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(54) Titre : FLUIDE DE FORAGE COMPORTANT DES AGENTS TENSIO-ACTIFS
(54) Title: DRILLING FLUID COMPRISING SURFACTANTS

(57) Abrégé/Abstract:
The present disclosure relates to drilling fluids for use in bitumen recovery from oil sands. In particular, the disclosure relates to a drilling fluid composition containing surfactants having HLB values of less than about 7.0, and a method and use of the composition.

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ABSTRACT OF THE DISCLOSURE

The present disclosure relates to drilling fluids for use in bitumen recovery from oil sands. In particular, the disclosure relates to a drilling fluid composition containing surfactants having HLB values of less than about 7.0, and a method and use of the composition.

TITLE: Drilling Fluid Comprising Surfactants

FIELD OF THE DISCLOSURE

The present disclosure relates to drilling fluid compositions comprising surfactants for use in bitumen recovery from oil sands, and a method and use of said compositions to encapsulate bitumen.

BACKGROUND OF THE DISCLOSURE

In Canada, South America and China, there are very large oil sands deposits known as oil-rich bitumen sands. These oil sands consist of a mixture of crude bitumen (a semi-solid form of crude oil), silica sand, clay minerals, and water. The Canadian oil sand deposits cover over about 141,000 square kilometers and have about 28 billion cubic meters (174 billion barrels) of economically recoverable crude bitumen. There are two ways to recover the crude bitumen from these oil sand deposits. One way is mining and the other, is *in-situ* operations. In Canada, approximately 15.6 billion cubic meters (98 billion barrels) of crude bitumen deposit can be recovered *via in-situ* operations. Steam Assisted Gravity Drainage (SAGD) is the main *in-situ* operation to recover crude bitumen from these oil sand deposits. SAGD uses dual horizontal wells, situated one on top of another, to recover the crude bitumen from these oil sand deposits. The main challenge of drilling the horizontal wells through these oil sand deposits is the bitumen sticking to the drilling components. The mixture of the crude bitumen or heavy oil, often referred to as tar sands, makes the drilling cuttings from these formations malleable and sticky. Bitumen is a mixture of hydrocarbon compounds containing the other elements of nitrogen, sulfur, oxygen, metals and the like. Bitumen is known to have, overall, an anionic charge and hydrophobic surfaces. When the conventional water-base drilling fluids are used to drill through the oil sand deposits, the anionic polymer additives in the drilling fluids increase the anionic surface charge of bitumen particles, causing bitumen to disperse into the drilling fluids. The dispersed bitumen particles in the drilling fluids re-aggregate on the surfaces of metal or plastic or oil-like substances, which have very strong affinity for the bitumen or heavy oil. The

re-aggregated bitumen sticks to oil sand cuttings and causes the bitumen accretion or sticking problem known to occur while drilling oil sands deposits. Bitumen accretion causes many drilling problems, such as high torque and drag, slow travel, blinding of the shakers while drilling oil sand deposits and getting the liners stuck while running in the liners.

SUMMARY

The present disclosure relates to drilling fluid compositions comprising surfactants, wherein the surfactants have hydrophilic-lipophilic balance (HLB) values of less than about 7.0, which prevents the bitumen from dispersing into the drilling fluid. In addition, the surfactants in the drilling fluid reduce the friction coefficient of the drilling fluid. The compositions also include one or more hydrophobically associating polymers, wherein the hydrophobically associating polymers are anionic, non-ionic, cationic and/or ampholytic polymers. The hydrophobic group of hydrophobically associating polymers strongly adsorbs on the bitumen surfaces through its affinity for oil, and the hydrophilic groups of the hydrophobically associating polymers make the bitumen surface water wet and provides less sticking. Further, the hydrophobically associating polymers also help to prevent the bitumen from dispersing. Accordingly, these compositions comprising a surfactant with an HLB value of less than about 7.0 and hydrophobically associating polymers are excellent bitumen and/or tar, flocculent and sticking inhibitors. As the hydrophobically associating polymers only have negative charges or very small amount of ampholytic charges, they are compatible with conventional drilling fluid additives, which normally possess a negative charge. Therefore, hydrophobically associating polymers, when used in drilling fluid systems to drill oil sand formations, will inhibit bitumen sticking and be compatible with conventional anionic drilling fluid additives.

Accordingly, the present disclosure includes a drilling fluid composition comprising:

(a) one or more hydrophobically associating polymers;

(b) one or more surfactants having a hydrophilic-lipophilic balance value of less than about 7.0;

(c) a water continuous phase comprising clay minerals; and

(d) one or more conventional drilling fluid additives.

In another embodiment, the surfactants are present in an amount effective to inhibit dispersion of bitumen during bitumen recovery from oil sands. In another embodiment, the surfactants are present in an amount effective to reduce the friction coefficient of the drilling fluid. In another embodiment therefore, the drilling fluid further comprises oil sands. In another embodiment, the friction coefficient of the drilling fluids is between 0.01 and 0.15, optionally between 0.02 and 0.10, or about 0.02 and 0.05.

In another embodiment of the disclosure, the surfactants are nonionic, anionic, cationic or ampholytic surfactants with Hydrophile-Lipophile Balance (HLB) values less than 7.0, optionally less than about 6.5, or less than about 6.0, or less than about 5.0. In another embodiment of the disclosure, the surfactants are nonionic, anionic, cationic or ampholytic surfactants with Hydrophile-Lipophile Balance (HLB) values between 1.0 and 7.0, optionally 1.0 and 5.0. In a further embodiment, the concentration of the surfactant is in the range of about 0.1 to about 50 kilograms per cubic meter of drilling fluid composition. In another embodiment, the concentration of the surfactant is about 1 to about 5 kilograms per cubic meter of drilling fluid composition.

In one embodiment, the surfactant is any compound that lowers the surface tension of a liquid, allowing easier spreading, and lowering of the interfacial tension between two liquids, or between a liquid and a solid. Surfactants may act as: detergents, wetting agents, emulsifiers, foaming agents, de-foaming agents, dispersants, and lubricants, and examples of surfactants include, but are not limited to, alkyl benzene sulfonates, polyethylene oxides, polypropylene oxides, siloxane defoamers / lubricants, carboxylates (fatty acids or salts). In another embodiment, the surfactant is a fatty acid, for example, long, branched or unbranched, aliphatic chain carboxylic acids or carboxylates (CO_2^- or CO_2H) containing between about 4 to about 28 carbon atoms. In another embodiment, the fatty acid is esterified. In another embodiment, the surfactant is a long chain fatty acid containing

between 8 and 24 carbon atoms (C_8-C_{24}-carboxylic acid), wherein long aliphatic chain is either saturated or unsaturated.

