METHOD OF TREATMENT AND PERFORATION OF NEAR-WELL ZONE

Inventors: Leon Marmorshteyn, Foster City, CA (US); Peter Mouler, Irvine, CA (US)

Assignee: Argosy Technologies, Palm Desert, CA (US)

Filed: Jul. 10, 2012

Publication Classification

Int. Cl. E21B 43/11 (2006.01)

U.S. Cl.

USPC 166/298

ABSTRACT

A method of treatment and perforation of a near-well zone of oil and gas recovery wells, includes making an oil or gas recovery well in deposits with carbonate collectors, performing slotting opening by sand treatment with a jet containing sand and a sand carrying liquid, and using as the sand carrying liquid a sand carrying liquid which contains light hydrocarbons C₃-C₁₂.
METHOD OF TREATMENT AND PERFORATION OF NEAR-WELL ZONE

BACKGROUND OF THE INVENTION

[0001] The present invention generally related to oil and gas industry and in particular to methods of treatment and perforation of oil- and gas-producing wells.

[0002] In the processes of oil and gas recovery the efficiency of the process significantly depends on a permeability of oil and gas containing formations on a radius of carrying out of the process. The higher the permeability of the oil or gas deposit and the greater the radius of carrying out of the process, the greater the quantity of oil and gas recovered and the higher is the efficiency of the recovery process. For this reason efforts have been made to increase the permeability of the gas and oil containing formations and to increase the radius of carrying out of the process of oil and gas recovery. It is believed that the existing processes of treating and perforation of the near-well zone of gas and oil wells can be further improved.

SUMMARY OF THE INVENTION

[0003] Accordingly, it is an object of the present invention to provide a method of treatment and perforation of near-well zone which is a further improvement of existing methods of this type.

[0004] More particularly it is an object of the present invention to provide a method of treatment and perforation of near-well zone which allows to improve permeability of formations and to increase radius of covering of the formation for gas an oil recovery.

[0005] In keeping with these objects and with others which will become apparent hereinafter one feature of the present invention resides in that in a prepared well located in a deposit with carbonate collectors, a slotted opening is performed by sand treatment with a jet containing sand and a carrying liquid, and the sand carrying fluid which is used, contains light hydrocarbons C₃-C₁₂.

[0006] In accordance with another feature of the present invention, slotted opening is performed with a pressure of the sand-carrying liquid selected so that the hear-well of the well is saturated with the above mentioned light hydrocarbons.

[0007] A further feature of the present invention resides in that in order to obtain the desired pressure of the sand-carrying liquid a valve is provided in a return line for conveying the sand and liquid containing jet.

[0008] It is another feature of the present invention to use as a light hydrocarbons individual paraffins of a row C₃-C₁₂ or their mixtures, such as benzene, kerosene, diesel fuel etc.

[0009] Still another feature of the present invention resides in that at and end of the slotted opening the pressure of supplying the sand and liquid containing jet is reduced to reduce a speed of circulation of the sand and liquid jet and to provide partial deposition of sand and filling of cracks, of perforation channels and partially of a well bore to enhance uniform saturation of a formation with the light hydrocarbons to initiate a process of liquid oxidation of the light hydrocarbons inside the formation.

[0010] In accordance with a further feature of the present invention the near-well zone is heated to, and then after the heating an air is pumped into the well to produce a highly efficient acting agent comprising a mixture of carbonic acids and solvents.

[0011] The novel features of the present invention are set forth in particular in the appended claims.

[0012] The invention itself however will be best understood from the following description of preferred embodiments.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0013] In accordance with the present invention it is proposed to treat and perforate a near-well zone of oil or gas recovery wells so as to improve permeability and radius of action. The inventive method is used oil and gas recovery wells which are made in zones with carbonate collectors. A slotted opening is performed with the use of a sand containing jet which has sand and a sand carrying liquid. The sand carrying liquid in the inventive method includes light hydrocarbons C₃-C₁₂. As the above mentioned hydrocarbons, individual paraffins of homologous raw C₃-C₁₂ or their mixtures can be utilized, including benzene, kerosene, diesel fuel, etc.

