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(54) A method for reverse cementing of casing pipes

Sample of Russian to English translation

Abstract. A method for the reverse cementing of casing pipes that can be used for cementing oil wells by the reverse circulation method under lost circulation horizon or abnormally high seam pressure conditions. The offered method reduces the probability of breaking the continuity of the cement slurry flow when it moves into the annular space and [reduces] the probability of an additional pipe string getting stuck with the cement slurry that inflows into the casing pipe. The essence of the present invention consists in using an additional pipe string in the casing pipe. The cement slurry is pumped into the annular space and the drill fluid is circulated simultaneously. The drill fluid circulation is carried out in the additional pipe string and in the internal path of the casing pipe. The circulation is carried out with a variable flow over time. Such circulation creates a back pressure of 0.2 – 0.5 MPa against the cement slurry pumping during the entire time of pumping. After the cement slurry pumping, the bottom of the casing pipe is plugged. After the plugging of the casing pipe, the drill fluid circulation is continued until the cement slurry is removed from the casing pipe and the cement slurry in the annular space is allowed to set completed. Then, the additional pipe string is retrieved. A flushing liquid that contains condensed sulfite waste liquor (CSWL) in the amount of 0.1 – 0.5% of the liquid volume is used as the drill fluid for the circulation. 3 drawings. 1 claim.

The present invention relates to the casing of oil and gas wells; particularly, to the cementing of wells by the reverse circulation method, and is aimed at improving the quality of the casing of wells that have a lost circulation horizon and wells with abnormally high seam pressure.

A method is known for the reverse cementing of casing pipes comprising a cement slurry that has been treated with radioactive elements being pumped into the annular space.

A method is known for the reverse cementing of casing pipes with the use of an additional pipe string.

The method is realized in the following manner. An additional pipe string is lowered into the well and a cement slurry is pumped into the annular space; after that, the pressure differential between the additional pipe string and the casing pipe is measured, and the beginning of the cross-flow of the cement slurry behind the casing into the cemented pipe string is judged by an increase in the pressure differential.

A method is known for the reverse cementing of casing pipes comprising an additional washover string being lowered into the casing pipe, [the lower portion of said string being] equipped with a sealing pack and a tappet pushrod that allows the release of a shutoff sphere from a non-return valve which provides the conditions for the reverse circulation. After the cement slurry has been pumped in and the lower part of the casing pipe is sealed, the circulation of a flushing liquid through the additional pipe string is switched on, which results in the washing-out from the well of the cement slurry that has milled up into the tubing string.

The disadvantage of the known method is the possibility of the additional pipe string becoming stuck with the cement slurry that inflows into the casing pipe, because the cement slurry inflowing into the casing pipe is substantially dewatered and has an enhanced structural gel strength; this makes it difficult to wash out a kick of the cement slurry if its height is considerable.

The object of the present invention is to increase the effectiveness of the cementing by reducing the probability of a break in the continuity of the cement slurry flow when it moves into the annular space and reducing the probability of the additional pipe string becoming stuck with the cement slurry that inflows into the casing pipe.

The above indicated object is achieved by pumping the cement slurry into the annular space of the casing pipe simultaneously with circulation of the drill fluid in the additional pipe string and the internal channel of the casing pipe, and in the process the drill fluid circulation is carried out with a variable flow over time in order to provide a back pressure of 0.2 – 0.5 MPa against the pumping of the cement slurry during the entire period of pumping; after the casing pipe has been plugged, the drill fluid circulation is continued in order to remove the cement slurry from the casing pipe, and this takes place during the period until the cement slurry in the annular space of the casing pipe has completely set. A flushing liquid containing CSWL in the amount of 0.1 – 0.5% of the liquid volume is used as a drill fluid for the circulation in the additional pipe string and in the internal channel of the casing pipe.

The advantageous effect of the use of the present invention is a savings in the costs associated with accidental eliminations and the release of the cement stuck to the additional pipe string as [occurs] in the conventional technology.

In Figs. 1 and 2, a general schematic view of the cementing of the casing pipe is presented, which has components such as casing pipe 1 equipped with plug seat 2, additional pipe string 3 equipped with a washing-out sealing unit 4, which has sealing element 5 and circulation channels 6. On the wellhead is mounted preventer 7, which has outlet 8 with manometer 9, packing 10 and outlet 11. The additional pipe string is centered with the use of centralizer 12. The sealing pack is connected to the additional pipe string with mandrel sub 13 that has left-handed threads.

The present method is realized in the following manner.

Casing pipe 1 equipped with plug seat 2 and additional pipe string 3 equipped with flushing sealing pack 4 are lowered into a well. The space between the casing pipe and the additional pipe string is sealed with packing 10.