In another embodiment of the disclosure, the one or more hydrophobically associating polymers include anionic and ampholytic polymers.

In a further embodiment, the hydrophobically associating polymer is selected from homopolymers, copolymers, terpolymers, tetrapolymers and mixtures thereof comprised of monomer units of the following groups i)-iv):

i) vinyl monomers comprising at least one amide group;

ii) vinyl monomers comprising at least one carboxylic acid group or carboxylate group;

iii) vinyl monomers comprising at least one of a quaternary nitrogen atom, a quaternary nitrogen atom with an alkyl sulfonate group, a quaternary nitrogen atom with a carboxylic acid group or a quaternary nitrogen atom with a carboxylate group; and

iv) vinyl monomers comprising a hydrophobic group, selected from a C_{8-20}alkyl group, a C_{8-20}alkenyl group, a C_{8-20}alkynyl group, a C_{8-20}alkylenearyl group and an aryl group, wherein the aryl group is substituted by at least one C_{4-20}alkyl group, and, optionally, a carboxylic acid group, a carboxylate group or an amide group.

In another embodiment, the hydrophobically associating polymer is a tetra-polymer comprising one unit selected from each of the monomer groups i-iv) as described above.

In another embodiment, the vinyl monomer of group (i) is acrylamide, and the vinyl monomer of group (ii) is acrylic acid or an acrylate.

In another embodiment of the disclosure, the vinyl monomer of group (iii) is 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethylammonium chloride (DADMAC).

In another embodiment, the vinyl monomer of group (iv) comprises a hydrophobic group selected from a C_{8-16}alkyl group, a C_{8-16}alkenyl group, a C_{8-16}alkynyl group, a C_{8-16}alkylenearyl group and an aryl group, wherein the aryl group is substituted by at least one C_{4-20}alkyl group. In a further embodiment, the vinyl monomer of group (iv) comprises a hydrophobic group selected from C_{8-20}alkyl methacrylate ester. In another embodiment, the vinyl monomer of group (iv) is selected from C_{8-16}alkyl methacrylate ester.

In another embodiment, the hydrophobically associating polymer comprises

(i) acrylamide (a non-ionic monomer) present at about 87 to about 98%;

(ii) sodium acrylate (an anionic monomer) present at about 0.5 to about 5%;

(iii) a mixture of (a) dially dimethyl ammonium chloride,
(b) acryloyloxyethyl trimethyl ammonium chloride,
(c) [2-(methacryloyloxy)ethyl]trimethyl ammonium chloride (cationic monomers)

present at about 0.5 to about 5%, and

(iv) a mixture of (a) acrylate (C_8-C_{18})-alkyl ester,
(b) methyl acrylate (C_8-C_{18})-alkyl ester,
(c) N-(C_8-C_{18})-alkoxymethyl acrylamide,
(d) dimethyl ally (C_8-C_{18})-alkyl ammonium chloride,
(e) acryloyloxyethyl dimethyl (C_8-C_{18})-alkyl ammonium chloride,
(f) methyl dially (C_8-C_{18})-alkyl ammonium chloride,
(g) [2-(methacryloyloxy)ethyl]dimethyl (C_8-C_{18})-alkyl ammonium chloride (hydrophobic monomers),

present at about 0.3 to about 3%.

In an embodiment, the hydrophobically associating polymer comprises a copolymer, terpolymer or tetrapolymer comprising monomer units

selected from (i) acrylamide, (ii) acrylic acid or an acrylate, (iii) 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethyl ammonium chloride (DADMAC), and (iv) a C_{8-20}alkyl methacrylate ester.

In another embodiment, the hydrophobically associating polymer comprises tetrapolymers comprising monomers selected from (i) acrylamide, (ii) acrylic acid or an acrylate, (iii) and 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethyl ammonium chloride (DADMAC) and (iv) a C_{8-20}alkyl methacrylate ester.

In another embodiment, the clay mineral comprises bentonite. In another embodiment, the clay mineral comprises dispersible shale clay cuttings and shale formations which are located on the top of oil sands.

In another embodiment of the disclosure, the conventional drilling fluids additives are selected from one or more of viscosifiers, filtrate loss reducers, drilling fluid thinners, dispersants, shale inhibitors, clay inhibitors, defoaming agents, bridging agents, weighting agents, pH adjusting agents and the circulation loss materials.

In another embodiment, the composition further comprises one or more of clay inhibitors, drilling fluid lubricants, drilling fluid bridging agents, drilling fluid weighting agents and/or circulation loss materials. In another embodiment, the clay inhibitors are selected from one or more of potassium silicate, amine, glycol and inorganic salts.

The present disclosure also includes a method of recovering bitumen from oil sands comprising:

(a) contacting a drilling fluid composition as defined above with the oil sands to obtain a mixture; and

(b) recovering the bitumen from the mixture, wherein the surfactants are present in an amount effective to reduce the friction coefficient of the mixture.

In another embodiment of the disclosure, the contacting of the composition is done under conditions to encapsulate the bitumen. In a further embodiment, the conditions to encapsulate the bitumen comprise mixing the composition with the oil sands. In another embodiment, the composition is

contacted with the oil sands during a drilling operation using drilling components. In another embodiment, the composition inhibits sticking of the bitumen to the drilling components. In a further embodiment, the drilling operation is a steam assisted gravity drainage. In another embodiment, the drilling operation produces oil sand cuttings which are contacted with the composition. In another embodiment, the composition encapsulates the bitumen in the oil sand cuttings.

The present disclosure also includes a use of a drilling fluid composition for the encapsulation of bitumen in oil sands, the composition comprising:

(a) one or more hydrophobically associating polymers;

(b) one or more surfactants having an HLB value of less than about 7.0;

(c) a water continuous phase comprising clay minerals; and

(d) one or more conventional drilling fluid additives,

wherein the one or more hydrophobically associating polymers are present in an amount effective to inhibit sticking and/or dispersion of bitumen during bitumen recovery from oil sands.

In another embodiment, the hydrophobically associating polymers are present in an amount effective to encapsulate the bitumen.