[0014] The slotted opening is performed with a pressure in the well, which is necessary for saturation of the near-well zone with the above mentioned light hydrocarbons C₃-C₁₂. This pressure can be obtained by using a valve provided in a return line of the flow of the sand and the sand carrying liquid containing jet. At the end of the slotted opening the pressure of pumping of the above mentioned medium is reduced. Thereby the speed of its circulation is reduced as well, and a partial deposition of sand takes place, and the sand fills cracks, perforation channels and partially a well bore.

[0015] The presence of sand in these cavities results in obtaining a more uniform saturation of the formation with the light hydrocarbons C₃-C₁₂, so that the process of their oxidation inside the formation can be guaranteed, and a possibility of explosion in the well is prevented.

[0016] Then, a warming up of the near-well zone of the well is performed to temperature of 150-200 degrees C. This operation can be performed with the use of chemical reactants which generate heat during their interaction with each other. On the other hand, the warming up can be performed by an electric heater designed to operate at certain depths.

[0017] After warming up of the near-well zone, air is pumped into the well bore in the quantity of 2,500-12,500 cubic meters per 1 meter of perforation interval. This quantity of air is needed to produce directly in the formation 1.5-7.5 kg per 1 meter of perforation interval a highly efficient acting agent, containing a mixture of carbonic acids (formic acid, acetic acid, etc.) and solvents (ketons, alcohols, ethers etc.). After a certain time is maintained, the well is discharged and is ready for operation.

[0018] It has been established in a new, unobvious way that the carrying out of reaction of oxidation inside the formation with temperatures below 150 degrees C can lead to an interruption and stopping of the process. Only an insignificant amount of the acting agent will be produced in the formation. On the other hand, the upper limit of the temperature of 200 degrees C is determined by the situation that the higher temperature of reaction of the liquid phase oxidation inside the formation can lead to a fire-generating reaction.

[0019] Example of the tests of the inventive method are presented hereinafter.
EXAMPLE 1

[0020] A well is provided in a carbonate collector in interval 1,220-1,228 m, effective thickness 4 m, porosity of collector 12%, formation pressure 12 MPa, reception of the well 1 cubic m per day with repression of 10 MPa. A slotting opening is performed with a speed of movement of the sand perforator 5 mm/min, liquid supply through the perforator 9 l/sec.

[0021] Time of opening 14 hours. The liquid used as sand carrier is benzene.

[0022] After the opening the reception of the well 15 cubic m per day for liquid with 10 MPa repression. A valve is arranged in a return line, which provided an inlet pressure of 13.1 MPa with the flow rate of liquid through it 9 l/sec. The repression during this 10 MPa, and 9 cubic m of benzene is introduced in the process of slotting opening. Then the pressure of the liquid solution which is being pumped is reduced to 4 MPa, the speed of circulation of the solution diminishes, and the process of filling of cracks, perforation channels and partially of well bore with sand starts.

[0023] During the process of filling the cavities with sand, 150 kg of granulated magnesium is added, and the perforator is lifted above the productive formation to avoid it blocking. The height of the thusly made artificial filter is determined by quantity of sand dispersed in the liquid in the working solution and granulated magnesium. In this case for forming the filter the quantity of sand was 450 kg, and of magnesium 150 kg.

[0024] Then 2.8 cubic m of hydrochloric acid with 20% concentration is pumped into pump-compressor pipes. It interacts with the granulated magnesium and provides warming up of the near-well zone to 150-160 degrees C. Then air is pumped in with the quantity of 22,500 cubic m.

[0025] The well is placed on hold for 48-50 hours, then discharged, and put into operation.