After flushing the casing pipe by direct and reverse circulation into the annular space through outlet 8, the cement slurry is pumped in with preventer 7 being closed. Simultaneously, the flushing liquid is pumped in through the additional pipe string, which, similarly to the cement slurry, flows from the annular space to the wellhead through the outlet 11 (Fig. 1). In this case, the admission of the flushing liquid is regulated so that the pressure indicated by manometer 9 does not drop below zero (approximatelyt 0.2 – 0.5 MPa) while the cement slurry is being pumped in. The volume of the cement slurry pumped into the well is calculated from the cement slurry volume required to fill the annular space and the cement slurry volume used to form the mixing zone.

After the cement slurry has inflowed into the casing pipe, **its admission into the additional pipe string** and the shutting off of the flushing channel of plug seat 2 with the sealing pack are realized. The flushing liquid circulation through the additional pipe string is continued until the complete washout of the cement slurry mixing zone from the casing pipe (Fig. 2). After the cement slurry in the well bottom has completely set, the additional pipe string is lifted to the surface (Fig. 3).

The offered method differs from the prior art in that the cement slurry inflowing into the casing pipe immediately mixes with the flushing liquid flow and is washed out from the casing pipe without creating an emergency situation.

Thus the cement slurry flow velocity in the annular space is controlled, which allows the prevention of a break in the continuity of the cement slurry flow.

Example of a specific implementation.

It is necessary to cement a casing pipe with a diameter d_p = 0.168 m in a well with a depth of 1500 m and a diameter of D_{well} = 0.216. At a depth of h = 1400 m, there is a lost circulation horizon which does not allow the cement slurry to be raised up to wellhead using straight circulation. The statistical temperature at the well bottom is –65 ºC. A Portland cement-based cement slurry that has a setting time of t_{begin} = 2 – 30 hours and t_{end} = 2 – 40 hours is used for cementing.

The cementing of the casing pipe is carried out using the method of the reverse circulation.

[First a] casing pipe and then an additional producing string with a 0.73 m diameter are lowered into the well. A pressure test is performed on the docking unit, then the reverse circulation of the drill fluid is recovered, and the pumping of the cement slurry into the annular space begins with the closing of

the preventer. The cement slurry volume, $V_{c.s.}$, is determined as the sum of the annular space volume, $V_{a.s.}$, and the cement slurry volume, $V_{c.s.mix}$, used for the formation of the volume of mixing ($V_{c.s.mix.}$ = ½ mix.).

The mixing zone is about 5% of the total volume of the cement slurry. Thus, $V_{c.s.} = V_{a.s.} + \frac{V_{см}}{2} = 22 + \frac{1}{2} = 22{,}5\ м^3$.

Simultaneously with the pumping of the cement slurry, the flushing liquid is circulated through the additional pipe string using a cementing unit. Flushing is carried out using drill fluid that is treated with a fluidizing agent (for example, CSWL = 0.1 – 0.5% of the volume of the liquid). When the cement slurry is pumped in, a positive pressure of 0.2 – 0.5 MPa is maintained on the manometer. The pumping efficiency is Q = 20 L/s. Upon injection of the last portion of the cement slurry, the additional pipe string is admitted to the plug seat, and pumping of the cement slurry is stopped. In this case, the duration of the cementation is about 20 min ($t = \frac{V_{т.р.}}{Q} = \frac{22{,}5}{0{,}02} = 20$ мин). Circulation of the flushing liquid through the producing string continues until the cement slurry that has inflowed into the casing pipe has been completely washed out. The producing string is lifted three hours after the cementing has begun (the duration of the cementing is 20 min plus the time for the cement slurry to set $t_{begin\ cem}$ = 2 – 40 h).

Claims

1. A method for the reverse cementing of casing pipes, comprising an additional pipe string that is lowered into a casing pipe to the depth of the casing pipe draw-off, pumping of a cement slurry into an annular space of the casing pipe simultaneously with the drill fluid being forced out through its internal channel, plugging of the lower part of the casing pipe and retrieval of the additional pipe string, wherein in order to increase the effectiveness of cementing by reducing the probability of a break in the continuity of the cement slurry flow when it moves into the annular space and by reducing the probability of the cement slurry that has inflowed into the casing pipe becoming stuck on the additional pipe string, the pumping of the cement slurry into the annular space of the casing pipe is conducted simultaneously with the circulation of the drill fluid through the additional pipe string and the internal channel of the casing pipe, where in this process the drill fluid circulation is carried out with a variable flow over time in order to provide a back pressure of 0.2 – 0.5 MPa against the pumping of the cement slurry during the entire period of the pumping, and after the casing pipe has been plugged, the drill fluid circulation is continued in order to remove the cement slurry from the casing pipe until the cement slurry in the annular space of the casing pipe has completed set.
2. The method according to Claim 1, wherein in order to realize the circulation through the additional pipe string and in the internal channel of the casing pipe, a flushing liquid containing CSWL in the amount of 0.1 – 0.5% of the volume of the liquid is used as the drill fluid.