In another embodiment of the use, the composition is contacted with the oil sands under conditions to encapsulate bitumen. In a further embodiment, the conditions to encapsulate the bitumen comprise mixing the oil sands with the composition. In a further embodiment, the composition is contacted with the oil sands during a drilling operation using drilling components. In another embodiment, the composition inhibits sticking of the bitumen to the drilling components. In a further embodiment, the drilling operation is a steam assisted gravity drainage. In another embodiment, the drilling operation produces oil sand cuttings which are contacted with the composition. In a further embodiment, the composition encapsulates the bitumen in the oil sand cuttings.

Also included within the present disclosure is a use of one or more hydrophobically associating polymers to inhibit sticking and/or dispersion during bitumen recovery from oil sands. Also included within the present disclosure is a use of one or more hydrophobically associating polymers to encapsulate bitumen during bitumen recovery from oil sands.

Further included in the present disclosure is a method of inhibiting the sticking and/or dispersion of bitumen during bitumen recovery from oil sands comprising contacting the oil sands with one or more hydrophobically associating polymers. Also included in the present disclosure is a method of encapsulating bitumen during bitumen recovery from oil sands comprising contacting the oil sands with one or more hydrophobically associating polymers.

Other features and advantages of the present disclosure will become apparent from the following detailed description. It should be understood, however, that the detailed description and the specific examples while indicating preferred embodiments of the disclosure are given by way of illustration only, since various changes and modifications within the spirit and scope of the disclosure will become apparent to those skilled in the art from this detailed description.

DETAILED DESCRIPTION OF THE DISCLOSURE

DEFINITIONS

The term "C_{m-n}alkyl" as used herein means straight and/or branched chain, saturated alkyl groups containing from "m" to "n" carbon atoms and includes (depending on the identity of m and n) n-butyl, s-butyl, isobutyl, t-butyl, 2,2-dimethylbutyl, n-pentyl, 2-methylpentyl, 3-methylpentyl, 4-methylpentyl, n-hexyl and the like, where the variable m is an integer representing the smallest number of carbon atoms in the alkyl radical and n is an integer representing the largest number of carbon atoms in the alkyl radical.

The term "C_{8-n}alkenyl" as used herein means straight and/or branched chain, unsaturated alkyl groups containing from 8 to "n" carbon atoms and one or more, suitably one to five, more suitably one to three double

bonds, and includes (depending on the identity of n), 2-methylprop-1-enyl, but-1-enyl, but-2-enyl, but-3-enyl, 2-methylbut-1-enyl, 2-methylpent-1-enyl, 4-methylpent-1-enyl, 4-methylpent-2-enyl, 2-methylpent-2-enyl, 4-methylpenta-1,3-dienyl, hexen-1-yl and the like, where the variable n is an integer representing the largest number of carbon atoms in the alkyl radical.

The term "C_{8-n}alkynyl" as used herein means straight and/or branched chain, unsaturated alkyl groups containing from 8 to "n" carbon atoms and one or more, suitably one to five, more suitably one to three triple bonds, and includes (depending on the identity of n), 2-methylprop-1-ynyl, 1-butynyl, 2-butynyl, 3-butynyl, 1,3-butadiynyl, 3-methylbut-1-ynyl, 4-methylbut-ynyl, 4-methylbut-2-ynyl, 2-methylbut-1-ynyl, 1-pentynyl, 2-pentynyl, 3-pentynyl, 4-pentynyl, 1,3-pentadiynyl, 1,4-pentadiynyl, 3-methylpent-1-ynyl, 4-methylpent-2-ynyl4-methylpent-2-ynyl, 1-hexynyl and the like, where the variable n is an integer representing the largest number of carbon atoms in the alkyl radical.

The term "C_{8-n}alkylenearyl" as used herein means a straight and/or branched chain, saturated alkylene group containing from eight to "n" carbon atoms bonded to an aryl group comprising a monocyclic or polycyclic aromatic ring system containing from 6 to 14 carbon atoms and at least one aromatic group, and wherein the alkylene group includes (depending on the identity of n), n-butylene, s-butylene, isobutylene, 2,2-dimethylbutylene, n-pentylene, 2-methylpentylene and the aryl group includes phenyl, naphthyl, anthracenyl, 1,2-dihydronaphthyl, 1,2,3,4-tetrahydronaphthyl, fluorenyl, indanyl, indenyl, ferrocenyl and the like, where the variable n is an integer representing the largest number of carbon atoms in the alkyl radical.

The term "aryl" as used herein means a monocyclic, bicyclic or tricyclic aromatic ring system containing from 6 to 14 carbon atoms and includes phenyl, naphthyl, anthracenyl, 1,2-dihydronaphthyl, 1,2,3,4-tetrahydronaphthyl, fluorenyl, indanyl, indenyl and the like.

The term "carboxylic acid" or as used herein means a group of the formula CO_2H.

The term "carboxylate" as used herein means a group of the formula $-CO_2R$ (or $-CO_2^-$), wherein R is C_{1-20}alkyl, suitably C_{1-6}alkyl, or where a hydrophobic group is required, C_{8-20}alkyl.

The term "amide" as used herein means a group of the formula $CONR'R''$, wherein R′ and R″ are independently selected from H and C_{1-20}alkyl, suitably C_{1-6}alkyl, or where a hydrophobic group is required, C_{8-20}alkyl.

The term "alkyl sulfonate" as used herein means a group of the formula SO_2R''', wherein R‴ is C_{1-20}alkyl, suitably C_{1-6}alkyl, or where a hydrophobic group is required, C_{8-20}alkyl.

The term “bitumen” as used herein refers to a mixture of organic liquids that are highly viscous, black, sticky, and is composed primarily of highly condensed polycyclic aromatic hydrocarbons but also contains other elements such as nitrogen, sulfur, oxygen, metals and the like. Bitumen is the residual (bottom) fraction obtained by fractional distillation of crude oil. It is the heaviest fraction and the one with the highest boiling point.

To “inhibit” or “suppress” or “reduce” a function or activity, such bitumen sticking, is to reduce the function or activity when compared to otherwise same conditions except for a condition or parameter of interest, or alternatively, as compared to another conditions.

The term "hydrophobically associating polymer" as used herein refers to a polymer composed of monomers, in which at least one monomer contains hydrophobic moieties, which associate with each other as a result of their hydrophobic nature. In one embodiment, a hydrophobically associating polymer contains non-ionic monomers, anionic monomers, cationic monomers, ampholytic monomers and hydrophobic monomers.

