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TREATMENT OF OIL WELLS

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7 Claims. (Cl. 166—21)

This invention relates to the treatment of an oil well, and more particularly to the chemical treatment of the sand adjacent a producing well in order to render the sand preferentially wettable by oil to thereby increase the proportion of oil and decrease the proportion of water produced by that well.

This is a division of my co-pending application Serial No. 212,976, filed June 10, 1938, Patent No. 2,246,725.

It is recognized that ordinary sand is more easily wet by water than by oil. It is further recognized that oil producing sands are predominantly water-wet. When the pore spaces of an oil producing sand contain both water and oil the fact that the sand surfaces are water-wet will cause the water to occupy the smaller capillaries and crevices to the exclusion of the oil, thereby limiting the flow of the oil to the larger capillaries only, this flow of oil through these capillaries being retarded because the pore spaces of the capillaries are substantially reduced in cross section by the presence of the relatively immobile water film on the sand grains. The oil flow into and through the smaller capillaries and crevices is opposed by the interfacial tension between the oil and the water. My invention resides in a method of causing oil to flow through all of the capillaries and crevices of an oil producing sand by removing the water film from the walls of the capillaries and crevices and rendering the surfaces oil-wettable. In this manner the flow of water into the well is retarded by the same force which obstructs the flow of oil through the average water-wet oil producing sand.

In Patent No. 2,024,119, issued to William V. Vietti and Allen D. Garrison, there is disclosed and claimed a method of treating a producing sand of this character which is wet with water, by the depositing of a water and oil insoluble precipitate on the sand grains, which precipitate is of such character that it does not fill or block the pore space of the sand and is preferentially wettable by oil.

The present invention constitutes an improvement over the method of said patent, and involves the pretreatment of the producing sand to dry or dehydrate the same so as to remove water from the pore space thereof and thus render the sand in more suitable condition to receive the preferentially oil wettable coating which is then deposited upon the sand grains. The present invention also involves the use of a different type of film coating from that disclosed in the patent, which coating has high effectiveness for the purpose intended and is particulrly repellent to oil field brine.

In my co-pending application Serial No. 212,974 filed June 10, 1938, Patent No. 2,241,253, there is broadly disclosed and claimed the dehydration of the producing sand followed by the depositing of a water and oil insoluble coating which has preferential oil wettability upon the sand grains; and there is specifically disclosed and claimed the method of dehydrating the sand by passing or blowing a heated gas therethrough, or by the combination of lowering a heated body into the well opposite the producing sand and then passing a gas into contact with the heated body and thence through the producing sand. In my Patent No. 2,246,725, there is disclosed and claimed the dehydrating of the sand by chemical treatment in connection with this method of rendering the water-wet producing sand preferentially wettable by oil. In accordance with the present invention and as claimed herein, the sand is dehydrated by lowering a heated body into the well opposite the producing sand and preferably into a pool of oil collecting in the bottom of the well to highly heat this oil above the boiling point of water, and then forcing the highly heated oil through the sand.

This is accomplished by lowering into the well by suitable cable an electric heater or other highly heated body until this heater is positioned opposite the producing sand. By use of such a heater alone, a substantial dehydration of the sand for several feet or more about the well bore may be accomplished. Or a heated body of this type may be lowered into oil accumulating in the bottom of the well bore in order to heat this oil to a high temperature above the boiling point of water, preferably to the boiling point of the oil, and then this highly heated oil forced into the sand to secure further dehydration thereof. The water is thus converted into steam, which is driven outwardly to recondense in the colder parts of the sand away from the well bore. This alternative heating of the oil and then forcing the oil through the sand may be repeated several times to effect the dehydration desired. This latter method of dehydration may be followed by a final chemical treat with a dehydrating agent, such as a mineral oil solution of acetic anhydride or other organic chemical which is miscible with mineral oil when dry but has preferential solubility for water in the presence of the latter as described in my said parent application Serial No. 212,976, although the heating and flushing with heated oil may be sufficient for most purposes.

In accordance with the present invention, there is deposited upon the sand grains a film coating of a water and oil insoluble bitumen, such as may be obtained from a petroleum or coal tar pitch, asphalt, natural asphalt and the like. A very satisfactory material for this purpose is a modified asphalt produced by sulfurizing asphalt at high temperatures, or by highly oxidizing

asphalt by airblowing for extended periods of time and at temperatures to produce a resultant asphaltic material which is substantially insoluble in crude oil as well as in water. A satisfactory and cheap starting material for the production of this water and oil insoluble asphalt is a cracked petroleum residue, such as a cycle fuel oil or a heavy pitch derived from cracking operations.

