METHOD FOR CLEANING DRILL CUTTINGS

Inventors: Lirio Quintero, Houston, TX (US); Anuradee Witthayapanyanon, The Woodlands, TX (US); Jonathan J. Brege, Spring, TX (US); David E. Clark, Humble, TX (US)

Assignee: BAKER HUGHES INCORPORATED, HOUSTON, TX (US)

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ABSTRACT

One method for treating cuttings from a subsurface formation may include treating the cuttings with at least one surfactant and at least one stabilizing agent. The method may include contacting the cuttings with the stabilizing agent(s) before contacting the cuttings with the surfactant(s). Another method for treating drill cuttings includes returning the drill cuttings to a substantially water-wet condition by using at least one stabilizing agent to remove at least a portion of a hydrocarbon from the drill cuttings.
Mixture #1 = Pre-Treatment with Oil Contaminated Drill Cuttings

Mixture #2 = Pre-Treatment and Treatment Fluid with Oil Contaminated Drill Cuttings
IFT Measurement of 0.5% and 2% DFE-1621 with Various Type of Oils

FIG. 2
METHOD FOR CLEANING DRILL CUTTINGS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority from U.S. provisional patent application no. 61/432,929, filed Jan. 14, 2011, the disclosure of which is incorporated herein by reference.

1. FIELD OF THE DISCLOSURE

[0002] This disclosure is directed to a method of cleaning naturally-occurring materials such as drill cuttings.

2. BACKGROUND OF THE DISCLOSURE

[0003] Non-aqueous drilling fluids (NAF), including oil-based drilling fluids, synthetic drilling fluids, form a general class of materials that may minimally comprise oil soluble additives, e.g., emulsifiers, and a mixture of particulate solids in a hydrocarbon fluid. These fluids are circulated through and around the drill bit to lubricate and cool the bit, provide suspension to help support the weight of the drill pipe and casing, cover the wellbore surface with a filter cake to prevent caving in and weight to balance against undesirable fluid flow from the formation, and to carry drill cuttings to the surface. At the surface, the drill cuttings are separated from the used drilling fluid. For effective waste management the cuttings should be cleaned of contaminants, such as the oil-based drilling mud.

[0004] The present disclosure addresses the cleaning of drill cuttings, as well as other naturally occurring substances.

SUMMARY OF THE DISCLOSURE

[0005] In aspects, the present disclosure provides a method for treating cuttings from a subsurface formation. The method may include treating the cuttings with at least one surfactant and at least one stabilizing agent. The method may include contacting the cuttings with the stabilizing agent(s) before contacting the cuttings with the surfactant(s).

[0006] In aspects, the present disclosure also provides a method for treating drill cuttings that includes returning the drill cuttings to a substantially water-wet condition by using at least one stabilizing agent to remove at least a portion of a hydrocarbon from the drill cuttings.

[0007] In variants, the method(s) may include applying the surfactant(s) after the stabilizing agent(s) is/are substantially homogenized with the cuttings. Also, water may be added with the surfactant(s). In some applications, the stabilizing agent substantially prevents interaction between water and a swellable component of the cuttings. The stabilizing agent(s) may be selected from one or more of an alcohol (e.g.: n-butanol), a solvent, a mutual solvent, and a glycol. The surfactant(s) may be selected from one or more of non-ionic, anionic, cationic, and amphotheric, zwitterionic and extended surfactants. In some arrangements, the method may include mechanically removing at least a portion of the hydrocarbons from the cuttings after treating the cuttings. Also, the method may include further treating the drill cuttings with a water softening agent.

[0008] Examples of the more important features of the disclosure have been summarized (albeit rather broadly) in order that the detailed description thereof that follows may be better understood and in order that the contributions they represent to the art may be appreciated. There are, of course, additional features of the disclosure that will be described hereinafter and which will form the subject of the claims appended hereto.