The term "effective amount" as used herein with respect to the surfactant refers to an amount of the surfactant present in the drilling fluid composition which is able to lower the friction coefficient of the drilling fluid compositions to a value between 0.01 and 0.15. The amount of the surfactant needed to reduce the friction coefficient of the mixture will be dependent upon the type of surfactant, and may be determined by a person skilled in the art.

The term "effective amount" with respect to hydrophobically associating polymer as used herein refers to an amount of hydrophobically associating polymer which inhibits sticking and/or dispersion of bitumen during bitumen recovery from oil sands, suitably by encapsulating the bitumen. The amount of the hydrophobically associating polymer needed to encapsulate the bitumen will be dependent upon the type of polymer, and may be determined by a person skilled in the art.

The term "friction coefficient" as used herein refers to the friction between the drilling string and wellbore or casing. A reduction in the friction coefficient of steel walls of drilling strings upon adsorption of the surfactants in drilling fluid compositions on the drilling strings surfaces results in the less drag and torque while drilling operations.

The term "hydrophilic-lipophilic balance value" as used herein refers to the degree of which a surfactant of the disclosure is hydrophilic or lipophilic. The HLB value of a non-ionic surfactant is calculated using the following formula, known as the Griffin formula:

$$HLB = 20 * Mh / M,$$

where Mh is the molecular mass of the hydrophilic portion of the Molecule, and M is the molecular mass of the whole molecule, giving a result on an arbitrary scale of 0 to 20. For ionic surfactants, the HLB value is calculated using the Davies formula, which is calculated by summing the hydrophilic/hydrophobic contributions afforded by the structural components of the surfactant:

$$HLB = \Sigma(\text{hydrophilic group contributions}) - \Sigma(\text{hydrophobic group contributions}) + 7$$

In one embodiment, surfactants used in the drilling fluids of the present disclosure have HLB values less than 7.0, optionally less than about 6.5, or less than about 6.0, or less than about 5.0. In another embodiment, the surfactants used in the present disclosure are hydrophobic (lipophilic), and adsorb on the bitumen surfaces to enhance the encapsulating ability of hydrophobic associating polymers and are also lubricants to greatly reduce the drag and torque while drilling operations.

In understanding the scope of the present disclosure, the term "comprising" and its derivatives, as used herein, are intended to be open ended terms that specify the presence of the stated features, elements, components, groups, integers, and/or steps, but do not exclude the presence of other unstated features, elements, components, groups, integers and/or steps. The foregoing also applies to words having similar meanings such as

the terms, "including", "having" and their derivatives. Finally, terms of degree such as "substantially", "about" and "approximately" as used herein mean a reasonable amount of deviation of the modified term such that the end result is not significantly changed. These terms of degree should be construed as including a deviation of at least ±5% of the modified term if this deviation would not negate the meaning of the word it modifies.

DRILLING FLUID COMPOSITIONS

The present disclosure relates to drilling fluid compositions which comprise surfactants having an HLB value of less than about 7.0. In one embodiment, upon contact of the drilling fluid with metal walls of drilling strings, the surfactants of the present disclosure adsorb on the metal surfaces of drilling strings and reduce the friction coefficient between the metal drilling strings and wellbore or casing, resulting in lower drag and torque while drilling operations. In addition, hydrophobically associating polymers in the drilling fluid inhibit bitumen from dispersing into drilling fluids and therefore inhibit sticking of the bitumen to drilling components during bitumen recovery processes. In one embodiment, the hydrophobically associating polymers are viscosifiers of the drilling fluid compositions, and in addition the polymers are also bitumen flocculents and bitumen sticking inhibitors for drilling fluids. In another embodiment, the surfactants with HLB values less than 7 enhance the bitumen encapsulating ability of hydrophobically associating polymers.

Accordingly, the present disclosure includes a drilling fluid composition comprising:

(a) one or more hydrophobically associating polymers;

(b) one or more surfactants having a hydrophilic-lipophilic balance value of less than about 7.0;

(c) a water continuous phase comprising clay minerals; and

(d) optionally one or more conventional drilling fluid additives.

In another embodiment, the surfactants are present in an amount effective to inhibit dispersion of bitumen during bitumen recovery from oil sands. In another embodiment, the surfactants are present in an amount effective to reduce the friction coefficient of the drilling fluids for drilling strings.

In another embodiment, the friction coefficient of the drilling fluids for the standard steel walls is between 0.01 and 0.15, optionally between 0.02 and 0.10, or about 0.02 and 0.05. In another embodiment, the surfactants are present in an amount effective to reduce the friction coefficient by at least 5 times, optionally 8 times, or about 10 times, as compared to a drilling fluid composition which does not contain a surfactant having an HLB value of less than about 7.0.

In another embodiment, the surfactants with HLB value less than 7.0 enhance the encapsulating bitumen ability of hydrophobically associating polymers.

In another embodiment of the disclosure, the surfactants are nonionic, anionic, cationic or ampholytic surfactants with Hydrophile-Lipophile Balance (HLB) values less than 7.0, optionally less than about 6.5, or less than about 6.0, or less than about 5.0. In another embodiment of the disclosure, the surfactants are nonionic, anionic, cationic or ampholytic surfactants with Hydrophile-Lipophile Balance (HLB) values between 1.0 and 7.0, optionally 1.0 and 5.0. In a further embodiment, the concentration of the surfactant is in the range of about 0.1 to about 50 kilograms per cubic meter of drilling fluid composition. In another embodiment, the concentration of the surfactant is about 1 to about 5 kilograms per cubic meter of drilling fluid composition.

In one embodiment, the surfactant is any compound that lowers the surface tension of a liquid, allowing easier spreading, and lowering of the interfacial tension between two liquids, or between a liquid and a solid. Surfactants may act as: detergents, wetting agents, emulsifiers, foaming agents, de-foaming agents, dispersants, and lubricants, and examples of surfactants include, but are not limited to, alkyl benzene sulfonates, polyethylene oxides, polypropylene oxides, siloxane defoamers / lubricants, carboxylates (fatty acids or salts). In another embodiment, the surfactant is a fatty acid, for example, long, branched or unbranched, aliphatic chain carboxylic acids or carboxylates (CO_2^- or CO_2H) containing between about 4 to about 28 carbon atoms. In another embodiment, the fatty acid is esterified.

In another embodiment, the surfactant is a long chain fatty acid containing between 8 and 24 carbon atoms (C_8-C_{24}-carboxylic acid), wherein long aliphatic chain is either saturated or unsaturated.

