

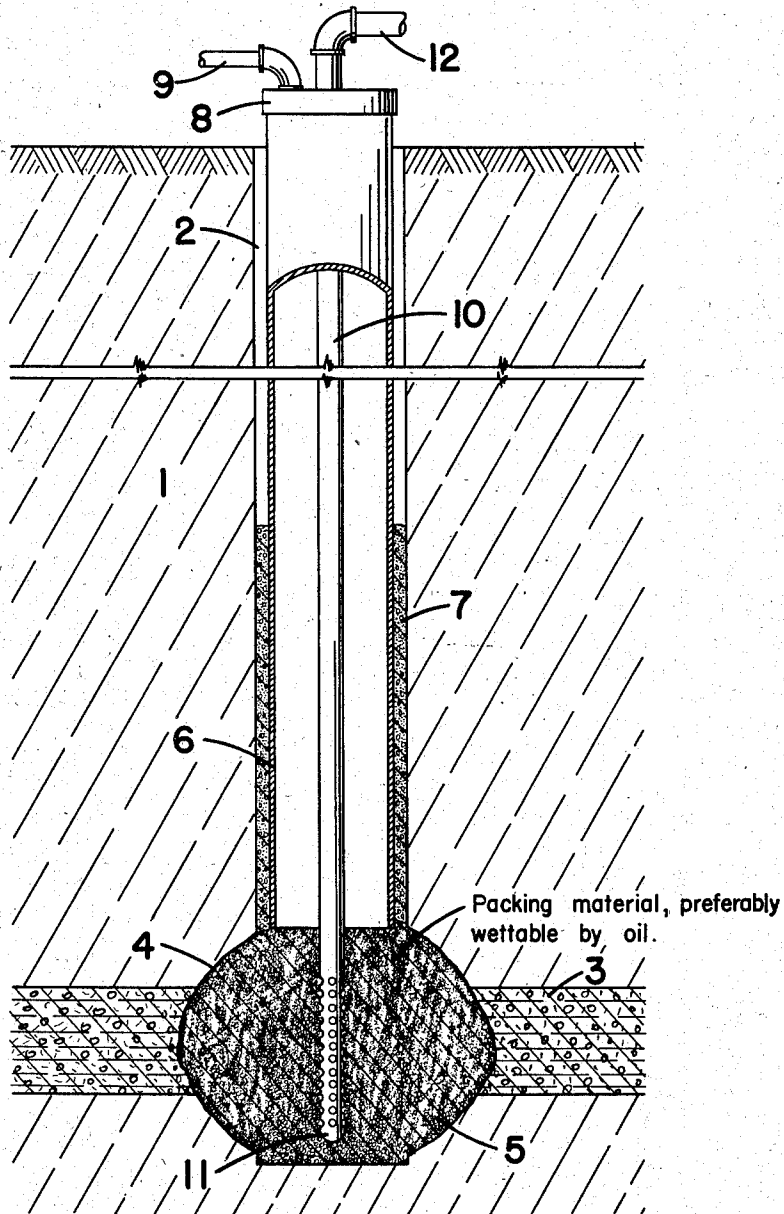
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INCREASING OIL PRODUCTION AND DECREASING WATER PRODUCTION OF A WELL

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INCREASING OIL PRODUCTION AND DECREASING WATER PRODUCTION OF WELLS

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The present invention is directed to the treatment of oil sands for the purpose of increasing oil flow and retarding the flow of water, and to a product to be used in such treatment.

It has already been proposed to treat oil sands by enlarging the cavity in the sand by under reaming and to fill the enlarged cavity so formed with gravel. Such treatment increases the flow of oil from the sand because it increases the amount of exposed surface of oil sand and minimizes or wholly eliminates the plugging up of the outlet from the formation by loose sand resulting from caveins or other disintegration of the formation. The various types of apparatus and procedure which have been proposed for this treatment of oil sands, which is known as gravelling, are discussed in an article entitled "Gravel packing oil sands," by W. A. Sawdon, appearing in two parts in vol. 9, Nos. 3 and 4 of Petroleum Engineering, at pages 83-86 and 86-92, respectively.

