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SOLUTION FOR USE IN TESTING WELLS

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13 Claims. (Cl. 175—183)

My invention relates to a testing solution or composition of matter for use in testing an oil well for determining the point at which water enters the well; and this application is a division of my application entitled Method of testing open wells, Serial No. 425,521, filed Feb. 3, 1930, now Patent No. 1,889,889.

In the drilling of an oil well it invariably occurs that water bearing strata is penetrated before the oil sands are reached. The water bearing strata must be sealed from the well; otherwise, the water will run thereinto, forming an emulsion, and in some instances reducing the oil yield of the well to the extent that the operation of the well is impractical.

According to present practice, the well is drilled and various casings are set in place. If it is found that water is leaking into the well the point of leakage must be found and the water bearing strata must be sealed off. This sealing operation is usually accomplished by extending a casing down to a shale or rock stratum below the water bearing strata and cementing the casing thereto.

The last casing usually installed in a well is known as the oil string. The lower end of the oil string is extended into the oil sands and is perforated to allow the oil to enter. The upper end of the oil string is above the surface of the ground and is connected to piping for conveying away the oil. Sometimes water bearing strata is located adjacent the oil sands and a portion of the perforated pipe passes therethrough, this allowing the ingress of water into the well. When this condition exists, the water bearing strata must be found and cemented from the wall.

The foregoing outlines the procedure of installing casing and cementing casing in a well when water leakages are encountered. There are processes at present for locating the leakage of water into the well after the casing strings have been set, and such a process is disclosed in my application entitled Method and apparatus for determining the location of water strata in wells, Serial No. 80,160, filed June 9, 1926, which issued into Patent No. 1,786,196 on December 23, 1930, and which was co-pending with the application of which this present application is a division.

During the period of drilling and setting the casing the well is kept full of rotary mud, which serves a number of purposes, such as holding the formations in place, preventing cave-ins, and preventing premature flows of oil. The rotary mud also holds back the seepage of water into the well, and because of this there will be no leakage of water into the well until after the casings have been set and the rotary mud removed from the well, so that the hydrostatic head is reduced sufficiently so that the pressure against the formation is insufficient to restrain an inward flow. At this time if there are any openings in or around the casing adjacent to or in communication with the water strata the water will start to leak into the well.

It will therefore be seen that ordinarily the operator of the well has no way of knowing whether or not there will be water leakages into the well until after all the casings have been installed, the rotary mud removed from the well and the hydrostatic head reduced. Many thousands of dollars are sometimes spent in installing a casing in a well, and then when the rotary mud is removed it is found that water still leaks into the well.

In my copending application Ser. No. 425,521, referred to, I disclose a method whereby the well may be tested for water leakages before all of the casings have been set and before the rotary mud has been removed from the well, thus enabling the water leakages to be located and then sealed by either cementing or by the installating of a casing. That invention further makes it possible to test a well for water leakages before any flow of oil has been started.

In performing that method of determining water leakages in an open hole there have been many difficulties to overcome and many problems to solve.

In an open hole; that is, a well in which all the casing has not been set and in which at least a portion is unprotected by casing, the rotary mud is maintained in the hole for a number of reasons, as pointed out above. In order to test the well to locate the water strata a testing solution must be introduced into the well. This testing solution which is to be used should possess all of the qualities of the rotary mud, such as pointed out heretofore, as well as certain qualities which render it suitable for use as a testing solution. It is further desirable that the testing solution have qualities which prevent it from stratifying and prevent it from being driven into the formations by the hydrostatic head in the well.

My invention provides a testing solution which has the essential qualities as specified above, which renders the method of testing in an open hole a success, by preserving the condition of the well during the testing.

There are two methods of testing a well for water leakages. One of such methods is disclosed

in my copending applications Ser. No. 425,521 and Ser. No. 80,160, both of which have been referred to, and consists of measuring the electrochemical qualities of the solution in the well by forming a voltaic cell in the well. The other of such methods is disclosed in the patents to Huber No. 1,555,801 and No. 1,555,802, both dated September 29, 1925, and consists of measuring the resistance or conductivity of the solution in the well by the use of spaced electrodes in circuit with a Wheatstone bridge and a source of energy.

It is the object of this invention to provide a testing solution for use in either of the aforementioned methods.

In the first mentioned method the testing solution must include a material having electrochemical qualities; and I will refer to such material as an electrolyte. In the second mentioned method the testing solution must include a material which has electrical resistance or conductivity; and I will refer to such material as resistance material. The electrolyte and the resistance material will be broadly referred to as testing solution.