In another embodiment of the disclosure, the hydrophobically associating polymers are present in an amount effective to encapsulate the bitumen. In an embodiment of the disclosure, the hydrophobically associating polymers are water-soluble polymers. The hydrophobically associating polymers may have an anionic charge, and, as such, these polymers not only inhibit the dispersion of bitumen into the drilling fluids, keep the bitumen water wet and less sticky, thereby inhibiting bitumen from sticking to drilling components, but they also have very little negative effects on the dispersing stability of the anionic colloids of clay/polymers, as they do not reduce the negative charge of the anionic colloids of clay/polymers or the anionic polymers.

In another embodiment of the disclosure, the one or more hydrophobically associating polymers include anionic and ampholytic polymers.

In a further embodiment, the hydrophobically associating polymer is selected from a homopolymer, copolymer, terpolymer, tetrapolymer and mixtures thereof comprised of monomer units of the following groups i)-iv):

i) vinyl monomers comprising at least one amide group;

ii) vinyl monomers comprising at least one carboxylic acid group or carboxylate group;

iii) vinyl monomers comprising at least one of a quaternary nitrogen atom, a quaternary nitrogen atom with an alkyl sulfonate group, a quaternary nitrogen atom with a carboxylic acid group or a quaternary nitrogen atom with a carboxylate group; and

iv) vinyl monomers comprising a hydrophobic group, selected from a C_{8-20}alkyl group, a C_{8-20}alkenyl group, a C_{8-20}alkynyl group, a C_{8-20}alkylenearyl group and an aryl group, wherein the

aryl group is substituted by at least one C_{4-20}alkyl group, and, optionally, a carboxylic acid group, a carboxylate group or an amide group.

In another embodiment, the hydrophobically associating polymer is a tetra-polymer comprising one unit selected from each of the monomer groups i-iv) as described above.

In another embodiment, the vinyl monomer of group (i) is acrylamide, and the vinyl monomer of group (ii) is acrylic acid or an acrylate.

In another embodiment of the disclosure, the vinyl monomer of group (iii) is 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethylammonium chloride (DADMAC).

In another embodiment, the vinyl monomer of group (iv) comprises a hydrophobic group selected from a C_{8-16}alkyl group, a C_{8-16}alkenyl group, a C_{8-16}alkynyl group, a C_{8-16}alkylenearyl group and an aryl group, wherein the aryl group is substituted by at least one C_{4-20}alkyl group.

In a further embodiment, the vinyl monomer of group (iv) comprises a hydrophobic group selected from C_{8-20}alkyl methacrylate ester. In another embodiment, the vinyl monomer of group (iv) is selected from C_{8-16}alkyl methacrylate ester.

In an embodiment, the hydrophobically associating polymer comprises a copolymer, terpolymer or tetrapolymer comprising monomer units selected from (i) acrylamide, (ii) acrylic acid or an acrylate, (iii) 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethyl ammonium chloride (DADMAC), and (iv) a C_{8-20}alkyl methacrylate ester

In another embodiment, the hydrophobically associating polymer comprises tetrapolymers comprising monomers selected from (i) acrylamide, (ii) acrylic acid or an acrylate, (iii) and 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethyl ammonium chloride (DADMAC) and (iv) a C_{8-20}alkyl methacrylate ester.

In another embodiment of the disclosure, the hydrophobically associating polymers are selected from BT1211, BT1212, BT1213, BT1214,

BT1215, BT1216, BT1217 and BT1218, supplied by the Chengdu Cationic Chemistry company.

In another embodiment of the disclosure, the hydrophobically associating polymers contain about 0.1 to about 10% of vinyl monomer units comprising hydrophobic groups by weight. In another embodiment, the hydrophobically associating polymers contain about 0.5 to about 5% vinyl monomer units containing hydrophobic groups by weight.

In another embodiment, the hydrophobically associating polymers are water soluble polymers.

In a further embodiment, the average molecular weight of the hydrophobically associating polymers is from about 200 to about 20 million grams per mole. In another embodiment, the average molecular weight of the mixture of the hydrophobically associating polymers is from about 50,000 to about 6 million grams per mole.

In another embodiment, the concentration of the polymers is about 0.1 to about 20 kilograms per cubic meter of the drilling fluid composition. In another embodiment of the disclosure, the concentration of the polymers is about 2 to about 10 kilograms per cubic meter of the drilling fluid composition. In another embodiment of the disclosure, the concentration of the polymers is about 3 to about 5 kilograms per cubic meter of the drilling fluid composition.

In another embodiment, the composition comprises about 5 to about 100 kilograms clay minerals per cubic meter of the drilling fluid composition. In another embodiment, the drilling fluid composition comprises about 5 to about 30 kilograms clay minerals per cubic meter of the drilling fluid composition. In another embodiment, the drilling fluid composition comprises about 10 to about 30 kilograms clay minerals per cubic meter of the drilling fluid composition.

In another embodiment, the clay mineral comprises bentonite. In another embodiment, the clay mineral comprises dispersible shale clay cuttings and shale formations which are located on the top of oil sands.

In another embodiment of the disclosure, the conventional

drilling fluids additives are selected from one or more of viscosifiers, filtrate loss reducers, drilling fluid thinners, dispersants, shale inhibitors, clay inhibitors, lubricants, defoaming agents, bridging agents, weighting agents, pH adjusting agents and the circulation loss materials.

In another embodiment, the composition further comprises one or more of clay inhibitors, drilling fluid lubricants, drilling fluid bridging agents, drilling fluid weighting agents and/or circulation loss materials. In another embodiment, the clay inhibitors are selected from one or more of potassium silicate, amine, glycol and inorganic salts.

In another embodiment of the disclosure, the conventional drilling fluids additives are selected from one or more of viscosifiers, filtrate loss reducers, drilling fluid thinners, dispersants, shale inhibitors, clay inhibitors, lubricants, defoaming agents, bridging agents, weighting agents, pH adjusting agents and the circulation loss materials.

In another embodiment of the disclosure, the viscosifiers comprise polymers selected from one or more of xanthan gum, polyanionic cellulose (PAC), carboxyl methyl cellulose (CMC), guar gum, hydroxyl propylene guar gum, hydroxyl ethylene cellulose (HEC), partial hydrolyzed polyacrylamide (PHPA) and zwitterionic polymers. In another embodiment, the concentration of the viscosifiers is about 0.1 to about 5 kilograms per cubic meter of the drilling fluid composition. In another embodiment, the concentration of the viscosifiers is about 1 to about 4 kilograms per cubic meter of the drilling fluid composition. In another embodiment, the concentration of the viscosifiers is about 1 to about 3 kilograms per cubic meter of the drilling fluid composition.