EXAMPLE 2

[0026] Well opened a carbonate collector of oil in interval of 1,220-1,228 m. Effective thickness is 4 m, porosity is 12%, formation pressure 12 MPa, reception of the well 2 cubic m per day for liquid at repression of 10 MPa. Slotting opening of the formation is performed with speed of movement of the sand blasting perforator 5 mm/min, with flow rate of liquid through the perforator 9 l/sec, the time of opening is 14 hours. As the liquid for carrying sand, a mixture of light hydrocarbons C₅-C₁₂ is utilized. After the opening the reception of well is 15 cubic m per day for liquid at repression of 10 MPa.

[0027] A valve is arranged on the return line to provide an inlet pressure of 13.1 MPa, at flow rate of liquid through it of 9 l/sec. With this the repression is 100 MPa, and during the slotting opening 9 cubic m of mixture of light hydrocarbons is into the formation. Then the pressure at the inlet of the well (of the working agent) is reduced, and the process of filling crack, perforation channels and partially of well bore will start. During the process of filling of the cavities with sand the perforated is lifted above the productive layer by 5-6 m to prevent its locking. The height of the artificially created filter is determined by the quantity of sand suspended in liquid. In this case for forming the filter the quantity of sand was 450 kg.

[0028] Then the sand-blasting perforator is removed from the well, and a gas burner is lowered to be located directly above the artificial filter, and the near-well zone is warmed up to 200 degrees C. The gas burner is then turned off, and 22,500 of cubic m of air is pumped into the well. The well is placed on hold for 48-50 hours, then discharged, and then put into operation.

[0029] The utilized light hydrocarbons can include any hydrocarbons of homological raw C₅-C₁₂ individually or in mixtures. As an example such hydrocarbons as butane, lene, heptane etc can be used. Also their mixtures can be used, such as unstable benzene from gas-processing plant, head of oil stabilization oil excavations, light gas condensates.

[0030] The present invention significantly increases the efficiency of treatment of near-well zone as a result of deeper and more uniform penetration into a formation of products of reaction of liquid-phase oxidation in the formation of light hydrocarbons C₅-C₁₂, which improves hydrodynamic properties of the collector.

[0031] It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of methods differing from the types described above.

[0032] While the invention has been illustrated and described as embodied in a method of treatment and perforation of near-well zone, it is not intended to be limited to the details shown, since various modifications and structural changes may be made without departing in any way from the spirit of the present invention.

[0033] Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can, by applying current knowledge, readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims:

1. A method of treatment and perforation of a near-well zone of oil and gas recovery wells, comprising the steps of making an oil or gas recovery well in deposits with carbonate collectors;

   - performing slotting opening by sand treatment with a jet containing sand and a sand carrying liquid; and
   - using as the sand carrying fluid a sand carrying fluid which contains light hydrocarbons C₅-C₁₂.

2. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 1, further comprising performing the slotting opening with a pressure of the sand-carrying liquid selected so that the near-well zone of the well is saturated with the light hydrocarbons.

3. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 2, further comprising obtaining the pressure of the sand-carrying liquid by providing a valve in a return line for conveying the sand and liquid containing jet.

4. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 1, further comprising using as the light hydrocarbons individual paraffins of a row C₅-C₁₂ or their mixtures, including benzene, kerosene, diesel fuel.

5. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 2, further comprising, at and end of the slotting opening reducing the pressure of supplying the sand and liquid containing jet to reduce a speed of circulation of the sand and liquid containing jet and to provide partial deposition of sand and filling of cracks, of perforation channels and partially of a well bore to enhance uniform saturation of a formation with
the light hydrocarbons to initiate a process of liquid oxidation of the light hydrocarbons inside the formation.

6. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 1, further comprising heating the near-well zone, and after the heating pumping air into the well to produce an efficient acting agent comprising a mixture of carbonic acids and solvents.

7. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 6, further comprising performing the heating to a temperature of 150-200 degrees C., and performing the pumping of air in a quantity of 2,500-12,500 cub meters on 1 meter of interval of perforation.

8. A method of treatment and perforation of a near-well zone of oil and gas recovery wells as defined in claim 6, wherein the heating includes heating in a manner selected from the group consisting of heating by reactants which generate heat during their reaction and by a depth electric heater.

* * * * *