Determination of reasonable displacement of washing for water injection well

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Abstract. As the oilfield enters the development phase of extra-high water content, it is an important precondition to ensure the steady and steady production of the oilfield. Water injection wells washing wells become one of the most important conventional measures to maintain the water absorption capacity of the formation and improve the water injection effect. In this paper, we determined the well flushing displacement in the field flushing operation. We think that different well flushing operation methods for different strata, pressure, permeability and water absorption conditions can effectively improve the well flushing effect of water injection wells, It solves the problem of frequent job re-allocation due to sand burial of sand produced in the formation, reduces the starting pressure of water injection well and preconditions for casing protection.

1. The purpose of washing for water injection well
After inject water for a period of time, the suspended matter and mechanical impurities in the water gathered near the wellbore and the borehole, which resulted in the decrease of water absorption ability and the increase of water injection pressure. Even water injection wells can not carry out normal fishing test, causing frequent operation rematch, which affects the water injection time rate and test pass rate. The main purpose of water injection well washing is to maintain formation water absorption in oilfield. Remove the accumulation in the wellbore and carry out the dirt attached to the tubing, casing, perforation section and bottom pocket through the circulation of the well washing fluid in the tubing, casing, perforated well and bottom pocket, so as to achieve the function of cleaning. In order to reduce the formation of pollution, improve the ability of water absorption.

2. Technology used for water injection well washing at present
According to the requirements of environmental protection, the washing well of the tank car has gradually replaced the outer drain well, which has become the main way at present. The use of well washing tank has little effect by location, season and other conditions, but because the tank capacity is small (usually 15m³), a limited number of devices, a single tank washing well received after the expiry of the need to stop the wells, well washing process is not continuous, due to intermittent flushing, the upper part of the column has been washed into the mud and sand, waste oil, or pipe scale impurities again dropped back to the bottom, easy to cause the nozzle blockage, and cause the injection well formation pressure of high excited sand washing water appears worse or not the condition of water. Therefore, the continuous washing method of tank cars is generally adopted. This technology is a self-cleaning four way device based on the original tanker's pulling and washing. It is made up of four links, high pressure rubber pipes (35Mpa), shell valves and measuring instruments. Well washing out a vent hose from water injection wellhead tubing, connected to the four, the four
connecting the high-pressure hose are respectively connected to the two tank, through a valve to control the washing liquid into the tank, can be kept well under the condition of deep well washing, continuous washing requirements, at the same time continuous measurement of washing water, pressure, and through washing sewage tanker will be transported to a nearby sewage recycling point.

3. Analysis of flow pattern of water injection well washing
Feng Yongjiang et al analyzed and calculated the flow state in the process of well washing by using the method of hydraulic dynamic research. According to the calculation of Reynolds number Re=85560~142600 > 2000. Therefore, it is difficult to determine the instantaneous velocity and direction of washing water particle in theory, but the average vertical velocity of water quality point is the same in macroscopic view, and the numerical value is \( v = \frac{4Q}{\pi d^2} \). Q is the discharge of well washing, obviously \( v \) is proportional to \( Q \), so in order to obtain good scour and cleaning effect, we must improve \( v \). make the debris in the well wash fluid by water rotation, and sand move along the pipe wall under the action of centrifugal force. In order to form adhesion effect, friction effect and hit effect on the dirt, the dirt is easy to fall off. Therefore, as far as the scour ability is concerned, the large displacement well washing should be adopted as far as possible. But in the field application, we must also consider the carrying capacity of the water flow.

4. Determination of reasonable displacement of washing for water injection well
According to the field practice in recent years, it is found that the large displacement of water injection well is easy to cause the formation water to return out, resulting in sand blockage. If the well washing capacity is too small, it will only rush out the deposits and impurities in the tubing and wellbore, which will not achieve the effect of washing. The washing capacity of the injection well with low injection pressure causes the well washing pressure to be higher than the formation starting pressure. Most of the washing water enters the stratum, and there is very little return water, which can not carry the impurities in the wellbore and can not achieve the effect of washing. Therefore, the washing should take different displacement according to the specific problems in order to meet the requirements. In the past, due to the lack of necessary understanding of the specific conditions of each well, the well washing pressure and displacement control and operation were often monotonous and lack of pertinence. Therefore, through comparison and experiments, we have summed up the following conditions for the optimization of well displacement.