A typical arrangement is shown in the accompanying drawing in which the single figure is a vertical section through a borehole in the earth. Referring to the drawing in detail, numeral 1 designates the earth in which is a borehole 2 penetrating an oil producing formation 3. The borehole adjacent the producing formation is enlarged to form a cavity 4 which is filled with gravel or other granular material 5 which is, as hereinafter more specifically described, preferentially oil wettable. Set in the borehole above the gravel is a casing 6 which is held in place by cement 7 and which has a casing head 8 provided with an inlet pipe 9. Concentrically arranged in the casing is a tubing 10 the lower end of which terminates in a perforated section 11 and the upper end of which is connected to a pipe line by a connection 12.

In the above described arrangement the cement casing and the tubing are conventional parts that are set in place in the completion of an oil well. The gravel is thereafter introduced by any one of a number of known means and may be fed in through pipe 9 directly whereby it drops through the casing to the bottom and fills the cavity. A bed of gravel surrounds the perforated section 11 of the tubing and prevents the sanding of the tubing as well as increasing the rate of production.

According to the present invention, an additional benefit is derived from gravelling by utilizing a granular material coated with a water insoluble substance having an affinity for oil as the packing for the enlarged cavity in the oil

producing formation. The use of this packing material facilitates the flow of oil from the formation to the outlet and at the same time retards the flow of water, thereby imparting to the particular well treated an increased oil-water ratio that is not attainable by the use of uncoated granular material.

In general, a suitable coating material, according to the present invention, is a water insoluble substance, preferably non-crystalline in character, which is capable of dissolving or being colloiddally dispersed in oil.

Examples of suitable coating materials are soaps of metals other than the alkali metals which, in general, are water insoluble. Such soaps may be derived from organic compounds of the most varied character, including sulphuric acid derivatives of open chain and closed chain hydrocarbons such as mineral oil sulfonic acids, fatty acids of both animal and vegetable acids, keto acids, naphthenic acids, hydroxy acids and the like.

The most suitable coating materials for the purpose of the present invention are the heavy metal soaps of fatty acids and particularly of unsaturated fatty acids. It has been found that lead oleate, for example, is capable of forming an extraordinarily strong bond with siliceous materials, so strong in fact as to give rise to the assumption that it is of a molecular nature. Dry gravel, when treated with a solution or colloidal dispersion of lead oleate, receives a coating which is resistant to practically all common types of chemical treatment. A similar result is obtained when other heavy metal soaps of unsaturated fatty acids are employed. The coatings so formed appear to resist even those liquids in which they were soluble before being applied to the gravel, thereby strengthening the conclusion that some sort of chemical union between the gravel and the soap occurs.

A suitable method for coating the gravel or other granular material with an oil wettable agent of the general character described above is to immerse the gravel in or spray it with a solution or colloidal dispersion of the treating agent in a hydrocarbon solvent such as kerosene or naphtha. In order to secure the strong bond between the granular material and the coating agent it is extremely desirable that the granular material be dry. Any moisture in the granular material or on its surface will weaken the bond between the coating and the granular material. For this reason it is preferable to coat the granular material before it is admixed

with the fluid, usually an aqueous mud, which is employed as a carrying medium for depositing the granular material in the enlarged cavity in the oil bearing formation. It is to be understood, however, that the benefits inherent in the use of coated granular material, according to the present invention, can be secured in part by treating the granular material in place in the enlarged cavity. Some improvement is noticeable when the coating material is added in a finely divided state to the mud employed for depositing the granular material in the formation. The results obtained by this procedure, however, are not uniform or reliable.

For satisfactory results it is preferable to employ a solution or dispersion of coating agent ranging in strength from about 0.5% to 20%, although higher concentrations can be employed without any detrimental effect. When the higher concentrations are employed it is advantageous to include in the composition some free acid, the salt of which is employed. When the immersion method is employed the best results are obtained by keeping the granular material immersed in the solution of the coating agent for an extended period, ranging from one to several hours. When spraying or immersion is the coating method employed, it is preferable to use a solvent of high volatility. When it is desired to treat the granular material in situ, it is permissible to use heavier solvents such as gas oil or even crude oil.

