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PROCESS FOR FREEING STUCK DRILLING TOOLS

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The present invention relates to a method for disintegrating agglomerations, debris or cuttings of earth formations encountered in well-drilling operations, and pertains to a process for freeing tools used in drilling, treating or testing boreholes, particularly boreholes which have been or are being drilled in exploring for or producing petroleum or natural gas.

It often happens in well-drilling operations that the drilling tool, e.g. the drill string and the bit, sticks in the well and cannot be pulled up again. It may also happen in well testing, e.g., in acoustic or electric testing of boreholes already drilled, or in treating these boreholes, such as in acid treatment, or in inserting packers, etc., that the tool being used becomes stuck.

In such cases attempts are made at freeing the tool by injecting acid, e.g. hydrochloric acid, into the well. If the tool has become jammed in a limestone layer, there is a possibility of succeeding in this way. However, an acid treatment is of no use for disintegrating a layer of clay, and is of little value in many other earth formations containing substantial amounts of clay, i.e., 10 percent clay or more.

It is therefore a primary object of this invention to provide a method for freeing a stuck tool used in the drilling, testing, treatment or production of wells.

A further object of the present invention is to provide a method for freeing a well drilling tool which has become stuck in earth formations, particularly those formations containing clay in substantial amounts.

Another object of this invention is to provide a method for cleaning out well pumps, wire screens or slotted liners at the bottom of a well which have become clogged with disintegratable earth particles.

Other objects of this invention will be understood from the following description of the invention.

According to the invention, a borehole in which the tool has become stuck is treated with hydrogen peroxide or with a liquid containing hydrogen peroxide, preferably with an aqueous hydrogen peroxide solution having a concentration of at least 10 percent. An aqueous hydrogen peroxide solution of any desired strength may be employed if the borehole has not traversed an oil or gas-bearing zone. In the event that an oil or gas-bearing zone has been drilled through, the concentration of hydrogen peroxide used should not exceed 50 percent from a safety standpoint.

The present method may be practiced by positioning in a borehole adjacent the zone to be treated a quantity of hydrogen peroxide in an amount of from one half to 50 barrels or more depending on the size of the borehole zone to be treated and on the concentration of the hydrogen peroxide.

As a result of the treatment with hydrogen peroxide, the formation disintegrates so that there is a considerably increased possibility of successfully pulling out the tool. Good results can be particularly obtained with this treatment when the tool has become stuck or jammed in a layer of clay. It may often be convenient to force under high pressure into the borehole the hydrogen peroxide or a liquid containing this substance.

It is not necessary for the formation, or packed drill cuttings, to become saturated throughout hydrogen peroxide in order to disintegrate when the hydrogen peroxide decomposes. Disintegration of the formation or of cuttings begins at the surface exposed to the hydrogen peroxide, and then gradually moves to the interior. The disintegrated material is like a powder.

In carrying out the treatment according to the invention, it is often an advantage to introduce into the borehole or to cycle through the borehole, either together with the hydrogen peroxide solution or afterwards, a buffer liquid, preferably a liquid which is immiscible or only slightly miscible with hydrogen peroxide and does not react with hydrogen peroxide or only slightly, so that the hydrogen peroxide arrives, as nearly as possible, in the desired concentration to the place of damage in the borehole. Carbon tetrachloride may be used, for example, as such a buffer liquid. It is preferred that a quantity of buffer liquid be placed both in front of and behind the hydrogen peroxide solution so as to isolate it during circulation in the borehole in a manner well known in the field of well drilling. Instead of circulating the hydrogen peroxide into position, it may be lowered into the borehole in any suitable container such as a bailer on a wire line in a manner well known in the art the container being opened or dumped after reaching the desired spot.

If highly concentrated hydrogen peroxide is used, the buffer liquid chosen may also be water or another liquid which is miscible with hydrogen peroxide, but does not react with it, or does so only slightly. In this case, despite the unavoidable mixing with the buffer liquid, a sufficiently high concentration of hydrogen peroxide can likewise be obtained at the place of damage in the borehole.

The use of a buffer is often very desirable, as otherwise the hydrogen peroxide might react with any clay present in suspension or otherwise in the well while on its way to the desired place and would thus lose a part of its effectiveness.

After carrying out the process, oil, for example, may be introduced into the well in order further to promote the freeing of the tool. An improved effect can often be obtained by adding to the hydrogen peroxide a small quantity of a caustic solution and/or inorganic salts, for example, ½ percent by weight of a caustic soda solution, together with ½ percent by weight of soda, calculated on the weight of the hydrogen peroxide.

In cleaning well screens or liners by disintegrating rock materials that clog said liners, sufficient hydrogen peroxide is preferably put in the well to fill the liner and the borehole outside the liner.

The invention is further illustrated by the following tests.

Example 1

A plastic mass of bentonite (50 percent by weight water) was treated with an aqueous 15 percent hydrogen peroxide solution at 15° C. at atmospheric pressure. The mass disintegrated in approximately 15 minutes; in water, however, an identical mass only disintegrated very slowly.