When a test is made in an open hole I find it most satisfactory to determine the weight and glutinous qualities of the rotary mud, and to then provide the testing solution with the same or nearly the same qualities. The testing solution should be of approximately the same specific gravity as the rotary mud, in order that the testing solution will not flow from the level at which it is placed.

It is usually desirable to provide the testing solution with glutinous characteristics which will prevent stratification of the substances comprising the solution and prevent the solution from being driven into the formations.

In some wells it is desirable to use both a weight material to give the testing solution the proper or desired specific gravity and also to use a glutinous material to give the testing solution the proper or desired glutinous characteristics. In some wells only the weight material is used in the testing solution and in other wells only the glutinous material is added. The materials used and the amounts used depend on the conditions in the well, such as the porousness of the formations; and the character of the rotary mud, such as the weight thereof.

I will now describe in detail a number of testing solutions incorporating the features of my invention.

I will first describe a testing solution adapted for use in the method of testing a well by measuring the electrochemical action of the solution in the well such as is fully disclosed in my copending applications referred to.

As previously explained, the testing solution used in this method must have electrochemical qualities, and many different electrolytes are suitable for use in my invention, and for this reason I will not attempt to name all of them.

For the electrochemical qualities of the testing solution I may use a solution of ammonium chloride, which is strongly ionizable, or an equivalent ionizable material which will retain its electrochemical qualities in the presence of the other substances which comprise a part of the electrolyte.

I may also use as an electrochemical material a solution which includes ammonium sulfate, sodium sulfate, and a colloidal material in a solution which is acid, with sulfuric acid and chromic acid. The colloidal material which I prefer to use if one is used, is alcohol fermentation product of waste molasses after the removal of the alcohol therefrom. It is known technically as slop. This electrochemically active solution may be made as follows:

#1 Slop solution

(A) Take 10 gallons of concentrated slop. (B) Take 5 gallons of water and add gradually ¾ gallon of sulfuric acid 66 degrees Bé. (C) Mix A and B and bring to boil, heat for ½ hour, let stand 12 hours. Siphon off 10 gallons.

#2 Ammonium sulfate solution

Dissolve 300# of ammonium sulfate (fertilizer grade 25% ammonia) in 60 gallons of cold water.

#3 Sodium bichromate solution

3½ parts (by weight) water, 3 parts (by weight) sodium bichromate, 1 part (by weight) 66 degrees Bé. sulfuric acid.

Mixing

(A) Take 90 gallons ammonium sulfate solution #2, add to this 10 gallons of slop solution #1 which will make up 100 gallons of A solution. Make up 150 gallons of sodium bichromate or B solution. Mix 4 parts by volume of A solution and 6 parts of B solution, making 250 gallons of chemical solution to be distributed in fluid contents of well by patented dose distributor. The amount of solution used is 1 gallon of solution approximately to each 48 gallons of liquid in the well.

To endow the electrolyte with the necessary weight qualities which in the testing of some wells may be essential to the electrolyte in order that it may support the walls of the hole and hold back the flow of oil, a heavy mineral in finely divided form is included in the electrolyte. As a weight material I prefer to use barium sulfate, $BaSO_4$, but of course other finely divided substances might be used, such for example as the ferro compounds or oxides. In some instances, as explained heretofore, I add to the testing solution a glutinous material or colloidal mineral such as bentonite clay or other colloidal clays or other inorganic or organic materials capable of providing glutinous qualities. The purpose of the bentonite clay, or the colloidal mineral, is to prevent the electrolyte from being driven by the hydrostatic head into the formation and to prevent stratification of the different substances which compose the electrolyte.

The proportions of the electrochemical material and the weight material, which is preferably barium sulfate, and the glutinous material, or colloidal mineral, which is preferably bentonite clay, is used in accordance with the requirements of the well. In some wells the formation is such that the specific gravity of the electrolyte may be made lower than in other wells, and likewise in some wells it is desirable to use more or less colloidal mineral ingredients with the tendency of the electrolyte to penetrate the strata. In some instances the colloidal material may be eliminated and in some instances the weight material may be eliminated, but I have found that the most satisfactory electrolyte is formed when at least a small percentage of glutinous material is used, due to the fact that the glutinous material acts as a suspender and prevents the different substances of the electrolyte from stratifying.

As an example of the proportions which I may use to form the testing solution of my invention I give the following formula. It should be understood, however, that this formula is illustra-

tive only and I do not intend to limit myself to the proportions stated.