BRIEF DESCRIPTION OF THE FIGURES

[0009] For detailed understanding of the present disclosure, reference should be made to the following detailed description of the preferred embodiment, taken in conjunction with the accompanying drawing:

[0010] FIG. 1 illustrates a flow chart showing one illustrative treatment method of the present disclosure;

[0011] FIG. 2 shows test results for a selected surfactant formulation applied to base oils to reduce interfacial tension; and

[0012] FIG. 3 shows test results for a selected treatment with stabilizing agent applied to drill cuttings to reduce the retention of oil on cuttings.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0013] The present disclosure relates to methods and devices for processing drill cuttings entrained in oil-based drilling mud. During drilling, oil-based muds displace water naturally occurring rock and earth into oil wet cuttings. Embodiments of the present disclosure treat oil-wet cuttings with one or more agents to return a substantial percentage of such cuttings to a water-wet condition. In certain embodiments, a method for removing oil from drilling cuttings may include a first treatment of an alcohol, glycol, solvent or mutual solvent and a second treatment with a second treatment fluid having at least one surfactant. The method may also include using a water softener. The combination of pre-treatment and treatment fluids may remove a high percentage of the oily material from the drilling cuttings and water-wet the solids.

[0014] Referring now to FIG. 1, there is shown a flow chart having a drill cutting cleaning method 10 according to one embodiment of the present disclosure. As used herein, the term “drill cutting” refers to the rock and earth recovered from a borehole formed in a subsurface formation. The method may include a first treatment 12 to stabilize the cuttings and a second treatment 14 to clean the cuttings of oil contaminants. The second treatment 14 may include one or more cleaning agents that substantially clean the cuttings of oil contaminants. By “substantially clean,” it is generally meant that at least a portion of the cuttings are in a water-wet condition. The stabilizing treatment 12 may include one or more agents formulated to stabilize the cuttings during the second treatment 14. The cuttings may be mixed with the added agent(s) at steps 16 and 18 in order to homogenize the cuttings. That is, the cuttings are mixed in a manner sufficient to allow the added agent(s) to disperse and interact with a substantially portion of the cuttings. At step 20, the treated cuttings may be conveyed to a separator that mechanically removes the oil contaminants and/or other fluids from the drill cuttings to form the water-wet cuttings 22. For example, a centrifugal-type separator may be used. In other embodiments, a distillation-type separator may be used. Further details are provided in the discussion below.

[0015] In one embodiment, the stabilizing agent(s) used during the stabilizing treatment 12 may be selected to interact with the contaminant oil and/or cuttings to enhance the effectiveness of the surfactant. For example, the stabilizing agent(s) may be selected to reduce the overall viscosity of the...
contaminant oil on the cuttings. Also, the stabilizing agent(s) may be selected to decrease the hydrophobicity of the contaminant to be removed. In other situations, the stabilizing agent(s) may be selected to inhibit or prevent water used during the second treatment from unfavorably reacting with the materials in the drill cuttings. For example, the agents may inhibit or prevent materials such as clay particles from swelling and occluding pores in rocks. Such occlusions may trap oil within the pores and render them inaccessible to the cleaning agents applied during the second treatment. A stabilizing agent may be used to isolate materials such as clay particles from interacting with water or other selected substances. As used herein, the term “water” refers to any liquid wherein water is at least a component (e.g., brine, salt water, aqueous solutions, etc.). Suitable stabilizing agents include, but are not limited to, an alcohol, solvent, mutual solvent, glycols, polyglycols, and polyglycerols.

In one embodiment, the second treatment may use one or more cleaning agents formulated to remove unwanted materials (e.g., hydrocarbons) from the drill cuttings in order to render the drill cuttings water-wet. The removal does not need to be a complete removal of all oil contaminants from the cuttings. Rather, the removal may be of a portion of the oil contaminants on or in the cuttings. Also, the removal need not be of a specific hydrocarbon, but generally the removal of any substance considered a hydrocarbon or oil soluble compound such as NAF emulsifiers and wetting agents. In some non-limiting embodiments, the cleaning agent(s) may be a surface active agent or surfactant. In embodiments, the second treatment may also include agents such as water softeners.