In an embodiment of the disclosure, the filtrate loss reducers are selected from one or more of polyanionic cellulose (PAC), carboxyl methyl cellulose (CMC), starch, modified starch, lignite, lignosulfonates, modified lignosulfonates and ampholytic polymers. In a further embodiment, the concentration of the filtrate loss reducers is about 0.1 to about 20 kilograms per cubic meter of the drilling fluid composition. In a further embodiment, the concentration of the filtrate loss reducers is about 1 to about 10 kilograms per

cubic meter of the drilling fluid composition. In a further embodiment, the concentration of the filtrate loss reducers is about 3 to about 9 kilograms per cubic meter of the drilling fluid composition.

In another embodiment of the disclosure, the thinners or dispersants are selected from one or more of lignite, lignosulfonates, modified lignosulfonates and ampholytic polymers. In a further embodiment, the concentration of the thinners or dispersants is about 0.1 to about 5 kilograms per cubic meter of the drilling fluid composition. In a further embodiment, the concentration of the thinners or dispersants is about 1 to about 3 kilograms per cubic meter of the drilling fluid composition.

In a further embodiment of the disclosure, the defoamers are selected from one or more of a silicone defoamer, an alcohol defoamer, an aluminum stearate defoamer and a calcium oleate defoamer. In an embodiment, the concentration of the defoamers is about 0.1 to about 5 kilograms per cubic meter of the drilling fluid composition. In an embodiment, the concentration of the defoamers is about 1 to about 3 kilograms per cubic meter of the drilling fluid composition.

In another embodiment of the disclosure, the pH adjusting agents are selected from one or more of NaOH, Na_2CO_3, $NaHCO_3$, KOH, K_2CO_3, $KHCO_3$, citric acid and sulfamic acid. In another embodiment, the concentration of the pH adjusting agent is about 0.1 to about 5 kilograms per cubic meter of the drilling fluid composition. In another embodiment, the concentration of the pH adjusting agent is about 0.1 to about 3 kilograms per cubic meter of the drilling fluid composition. In another embodiment, the concentration of the pH adjusting agent is about 0.5 kilograms per cubic meter of the drilling fluid composition.

In another embodiment, the drilling fluid compositions of the present disclosure further comprise one or more of clay inhibitors, drilling fluid lubricants, drilling fluid bridging agents, drilling fluid weighting agents and/or circulation loss materials.

In another embodiment of the disclosure, the clay inhibitors are selected from one or more of potassium silicate, amine, glycol and inorganic salts.

The present disclosure also includes a method recovering bitumen from oil sands comprising:

(a) contacting a drilling fluid composition as defined in any of the above embodiments with the oil sands to obtain a mixture; and

(b) recovering the bitumen from the mixture. In one embodiment, the one or more surfactants are present in an amount effective to reduce the friction coefficient of the mixture and/or reduce the dispersion of bitumen during bitumen recovery from oil sands.

In another embodiment of the disclosure, the contacting is done under conditions to reduce the friction coefficient of the mixture, comprising mixing the composition with the oil sands. In another embodiment, the composition is contacted with the oil sands during a drilling operation, such as a steam assisted gravity drainage operation, using drilling components, wherein the composition inhibits sticking of the bitumen to the drilling components. In a further embodiment, the drilling operation produces oil sand cuttings which are contacted with the composition, wherein the composition encapsulates the bitumen in the oil sand cuttings, and also reduces the friction coefficient of the mixture (cuttings and composition). It will be understood by a person skilled in the art that the compositions of the present disclosure are able to reduce the friction coefficient and encapsulate bitumen in oil sands directly or from the cuttings of a drilling operation. When drilling components drill through the oil sands during a drilling operation, the drilling results in cuttings which contain bitumen, which are contacted with the composition.

The present disclosure also includes a use of a drilling fluid composition for the encapsulation of bitumen in oil sands and to reduce the friction coefficient, wherein the drilling fluid is as defined in any of the above embodiments. In one embodiment, the surfactants are present in an amount

effective to reduce the friction coefficient of the drilling fluid mixture (oil sands and drilling fluid).

Further included in the present disclosure is a method of inhibiting the sticking and/or dispersion of bitumen during bitumen recovery from oil sands comprising contacting the oil sands with one or more hydrophobically associating polymers. Also included in the present disclosure is a method of encapsulating bitumen during bitumen recovery from oil sands comprising contacting the oil sands with one or more hydrophobically associating polymers.

The following non-limiting examples are illustrative of the present disclosure:

EXAMPLES

The xanthan gum (polyxan), bentonite (Gel), fatty acids, drilling starch (Aquastar EX) were supplied by Diversity Technologies Corp. Polyanionic Cellulose (PAC HV/LV) was provided by Luzhou North Qiaofeng Chemical Company. The hydrophobically associating ampholytic polymer (BT 1217) was provided by Chengdu Cationic Chemistry Company. The cationic polymer (Ultimer 7753™) was supplied by Nalco Global Equipment Solutions Company. The polymer flocculant (Hyperfloc CE 2340™) was supplied by Hychem Inc. The oil sand sample was supplied by Nexen Inc. A Hamilton Beach mixer was used to mix the drilling fluid compositions. An EP/Lubricity Tester Model 212 Fann Instrument Company was used to test the coefficient of friction of the prepared silicate drilling fluids. A Viscometer Model 35 from Fann Instrument Company was used to test viscosity and an API Filter Press from Fann Instrument Company was used to test the filtrate loss of drilling fluids. A Brookfield Viscometer was supplied by Brookfield Engineering Company.

Example 1: Preparation of a Polymer Drilling Fluid Compositions

To tap water was added 20 kg/m^3 bentonite, 1 kg/m^3 of polyanionic cellulose regular (PAC HV), 1 kg/m^3 of polyanionic cellulose regular (PAC LV), 1 kg/m^3 of xanthan gum, and 4 kg/m^3 of drilling grade starch. This mixture was then mixed for 20 minutes using a Hamilton Beach mixer.