	Per cent
Electrolytic material	85
Glutinous material	10
Weight material	5

If the substrata of the well is very porous and the rotary mud quite heavy, a larger proportion of glutinous material may be used to prevent stratification and driving of the testing solution into the formation. If the mud be quite heavy a larger proportion of weight material may be used to give the desired specific gravity.

I will now describe a testing solution adapted for use in the method of testing a well by measuring the resistance or conductivity of the solution in the well, such as is described in the Huber patents referred to.

The testing solution need have no electrolytic qualities but must have qualities of resistance or conductivity different from that of the water in the well to be tested. The water which leaks into the well is either fresh water, or a salt water, or brine. Where the water which leaks into the well has no or very little salt content, the testing solution may be salt water or brine, and where it is salt water or brine which leaks into the well, water having no salt content may be used as a testing solution.

To provide the desired specific gravity I add a weight material, and to provide the glutinous characteristics I add a glutinous material in the same manner and according to the conditions in the well, as explained with respect to the first described testing solution.

Since both methods of testing a well are fully described in my copending applications, and the Huber patents, supra, I will not describe such processes herein. My invention is not limited to use in these two processes, and consists of a new composition of matter as defined in the appended claims.

I claim as my invention:

1. As a new composition of matter, a testing solution for use in testing leakages in wells, including: a large volume of acid electrolyte; and a small volume of bentonite clay intimately mixed therewith.

2. As a new composition of matter, a testing solution for use in testing leakages in wells, including the following material in approximately the percentages given: acid electrolyte, 85%; colloidal mineral, 10%; and at least 5% of weight material.

3. As a new composition of matter, a testing fluid for use in testing leakages in wells, including: an acid electrolyte; bentonite clay; and barium sulfate, said testing fluid being free from rotary mud.

4. As a new composition of matter, a testing fluid for use in testing leakages in wells, including: an acid electrolyte; bentonite clay; and barium sulfate, said materials being thoroughly mixed together to form a uniform acid electrolytic body, said testing fluid being free from rotary mud.

5. As a new composition of matter, a testing fluid for use in testing leakages in wells, consisting of an intimate mixture of bentonite clay, barium sulfate, and an acid electrolyte which is of an even and stable mixture, said testing fluid being free from rotary mud.

6. As a new composition of matter, a testing fluid for use in testing leakages in wells, consisting of an intimate mixture of bentonite clay and an acid electrolyte which is of an even and stable mixture, said testing fluid being free from rotary mud.

7. As a new composition of matter, a testing fluid for use in testing leakages in wells, consisting of an intimate mixture of a clay having the characteristics of bentonite clay, a weight material having the characteristics of barium sulfate, and an acid electrolyte which forms an even and stable mixture, said testing fluid being free from rotary mud.

8. A testing fluid for use in testing leakages in wells comprising an intimate mixture of an acid electrolyte, a weight material having the characteristics of barium sulfate and of a colloidal material capable of holding said weight material in proper suspension, said testing fluid being free from rotary mud.

9. An electrolytic testing fluid for use in testing leakages into wells and which will not flow into the formation nor be dispersed in the fluid in the well, comprising: an acid electrolyte; and bentonite clay thoroughly mixed therewith to produce an electrolyte having acid characteristics and having glutinous characteristics.

10. An electrolytic testing fluid for use in testing leakages into wells and which will not flow into the formation nor be dispersed in the fluid in the well, comprising: an acid electrolyte; and a small quantity of bentonite clay thoroughly mixed therewith to produce an electrolyte having acid characteristics and having glutinous characteristics.

11. An electrolytic testing fluid for use in testing leakages into wells and which will not flow into the formation nor be dispersed in the fluid in the well, comprising: an acid electrolyte solution consisting of electrolyte and water; and bentonite clay thoroughly mixed therewith to produce an electrolyte having acid characteristics and having glutinous characteristics.

12. An electrolytic testing fluid for use in testing leakages into wells and which will not flow into the formation nor be dispersed in the fluid in the well, comprising: an acid electrolye solution consisting of electrolyte and water; and a small quantity of bentonite clay thoroughly mixed therewith to produce an electrolyte having acid characteristics and having glutinous characteristics.

13. An electrolytic testing fluid for use in testing leakages into wells and which will not flow into the formation nor be dispersed in the fluid in the well, comprising: an acid electrolyte solution consisting of electrolyte which includes sodium bichromate and water; and bentonite clay thoroughly mixed therewith to produce an electrolyte having acid characteristics and having glutinous characteristics.

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