Suitable surfactants include, but are not limited to, anionic, nonionic, cationic, ampholytic, zwitterionic, extended surfactants and blends thereof. Still other suitable nonionic surfactants include, but are not necessarily limited to, alkyl polyglycosides, sorbitan esters, methyl glucoside esters, amine ethoxylates, diamine ethoxylates, polyglycerol esters, alkyl ethoxylates, alcohols that have been polypropylated and/or polyethoxylated or both.

Suitable anionic surfactants selected from the group consisting of alkali metal alkyl sulfates, alkyl ether sulfonates, alkyl sulfonates, alkyl aryl sulfonates, and branched alkyl ether sulfates and sulfonates, alcohols, polypropylated sulfates, alcohol polyethoxylated sulfates, alcohol polypropylated polyethoxylated sulfates, alkyl disulfonates, alkylaryl disulfonates, alkyl sulfonates, alkyl sulfonates, alkyl ether sulfates, linear and branched ether sulfates, alkali metal carboxylates, fatty acid carboxylates, and phosphate esters; suitable cationic surfactants include, but are not necessarily limited to, arginine methyl esters, alkanolamines and alkenylenediamines. Suitable surfactants may also include surfactants containing a non-ionic spacer-arm central extension and an ionic or nonionic polar group. Other suitable surfactants are dimeric or gemini surfactants and elavable surfactants. Suitable zwitterionic surfactants include, but are not necessarily limited to, phospholipids, alkyl betaines, alkyl sulfonates, alkyl amido propyl betaine, alkyl sulfobetaines, dihydroxy alkyl glycinate, alkyl amphoteric acid, alkyl amphoteric acids, alkyl amino monopropionic acids, alkyl amino monopropionic acid, alkyl amino diphosphonic acids, alkyl amino acids, or alkyl amine oxides. In certain applications, a pH control agent may be used to improve the efficiency of the cleaning agent(s). Suitable pH control agents include, but are not necessarily limited to, sodium bicarbonate, sodium hydroxide, ethanolamines, or buffered systems.

Suitable classes of water softeners/builders include, but are not limited to, coordination compounds, phosphates (complex phosphates, polyphosphates), silicates, zeolites, carbonates, and citrates. Illustrative coordination compounds include, but are not limited to, EDTA; Illustrative Phosphates include, but are not limited to, trisodium phosphate, disodium phosphate, tetr sodium pyrophosphate, sodium tripolyphosphate, sodium hexametaphosphate; Illustrative silicates include, but are not limited to, sodium silicate; Illustrative carbonates include, but are not limited to, sodium carbonate, potassium carbonate, sodium percarbonate; Illustrative citrates include, but are not limited to, sodium citrate, calcium citrate, citric acid.

One factor in the selection of a suitable cleaning agent is the effectiveness of that agent in reducing interfacial tension (IFT). Generally speaking, IFT is the surface tension at the surface (interface) separating two non-miscible liquids. In embodiments, an effective cleaning agent is an agent that reduces the IFT below 1.0 mN/m, preferably less than 0.1 mN/m. In one test, different concentrations of surfactant in solutions were applied to a series of base oils. The tested surfactant was DFE-1621, a surfactant available from BAKER HUGHES INCORPORATED. The base oils included Carbo- sen 2 and CarboSea 1, which were taken by centrifuging field cuttings contaminated with oil-based mud. Total DFE, Clairsol 370, Clairsol NS, Diesel, EDC95-11, n-Paraffin, and GT-3000. As shown in FIG. 2, the treated base oils exhibited an IFT in the range of 10^{-1} to 10^{-4} mN/m. Line 26 generally illustrates the IFT values for 0.5% DFE-1621 and line 28 generally illustrates the IFT values for 2.0% DFE-1621.