Example 2: Bitumen Encapsulation Test of a Drilling Fluid Composition

To the polymer drilling fluid composition of Example 1 was respectively added 5 kg/m^3 of BT 1217, 10 L/m^3 of Ultimer 7753™, 10 L/m^3 of Hyperfloc CE 2340™. This mixture was then mixed for 15 minutes using a Hamilton Beach mixer, at that point 100 kg/m^3 of oil sands were added. The mixture was then mixed for another 10 minutes using a Hamilton Beach mixer. After finishing mixing, observed the drilling fluid composition's color and the floating oils on the top of the drilling fluid compositions.

Example 3: The Tests of Rheolgy and API Filtrate of Drilling Fluid Compositions

The rheology of drilling fluid compositions were tested with Viscometer Model 35 from Fann Instrument Company and Brookfield Viscometer from Brookfield Engineering, and the filtrate loss of this mud is tested with API Filter Press form Fann Instrument Company. The coefficient of friction of this mixture was then determined using a Fann EP/Lubricity Tester. Table 1 and Table 2 show the testing results.

As illustrated in Table 1 andTable 2, the hydrophobically associating ampholytic polymer (BT 1217) greatly increases Brookfield Viscosity and Yield Point of the drilling fluid composition.

Example 4: Friction Coefficient Test of Drilling Fluid Compositions with Surfactants

To the drilling fluid compositions as prepared in (Example 2) 5L/m^3 of fatty acids were added. The mixture was then mixed for 5 minutes using a Hamilton Beach mixer. The coefficient of friction of this mixture was then determined using a Fann EP/Lubricity Tester. The Tester is a standard instrument designed for determining the coefficient of friction of drilling fluids and their additives. During the test, a hardened steel block and a ring are placed in contact with each other in the presence of the drilling fluid to be tested. A load of 150 inch pounds is placed upon a level arm which applies a

pressure of between 5,000 and 10,000 pounds per square inch on the drilling fluid to be tested which is between the block and the ring. The ring is rotated at 60 RPM. All the tested drilling fluids were run under these conditions, and, accordingly, the coefficients of the friction of values and torque reduction values are directly comparable to each other. The testing results are shown in Table 2.

As illustrated in Table 1 and Table 2, the fatty acids greatly reduce the friction coefficients of the drilling fluid compositions (from 0.26~0.30 to 0.03~0.06).

Table 1: Drilling Fluid Compositions without Surfactants

Mud Formulations	**A**	**B**	**C**	**D**
Bentonite (kg/m^3)	20	20	20	20
Xanthan Gum (Polyxan) (kg/m^3)	1	1	1	1
PAC HV (kg/m^3)	1	1	1	1
PAC LV (kg/m^3)	1	1	1	1
Drilling Starch (kg/m^3)	4	4	4	4
Surfactant (HLB: 1~5.5) (Fatty Acids) (L/m^3)		0	0	0
Hydrophobic Polymer (**BT1217) (kg/m^3)**		5		
Cationic Polymer (**Ultimer7753) (L/m^3)**			10	
Polymer Flocculant (**Hyperfloc 2340) (L/m^3)**				10
Nexen Oil Sand (kg/m^3)		100	100	100
Mud Properties				
600 rpm Reading	38	82	36	32
300 rpm Reading	27	54	24	21
200 rpm Reading	22	43	19	17
100 rpm Reading	14	31	14	12
6 rpm Reading	4	9	4	3
3 rpm Reading	3	7	3	2.5
Gels (10s/10min, Pa)	1.5/2.5	3.5/5	1.5/2.5	1.25/2
PV (mPa·s)	11	28	12	11
YP (Pa)	8	13	6	5
API Filtration Loss (ml)	12	8.3	9.4	9
Mud Cake Thickness (mm)	1	1	1	1
pH Value	7	7	8.5	8
Brookfield Viscosity at 0.3 rpm (mPa·s)	8,800	22,000	5,700	6,600
Brookfield Viscosity at 0.6 rpm (mPa·s)	5,200	15,000	4,000	4,200
Friction Coefficient	0.34	0.26	0.3	0.27
Mud Appearance				
Polymer Flocculation		none	some	some
Sticking to Rheometer / Blender		none	some	some
Floating Oil		none	some	some
Mud Color		Light grey	Light brown	Light brown

Table 2: Drilling Fluid Compositions with Surfactants

Mud Formulations	**A**	**B**	**C**	**D**
Bentonite (kg/m^3)	20	20	20	20
Xanthan Gum (Polyxan) (kg/m^3)	1	1	1	1
PAC HV (kg/m^3)	1	1	1	1
PAC LV (kg/m^3)	1	1	1	1
Drilling Starch (kg/m^3)	4	4	4	4
Surfactant (HLB: 1~5.5) (Fatty Acids) (L/m^3)		5	5	5
Hydrophobic Polymer (**BT1217) (kg/m^3)**		5		
Cationic Polymer (**Ultimer7753) (L/m^3)**			10	
Polymer Flocculant (**Hyperfloc 2340) (L/m^3)**				10
Nexen Oil Sand (kg/m^3)		100	100	100
Mud Properties				
600 rpm Reading	38	92	49	37
300 rpm Reading	27	67	32	24
200 rpm Reading	22	55	25	19
100 rpm Reading	14	38	18	13
6 rpm Reading	4	10	5	3
3 rpm Reading	3	8	4	2.5
Gels (10s/10min, Pa)	1.5/2.5	4/5	2/2.5	1.5/2
PV (mPa·s)	11	25	17	13
YP (Pa)	8	21	7.5	5.5
API Filtration Loss (ml)	12	8.2	9.2	8.8
Mud Cake Thickness (mm)	1	1	1	1
pH Value	7	7	8.5	8
Brookfield Viscosity at 0.3 rpm (mPa·s)	8,800	24,800	6,000	6,800
Brookfield Viscosity at 0.6 rpm (mPa·s)	5,200	15,600	4,200	4,400
Friction Coefficient	0.34	0.03	0.06	0.05
Mud Appearance				
Polymer Flocculation		none	some	some
Sticking to Rheometer / Blender		none	some	some
Floating Oil		none	some	some
Mud Color		Light grey	Light brown	Light brown

THE EMBODIMENTS OF THE INVENTION IN WHICH AN EXCLUSIVE PROPERTY OR PRIVILEGE IS CLAIMED ARE DEFINED AS FOLLOWS:

1. A drilling fluid composition comprising:

(a) one or more hydrophobically associating polymers;

(b) one or more surfactants having a hydrophilic-lipophilic balance value of less than about 7.0;

(c) a water continuous phase comprising clay minerals; and

(d) one or more conventional drilling fluid additives.

