</td>
</tr>
<tr>
<td></td>
<td>600</td>
<td>70</td>
<td>7**</td>
</tr>
</tbody>
</table>

* Temperature increased to about 200-270 °C after about 2 - 3 minutes
** Temperature remained uniform

It was observed that under some treatment conditions (*), the temperature of the coke started to rise to about 200 to about 270 °C two to three minutes after treatment. Without limiting this specification to any particular theory of operation, one possible theory for this observed phenomenon is low-dosage volume.

EXAMPLE SET 3
[0044] The examples in Example Set 3 demonstrate dewatering effectiveness of the quenching aid. As in Example Set 2, the quenching aid contained 25 wt% Tergitol 15-S-3 and 75 wt% Tergitol 15-S-7. To measure the dewatering effectiveness, the residual moisture content of the coke after quenching was measured. For these examples, the charged crucible with the quenched coke was allowed to cool to room temperature and weighed a second time. The charged crucible was again placed in an oven set at 100 °C and maintained at that temperature for 3 hours. The weight difference before and after heating at 100 °C was used to calculate the residual moisture content of the coke before and after quenching. The results are shown in Table 3.

<table>
<thead>
<tr>
<th>Quench Composition</th>
<th>Concentration (ppm)</th>
<th>Dosage (ml)</th>
<th>Residual Moisture Content (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water (control)</td>
<td>N/A</td>
<td>70</td>
<td>7.9</td>
</tr>
<tr>
<td><strong>Exemplary Quenching Aids</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Water with quenching aid</td>
<td>600</td>
<td>70</td>
<td>3.5</td>
</tr>
</tbody>
</table>

[0045] These examples show that residual moisture content may be reduced through the use of the quenching aid of the present invention. Reducing residual moisture content in coke would positively impact the energy requirement in downstream applications.

[0046] Without limiting this specification to any particular theory of operation, the quenching aid may help the water molecules to penetrate deeper into the mass of coke particles resulting in uniform quenching across the mass of coke particles. The deeper penetration may be achieved by reducing the contact angle of the carrier water. In the case of water-quenched coke (i.e., no quenching aid), water cools less of the inside of the coke mass and hence is not as effective in quenching the entire coke mass.

[0047] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any
incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.
What is claimed is:

CLAIMS
1. A method for quenching a coke mass comprising:
   (a) providing said coke mass;
   (b) providing an aqueous stream with a quenching aid therein, said quenching aid comprising at least one fatty alcohol ethoxylated surfactant therein; and
   (c) contacting said coke mass with said aqueous stream.

2. The method of claim 1, wherein said fatty alcohol ethoxylated surfactant comprises at least one secondary alcohol ethoxylate of the formula:

   \[
   \begin{array}{c}
   R_1 \\
   \text{O} \\
   \text{R}_2
   \end{array}
   \{\text{EO}\}_n \text{H}
   \]

   where \(n\) may be an integer ranging from about 1 to about 20; EO is ethylene oxide; and \(R_1\) and \(R_2\) may be the same or different, and are straight \(C_{1-25}\) alkyls or branched \(C_{1-25}\) alkyls.

3. The method of claim 2, wherein \(n\) ranges from about 1 to about 15.

4. The method of claim 3, wherein \(n\) ranges from about 1 to about 10.

5. The method of claim 2, wherein said quenching aid has an average HLB ranging from about 8.0 to about 15.0.

6. The method of claim 5, wherein said quenching aid has an average HLB of about 11.0 ± 1.0.

7. The method of claim 2, wherein said fatty alcohol ethoxylated surfactant comprises at least one secondary alcohol ethoxylate selected from the group
consisting of polyethylene glycol trimethylnonyl ether, polyethylene glycol dodecyl ether, polyethylene glycol tetradecyl ether, and polyethylene glycol hexadecyl ether.

8. The method of claim 2, wherein said quenching aid comprises at least one short ethoxyl chain secondary alcohol ethoxylate and at least one long ethoxyl chain secondary alcohol ethoxylate.

9. The method of claim 8, wherein n of said short ethoxyl chain secondary alcohol ethoxylate ranges from about 1.0 to about 5.0.

10. The method of claim 8, wherein n of said long ethoxyl chain secondary alcohol ethoxylate ranges from greater than about 5.0 to about 10.0.