4.1 washing displacement of water injection well with decreasing absorption
It is generally believed that 15% decrease in water absorption is necessary to wash, and the water injection wells with decreased absorption are generally caused by the attachment to tubing, casing, perforated well section and bottom pocket dirt and so on. Therefore, through the circulation of well washing fluid in the string, the dirt in the downhole can be carried out to remove formation pollution, and the purpose of well washing can be achieved. With the increase of the flow rate and velocity of fluid in the wellbore. The stronger the scour force is, and the greater the velocity of water flow is, the greater the negative pressure will be near the perforating hole in the perforation section. In this way, more dirty water can be carried out in the near well zone. The washing effect of large displacement of water injection wells with decreased absorption is better than that of washing wells with medium and small displacement, mainly due to the large flow rate when washing wells with large displacement. Fast flow rate, strong scour force and good effect of well washing. Large displacement should be used as long as possible when dealing with this well. Under the premise of ensuring that the outlet discharge is larger than the inlet displacement. Close to and no more than allowable pressure to prevent well washing fluid from leaking into formation.

4.2 Washing displacement of water injection well with the resistance test
The main reason of the water injection well test is difficult in the oil pipe string, the underground pipe column in oil washing can achieve the purpose of washing the well. The effect of washing the well test
difficult injection well and small displacement in large displacement well washing effect is mainly due to the density of oil is less than water density, so washing well to wash slow the principle of well washing, in order to string the oil to the ground. But from economic considerations, test the resistance displacement of the injection well flushing efficiency is higher than that of the small displacement washing efficiency. The inner memory water of the annular space of the injection well and the memory water of the tubing are about 15m³. The 4-5 cycles of washing well can basically wash out the oil in the pipe column

4.3 washing well for sand production

For washing well of sand production, the most important thing is to avoid formation agitation to produce sand. Therefore, to ensure that the oil pressure at the well head is slightly higher than the starting pressure, it is necessary to first adjust the well wash discharge to 10 ~ 15 m³/h. After washing wells with small displacement for 1 hour or so, the wellhead oil pressure will remain unchanged, and the well washing capacity will be adjusted to 20 ~ 25 m³/h, and the well will be washed for more than 3 hours with strong strength, before the sundries in the wellbore can be thoroughly washed.

4.4 Washing displacement of water injection well for discharge more than 15 days

The main reason for washing water injection wells with shut-in more than 15 days is to wash out the impurity in the bottom of the well before resumed. Because the formation is not injected for a long time, the formation deficit is large, so the water injection wells of this kind are washed. In order to prevent the well washing fluid from leaking into the formation and impurity in the well to block the formation, the first step is to extend the time of release and overflow for 20 minutes, and the second is to strictly follow the 10 m³/h 15 m³/h discharge rate. 20 m³/h, 25 m³/h, from small to large, the emissions are gradually increasing.

5. Reasonable operation method for water injection well flushing

There are many sub-layers of water injection wells. with the extension of water injection time, the interlayer pressure is different and interlayer interference is serious. the formation factors are ignored in the flushing process, and only the flushing pressure, time and displacement are emphasized to cause the flushing effect is not obvious. In order to achieve the ideal flushing quality, different flushing operation methods should be adopted for wells with different strata, pressure, permeability and water absorption conditions.

As part of the well can't wash well for a long time, oil, sand buried in the bottom, resulting in wash well impassability. For such wells, firstly, the overflow and pressure reduction are performed, then the reverse flow is injected for 20 minutes, then the overflow and flushing are performed, the circulation operation is performed, and the blocking substances are washed away by utilizing the transfer effect of the fluidity, permeability of water and the pressure difference between the inside and outside of the oil pipe, so that the operation is effective for some wells.

For wells with poor permeability and low water volume, stable pressure control method is adopted. This kind of well in the process of flushing the inlet water quantity is large, and the outlet water quantity return less, even not return water. This occurs mostly in wells with poor water absorption, less water injection and low pressure. the reason is that the flushing pressure is higher than the minimum starting pressure of the well, resulting in part of water entering the formation. during flushing of such wells, the minimum starting pressure of the well shall be deduced according to the test indication curve, and the water distribution gate or casing gate shall be controlled so that the inlet pressure is controlled below or close to the minimum starting pressure of the well.

On the side slope, take the method of extending the flushing time.Because of the well depth structure and other reasons, the oil pollution, sludge, scaling in the pipe string is particularly serious, so the flushing time should be extended.
6. A few points of understanding

6.1 Continuous washing well reduces the start-up pressure of the injection well and does a good job of casing protection.

6.2 For water injection wells with reduced water absorption, the reasonable well washing discharge is the maximum washing pressure equal to the allowable pressure, and the large discharge water well washing should be used as long as possible, and for the water injection wells where the test is blocked. The reasonable well washing displacement is about 20m3 / h, and for the water injection well with test pressure holding down, the reasonable well wash displacement is small.

6.3 different techniques and methods should be adopted according to specific wells to improve the well washing quality.

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