As is known, the granular material will generally vary in size from about $\frac{1}{4}$ of an inch in diameter to about 1 inch in diameter, although granular material as small as 60 mesh may be employed. Gravel is the customary granular material employed, but other materials such as granulated blast furnace slag and granulated minerals of siliceous type can be used.

In the above description reference has been made to the use of aqueous mud as a carrying medium for conveying the granular material from the surface to the cavity in the oil bearing formation. Also contemplated is the use of oil as a carrying medium for this purpose.

The nature and objects of the present invention having been thus described, what is claimed as new and useful and is desired to be secured by Letters Patent is:

1. A method for producing oil from an oil bearing formation which comprises establishing a conduit between the formation and the surface and interposing between the inlet end of the conduit and the formation a granular material coated with an agent more readily wettable by oil than by water.

2. A method for producing oil from an oil bearing formation which comprises establishing a conduit between the formation and the surface, forming an enlarged cavity in the formation adjacent the inlet end of said conduit and filling said cavity with a granular material coated with a water insoluble soap.

3. A method for producing oil from an oil bearing formation which comprises establishing a conduit between the formation and the surface and interposing between the inlet end of the conduit and the formation a granular material coated with a heavy metal soap of an unsaturated fatty acid.

4. A method for producing oil from an oil bearing formation which comprises establishing a conduit between the formation and the surface and interposing between the formation and

the surface end of said conduit a granular material coated with an agent more readily wettable by oil than by water.

5. A method for producing oil from an oil bearing formation which comprises establishing a conduit between said formation and the surface and interposing between the formation and the surface end of said conduit a granular material coated with a water insoluble soap.

6. A method according to claim 5 in which the water insoluble soap is a heavy metal soap of an unsaturated fatty acid.

7. The method of completing an oil well having a perforated well screen which comprises placing in the well at the producing zone a filter pack of a granular, oil-wettable, water-repellent material of a size such that the interstitial spaces are of capillary dimensions.

8. The method of completing an oil well having a perforated well screen in a cavity in the oil producing zone, which comprises filling said cavity about the screen with an aggregate of a subdivided oil-wettable, water-repellent material the particles of which have a size between twenty and sixty mesh.

9. The method of increasing the ratio of oil to water in the production of an oil well which comprises placing and maintaining in the well at a predetermined depth a pack of particles of subdivided material the surface of which is capable of being wet by oil but which is repellent to water, the interstitial spaces of the pack being of capillary size.

10. The method of increasing the production of oil from a well with respect to the amount of water produced from the well, which comprises placing and maintaining in said well in the producing zone a body of gravel-like material of from twenty to sixty mesh, the surfaces of said material being oil-wettable but water-repellent so that oil will flow readily through the interstices in said body while water will be held back due to the increased adhesion tension of the material for oil and the decreased adhesion tension of the material for water.

11. The method of increasing the ratio of oil to water in the production of an oil well which comprises treating gravel-like material with a substance capable of rendering the surfaces of said material oil-wettable and water-repellent and then placing said treated material in the well cavity in the producing zone so that oil can enter the well through the interstices in the material while the passage of water through said interstices will be retarded.

12. The method of increasing the ratio of oil to water in the production of an oil well which comprises placing a bed of a gravel-like material in the cavity of the well formed in the producing oil sands and then treating said gravel-like material and the oil sands in the vicinity of the well cavity with a substance capable of rendering the gravel-like material and the oil sands oil-wettable and water-repellent.

13. A filter pack of a granular material whose surfaces are water and oil insoluble and which have the property of remaining oil-wettable and water-repellent in the presence of both oil and water, the particles of said material having a size between twenty and sixty mesh.

14. A packing material for an oil-bearing formation comprising a granular material coated with a heavy-metal soap of an unsaturated fatty acid.

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