11. The method of claim 8, wherein a weight ratio of said short ethoxyl chain to said long ethoxyl chain secondary alcohol ethoxylate ranges from about 05:95 to about 50:50.

12. The method of claim 11, wherein a weight ratio of said short ethoxyl chain to said long ethoxyl chain secondary alcohol ethoxylate ranges from about 15:85 to about 35:65.

13. The method of claim 12, wherein a weight ratio of said short ethoxyl chain to said long ethoxyl chain secondary alcohol ethoxylate ranges from about 20:80 to about 30:70.

14. The method of claim 1, wherein a weight ratio of said coke mass to said aqueous stream ranges from about 1.0:0.25 to about 1.0:10.0.

15. The method of claim 14, wherein a weight ratio of said coke mass to said aqueous stream ranges from about 1.0:1.0 to about 1.0:2.5.
16. The method of claim 1, wherein said quenching aid is present in an amount ranging from about 1 ppm to about 2000 ppm by volume of said aqueous stream.

17. The method of claim 16, wherein said quenching aid is present in an amount ranging from about 10 ppm to about 1000 ppm by volume of said aqueous stream.

18. A composition comprising at least two secondary alcohol ethoxylates of the formula:

\[
R_1 - O - \{\text{EO}\}_n - H
\]

where \( n \) may be an integer ranging from about 1 to about 20; EO is ethylene oxide; \( R_1 \) and \( R_2 \) may be the same or different, and are straight \( \text{C}_1-\text{C}_{25} \) alkyls or branched \( \text{C}_1-\text{C}_{25} \) alkyls.

19. The composition of claim 18, wherein \( n \) ranges from about 1 to about 15.

20. The composition of claim 19, wherein \( n \) ranges from about 1 to about 10.

21. The composition of claim 18, wherein said composition has an average HLB ranging from about 8.0 to about 15.0.

22. The composition of claim 21, wherein said quenching aid has an average HLB of about 11.0 ± 1.0.

23. The composition of claim 18, wherein said composition comprises at least one secondary alcohol ethoxylate selected from the group consisting of polyethylene glycol trimethylnonyl ether, polyethylene glycol dodecyl ether, polyethylene glycol tetradecyl ether, and polyethylene glycol hexadecyl ether.
24. The composition of claim 18, wherein said composition comprises at least one short ethoxyl chain secondary alcohol ethoxylate and at least one long ethoxyl chain secondary alcohol ethoxylate.

25. The composition of claim 24, wherein n of said short ethoxyl chain secondary alcohol ethoxylate ranges from about 1.0 to about 5.0.

26. The composition of claim 24, wherein n of said long ethoxyl chain secondary alcohol ethoxylate ranges from greater than about 5.0 to about 10.0.

27. The composition of claim 24, wherein a weight ratio of said short ethoxyl chain to said long ethoxyl chain secondary alcohol ethoxylate ranges from about 05:95 to about 50:50.

28. The composition of claim 27, wherein a weight ratio of said short ethoxyl chain to said long ethoxyl chain secondary alcohol ethoxylate ranges from about 15:85 to about 35:65.

29. The composition of claim 28, wherein a weight ratio of said short ethoxyl chain to said long ethoxyl chain secondary alcohol ethoxylate ranges from about 20:80 to about 30:70.

30. The composition of claim 18, wherein said composition further comprises a co-solvent.

31. The composition of claim 30, wherein a weight percent of said co-solvent in said composition ranges from about 0.1 wt% to about 10 wt%.

32. The composition of claim 31, wherein a weight percent of said co-solvent in said composition ranges from about 0.5 wt% to about 5 wt%.

33. The composition of claim 32, wherein said co-solvent is water.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

INV. C1QB39/04 F26B5/00 CO9 K3/18

According to International Patent Classification (IPC) or to both national classification and IPC.

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C1D CI08 F26B CO9 K

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category# Station of document, with indication, where appropriate, of the relevant passages Relevant to claim No.


Date of the actual completion of the international search

31 October 2013

Date of mailing of the international search report

07/11/2013

Name and mailing address of the ISA/Authorized officer

European Patent Office, P.B. 5618 Patentissen 2 NL-2280 HV Rijswijk,Tel: (+31-70) 340-2043, Fax: (+31-70) 340-3048 Zuurdeeg, Boudewijn
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