In order to apply bituminous or asphaltic materials of this type in a convenient manner to the sand, an extract of the same in a suitable non-aqueous solvent is preferably utilized. For example, aromatic solvents of the character of benzol, toluol, xylene, light coal tar oil and the like may be employed. Likewise, chlorinated aromatic solvents such as chlorbenzene and nitrated aromatic solvents such as nitrobenzene may be used. Also, certain chlorinated aliphatic solvents such as carbon tetrachloride, or other solvents of high solvent power such as carbon disulfide may be used. Xylene, nitrobenzene, or a mixture of xylene and nitrobenzene is preferred for this purpose. It is found that these solvents will dissolve a substantial proportion of the modified asphaltic material which is insoluble in crude petroleum oil, and consequently will be precipitated upon contact by and dilution with oil in the pore space of the sand. This method of introducing into the sand an oil miscible solution of a water and oil insoluble compound or material, which material is precipitated upon contact by and dilution with oil in the pore space of the sand to form a strongly adherent film coating upon the sand grains which is preferentially wettable by oil, is broadly disclosed and claimed in my Patent No. 2,241,253. In my Patent No. 2,246,725, there is claimed the particular water and oil insoluble bituminous or asphaltic material disclosed herein.

Obviously many modifications and variations of the invention as hereinbefore set forth may be made without departing from the spirit and scope thereof, and therefore only such limitations should be imposed as are indicated in the appended claims.

I claim:

1. The method of treating an oil well to convert a water-wet producing sand to one which is preferentially wettable by oil, which comprises lowering a heated solid body into the well opposite the said producing sand and into a pool of oil collecting in the bottom of the well to highly heat the said oil above the boiling point of water in the said sand, then forcing the highly heated oil into the said producing sand to effect dehydration of the said sand about the well, and then coating the sand grains of the dehydrated sand with a film of a material which is preferentially oil wettable and which does not block the said sand and is effective to increase the proportion of oil and decrease the proportion of water produced from that sand.

2. The method of treating an oil well to convert a water-wet producing sand to one which is preferentially wettable by oil, which comprises forcing into the said sand about the well a highly heated oil which is at a temperature above the boiling point of water to vaporize and remove water from the pore space of the sand about the well, and then coating the sand grains of the dehydrated sand with a film of a material which is preferentially oil wettable and which does not block the sand and is effective to increase the proportion of oil and decrease the proportion of water produced from that sand.

3. The method of treating an oil well to convert a water-wet producing sand to one which is preferentially wettable by oil, which comprises highly heating a pool of oil accumulated at the bottom of the well to a temperature above the boiling point of water in the said producing sand, forcing the highly heated oil into the producing sand to vaporize and remove water therefrom and then coating the sand grains of the said producing sand without blocking that sand with a film coating which is preferentially oil-wettable, to thereby increase the proportion of oil relative to water produced from that sand.

4. The method of treating an oil well to convert a water-wet producing sand to one which is preferentially wettable by oil, which comprises forcing into the said producing sand a highly heated oil which is at a temperature above the boiling point of water therein to vaporize and remove water from the pore space of the sand about the well, then introducing into the said producing sand a mineral oil solution of a chemical dehydrating agent which is miscible with mineral oil when dry but has preferential solubility for water in the presence of the latter to remove additional water remaining therein, and finally coating the sand grains of the said producing sand without blocking that sand with a film coating which is preferentially oil-wettable, to thereby increase the proportion of oil relative to water produced from that sand.

5. In the treating of a well, the method of dehydrating the pore space including the smaller capillaries of a substantial volume of a producing sand surrounding the bore hole of the well, which comprises highly heating a pool of oil accumulated in the bore hole of the well to a temperature above the boiling point of water in the said sand, and then forcing the highly heated oil from the said bore hole back into the said sand to vaporize and remove water from the pore space including the smaller capillaries of the said producing sand for a distance of several feet and more back from and surrounding the bore hole, whereby the pressure of the heated oil forced into the said sand drives vaporized water outwardly through the producing sand away from the well bore.

6. The method according to claim 5, in which the highly heated oil forced into the sand is followed by a flushing mineral oil solution containing a chemical dehydrating agent which is miscible with mineral oil when dry but has preferential solubility for water in the presence of the latter to remove additional water remaining in the said sand.

7. In the treating of a well, the method of dehydrating a formation surrounding the bore hole of the well which comprises forcing into the formation a highly heated liquid which is at a temperature above the boiling point of water in the said formation, and then forcing into the said formation a mineral oil solution of a chemical dehydrating agent which is miscible with mineral oil when dry but has preferential solubility for water in the presence of the latter to remove additional water remaining therein.

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