One factor related to the efficiency of the applied cleaning agent(s) is the variations in the rock formations and oil-based mud systems. As discussed previously, one or more stabilizing agents may be used to inhibit undesirable reactions such as the swelling of clay particles that may interfere with the cleaning process. In FIG. 3, the retention on cuttings (ROC), which is a definition of the amount of oil in drill cuttings defined by (mass of oil)/(mass of cuttings), is shown for three cuttings sample groups 40, 42, 44. Group 44 is illustrative of all three groups and will be discussed in greater detail. Sample group 44 includes the ROC for three cuttings samples 46, 48, and 50. Sample 46 shows the ROC for untreated cuttings. Sample 48 shows the ROC for cuttings washed with only a surfactant, which is lower than the ROC of the untreated sample 46. Sample 46 shows the ROC for cuttings washed with a surfactant and a stabilizing agent, which is lower than the sample 48. As can be seen, for each group 40, 42, 44, the use of a stabilizing agent significantly increased the effectiveness of the surfactant in reducing ROC.

While the foregoing disclosure is directed to the preferred embodiments of the disclosure, various modifications will be apparent to those skilled in the art. It is intended that all variations within the scope of the appended claims be embraced by the foregoing disclosure.

We claim:
1. A method for treating cuttings from a subsurface formation, comprising:
   treating the cuttings with at least one surfactant and at least one stabilizing agent.
2. The method of claim 1, further comprising contacting the cuttings with the at least one stabilizing agent before contacting the cuttings with the at least one surfactant.

3. The method of claim 2, further comprising applying the at least one surfactant after the at least one stabilizing agent is substantially homogenized with the cuttings.

4. The method of claim 1, wherein the at least one stabilizing agent substantially prevents interaction between water and a swellable component of the cuttings.

5. The method of claim 1, wherein the at least one stabilizing agent is selected to interact with the fluid by one of: (i) reducing a viscosity of a contaminant oil, and (ii) reducing a hydrophobicity of the contaminant.

6. The method of claim 5, wherein the water is added with the at least one surfactant.

7. The method of claim 1, wherein the at least one stabilizing agent is selected from a group consisting of: (i) an alcohol, (ii) a solvent, (iii) a mutual solvent, and (iv) a glycol.

8. The method of claim 1, wherein the at least one stabilizing agent is n-butanol.

9. The method of claim 1, wherein the at least one surfactant is selected from a group consisting of: (i) non-ionic, (ii) anionic, (iii) cationic and (iv) amphoteric and (V) zwitterionic surfactants.

10. The method of claim 1, further comprising mechanically removing at least a portion of the hydrocarbons from the cuttings after treating the cuttings.

11. The method of claim 1, further treating the drill cuttings with a water softening agent.

12. A treatment method for treating drill cuttings recovered from a subsurface formation, comprising: returning the drill cuttings to a substantially water-wet condition by using at least one stabilizing agent to remove at least a portion of a hydrocarbon from the drill cuttings.

13. The method of claim 12, comprising contacting the cuttings with at least one surfactant.

14. The method of claim 13, wherein the least one surfactant is selected from a group consisting of: (i) non-ionic, (ii) anionic, (iii) cationic (iv) amphoteric, and (V) zwitterionic surfactants.

15. The method of claim 13, further comprising applying the at least one surfactant after the at least one stabilizing agent is substantially homogenized with the cuttings.

16. The method of claim 13, wherein the at least one stabilizing agent inhibits a reaction between at least one material in the drill cuttings and water.

17. The method of claim 16, wherein the water is added with the at least one surfactant.

18. The method of claim 12, wherein the at least one stabilizing agent is selected from a group consisting of: (i) an alcohol, (ii) a solvent, (iii) a mutual solvent, and (iv) a glycol.

19. The method of claim 12, further comprising mechanically removing at least a portion of the hydrocarbons from the cuttings after treating the cuttings.

20. The method of claim 12, further treating the drill cuttings with a water softening agent.

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