2. The drilling fluid composition according to claim 1, further comprising oil sands, and wherein the surfactants are present in an amount effective to reduce the friction coefficient of the composition.

3. The drilling fluid composition according to claim 2, wherein the friction coefficient is between about 0.01 and 0.15.

4. The drilling fluid composition according to any one of claims 1 to 3, wherein the one or more hydrophobically associating polymers include anionic and ampholytic polymers.

5. The drilling fluid composition according to any one of claims 1 to 4, wherein the one or more hydrophobically associating polymers are selected from homopolymers, copolymers, terpolymers, tetrapolymers and mixtures thereof comprised of monomer units of the following groups i)-iv):

i) vinyl monomers comprising at least one amide group;

ii) vinyl monomers comprising at least one carboxylic acid group or carboxylate group;

iii) vinyl monomers comprising at least one of a quaternary nitrogen atom, a quaternary nitrogen atom with an alkyl sulfonate group, a quaternary nitrogen atom with a carboxylic

acid group or a quaternary nitrogen atom with a carboxylate group; and

iv) vinyl monomers comprising a hydrophobic group, selected from a C_{8-20}alkyl group, a C_{8-20}alkenyl group, a C_{8-20}alkynyl group, a C_{8-20}alkylenearyl group and an aryl group, wherein the aryl group is substituted by at least one C_{4-20}alkyl group, and, wherein the vinyl monomers further comprise a carboxylic acid group, a carboxylate group or an amide group.

6. The drilling fluid composition according to claim 5, wherein the hydrophobically associating polymer comprises a tetrapolymer comprising one monomeric unit selected from each of the monomer groups i-iv) as defined in claim 5.

7. The drilling fluid composition according to claim 5, wherein the vinyl monomer of group (i) comprises acrylamide.

8. The drilling fluid composition according to claim 5, wherein the vinyl monomer of group (ii) comprises acrylic acid or an acrylate.

9. The drilling fluid composition according to claim 5, wherein the vinyl monomer of group (iii) is 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethylammonium chloride (DADMAC).

10. The drilling fluid composition according to claim 5, wherein the vinyl monomer of group (iv) comprises a C_{8-16}alkyl group, a C_{8-16}alkenyl group, a C_{8-16}alkynyl group, a C_{8-16}alkylenearyl group or an aryl group, wherein the aryl group is substituted by at least one C_{4-20}alkyl group.

11. The drilling fluid composition according to claim 10, wherein the vinyl monomer of group (iv) comprises a C_{8-20}alkyl methacrylate ester.

12. The drilling fluid composition according to claim 11, wherein the vinyl monomer of group (iv) is a C_{8-16}alkyl methacrylate ester.

13. The drilling fluid composition according to any one of claims 1 to 12, wherein the hydrophobically associating polymer comprises a copolymer, terpolymer or tetrapolymer comprising monomer units selected from (i) acrylamide, (ii) acrylic acid or an acrylate, (iii) 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethyl ammonium chloride (DADMAC), and (iv) a C_{8-20}alkyl methacrylate ester.

14. The drilling fluid composition according to any one of claims 1 to 4, wherein the hydrophobically associating polymer comprises a tetrapolymer comprising monomer units selected from (i) acrylamide, (ii) acrylic acid or an acrylate, (iii) 2-methacryloyloxyethyltri-methylammonium chloride (DMC) or diallyl dimethyl ammonium chloride (DADMAC), and (iv) a C_{8-20}alkyl methacrylate ester.

15. The drilling fluid composition according to any one of claims 1 to 14, wherein the hydrophobically associating polymers contain about 0.1 to about 10% vinyl monomer units containing hydrophobic groups by weight.

16. The drilling fluid composition according to any one of claims 1 to 15, wherein the hydrophobically associating polymers are water soluble polymers.

17. The drilling fluid composition according to any one of claims 1 to 16, wherein the average molecular weight of the hydrophobically associating polymers is less than about 20 million grams per mole.

18. The drilling fluid composition according to claim 17, wherein the average molecular weight of the mixture of the hydrophobically associating polymers is from about 50,000 to about 6 million grams per mole.

19. The drilling fluid composition according to any one of claims 1 to 18, wherein the concentration of the polymers is about 0.1 to about 20 kilograms per cubic meter of the drilling fluid composition.

20. The drilling fluid composition according to any one of claims 1 to 19, wherein the clay mineral comprises bentonite or dispersible shale clay cuttings.

21. The drilling fluid composition according to any one of claims 1 to 20, wherein the conventional drilling fluids additives are selected from one or more of viscosifiers, filtrate loss reducers, drilling fluid thinners, dispersants, shale inhibitors, clay inhibitors, lubricants, defoaming agents, bridging agents, weighting agents, pH adjusting agents and the circulation loss materials.

22. The drilling fluid composition according to any one of claims 1 to 21, further comprising one or more of clay inhibitors, drilling fluid lubricants, drilling fluid bridging agents, drilling fluid weighting agents and/or circulation loss materials.

23. The drilling fluid composition according to any one of claims 1 to 22, wherein the surfactant is a branched or unbranched, saturated or unsaturated, C_4-C_{28}-carboxylic acid.

24. The drilling fluid composition according to claim 23, wherein the surfactant is a branched or unbranched, saturated or unsaturated, C_8-C_{24}-carboxylic acid

25. A method of recovering bitumen from oil sands comprising:

(a) contacting a drilling fluid composition as defined in any one of claims 1 to 24 with the oil sands to form a mixture;

(b) recovering the bitumen from the mixture, wherein the one or more surfactants are present in an amount effective to reduce the friction coefficient of the mixture.

26. A use of a drilling fluid composition as defined in any one of claims 1 to 24, for the recovery of bitumen from oil sands.

27. A use of one or more surfactants having a hydrophilic-lipophilic balance value of less than about 7.0 in a drilling fluid composition to reduce the friction coefficient of the composition.

28. The use of claim 27, wherein the friction coefficient is between about 0.01 and 0.15.

29. The use of claim 28, wherein the friction coefficient is between about 0.02 and 0.10.

30. The use of any one of claims 27-29, wherein the drilling fluid composition further comprises oil sands.

31. The use of any one of claims 27-30, wherein the surfactant is a branched or unbranched, saturated or unsaturated, C_4-C_{28}-carboxylic acid, wherein the carboxylic acid is optionally esterified.

32. The drilling fluid composition according to claim 31, 29wherein the surfactant is a branched or unbranched, saturated or unsaturated, C_8-C_{24}-carboxylic acid.