A portion of the same mass was also treated at a pressure of 150 atm. with a 15 percent hydrogen peroxide solution. The treatment was carried out at 50° C., i.e. under borehole conditions, and the mass entirely disintegrated in 45 minutes. No disintegration could be noticed with corresponding treatments of portions of the plastic mass with water.

Example 2

Talang Djimar clay was treated at normal pressure and temperature once with water and a second time with a 15 percent hydrogen peroxide solution. No disintegration occurred with water, whereas with hydrogen peroxide the clay disintegrated within a short time.

Example 3

Drill cuttings comprising a predominant portion of clay and a smaller portion of shale from a well at Pijnacker (Holland) were treated with 15 percent hydrogen peroxide to which had been added ½ percent by weight of sodium hydroxide and ½ percent by weight of sodium carbonate (calculated on the 15 percent hydrogen peroxide solution). Within an hour the cuttings had completely disintegrated. A similar treatment with an aqueous solution of the same concentration of sodium hydroxide plus sodium carbonate but without hydrogen peroxide, gave no result. With the treatment with a 15 percent hydrogen peroxide solution only, the cuttings disintegrated more slowly than with sodium hydroxide and sodium carbonate added.

I claim as my invention:

1. A method of treating formations and earth material containing a substantial amount of clay encountered in well drilling operations which comprises introducing a quantity of hydrogen peroxide into a borehole drilled into the earth, positioning said quantity of hydrogen peroxide adjacent the location to be treated, and maintaining said hydrogen peroxide in contact with the borehole wall at said location for at least 15 minutes until at least a portion of said earth material has disintegrated.

2. A method of treating formations and earth material containing a substantial amount of clay encountered in well drilling operations which comprises introducing a quantity of hydrogen peroxide into a borehole drilled into the earth, positioning said quantity of an aqueous hydrogen peroxide solution having a concentration of at least 10 percent adjacent the location to be treated, and maintaining said hydrogen peroxide in contact with the borehole wall at said location for at least 15 minutes until at least a portion of said earth material has disintegrated.

3. A method of treating formations and earth material containing a substantial amount of clay encountered in well drilling operations which comprises pumping under pressure a quantity of hydrogen peroxide into a borehole drilled into the earth, positioning said quantity of an aqueous hydrogen peroxide solution having a concentration of at least 10 percent adjacent the location to be treated, and maintaining said hydrogen peroxide in contact with the borehole wall at said location for at least 15 minutes until at least a portion of said earth material has disintegrated.

4. A method of freeing from earth agglomerations containing a substantial amount of clay a stuck tool used in well operations, said method comprising introducing a quantity of hydrogen peroxide into a borehole drilled in the earth, positioning said hydrogen peroxide adjacent said stuck tool, and maintaining said hydrogen peroxide in contact with the borehole wall in said position for at least 15 minutes until at least a portion of said earth agglomerations adjacent said tool has disintegrated.

5. A method of freeing from earth formations containing a substantial amount of clay a stuck tool used in well operations, said method comprising introducing a quantity of an aqueous hydrogen peroxide solution having a concentration of at least 10 percent into a borehole drilled in the earth, positioning said hydrogen peroxide adjacent said stuck tool, and maintaining said hydrogen peroxide in contact with the borehole wall in said position for at least 15 minutes until at least a portion of said earth formations adjacent said tool has disintegrated.

6. A method of freeing from earth formations a stuck tool used in well operations, said method comprising introducing a predominant quantity of hydrogen peroxide together with minor quantities of a caustic solution and an inorganic salt into a borehole drilled in the earth, positioning said hydrogen peroxide adjacent said stuck tool, and maintaining said hydrogen peroxide in contact with the borehole wall in said position until at least a portion of said earth formations adjacent said tool has disintegrated.

7. A method of freeing from earth formations containing a substantial amount of clay a stuck tool used in well operations, said method comprising introducing a predominant quantity of hydrogen peroxide together with minor quantities of a caustic soda solution and sodium carbonate into a borehole drilled in the earth, positioning said hydrogen peroxide adjacent said stuck tool, and maintaining said hydrogen peroxide in contact with the borehole wall in said position for at least 15 minutes until at least a portion of said earth formations adjacent said tool has disintegrated.

8. A method of cleaning disintegratable materials containing a substantial amount of clay from a liner used in the production of wells, said method comprising introducing into the well and positoning in said liner located in a well an amount of hydrogen peroxide sufficient to fill said liner, and maintaining said hydrogen peroxide in said position for at least 15 minutes until at least a portion of the material in said liner has disintegrated.

9. A method of cleaning disintegratable materials containing a substantial amount of clay from a liner used in the production of wells, said method comprising introducing into the well and positioning in said liner located in a well an amount of hydrogen peroxide sufficient to fill said liner and the well outside the liner, and maintaining said hydrogen peroxide in said position for at least 15 minutes until at least a portion of the material in said liner has disintegrated.

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