

Analysis of reducing pressure and increasing injection in high pressure water injection block of low permeability reservoir

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Abstract: The plugging phenomenon near the well zone of oil injection well will seriously affect the water injection development of oil field, and then affect the exploitation of oil resources. The water injection development of low permeability reservoir is affected by various factors. Due to the large difference between layers and the serious interference between layers, the physical property of oil layer is relatively poor, and the water injection pressure shows a trend of increasing year by year, which has a great impact on the development of oil resources. As the oilfield development benefit is not ideal, it is necessary to take reasonable measures to reduce the pressure of water injection to ensure the effect of water injection to improve the recovery of the reservoir. At present, the technology has been mature, which can reduce the pressure of water injection and ensure the oil recovery rate. The application in several oil Wells has verified the correctness of this conclusion.

Key words: Oil pressure; Jam; Water injection.

1. Introduction

Permeability of low permeability reservoir development is affected by many factors, in the oilfield development part of the sensitive layer contains a large number of clay minerals, these components exist in water collision and migration, formation permeability, which to a large extent affect the specific development effect, so in production, after water injection geological contains clay layer formation permeability decline, It directly affects the actual production of oil Wells. However, many oil Wells still do not absorb water after water injection, and the formation operation cannot be carried out smoothly, and the pressure cannot produce, which brings great harm to the surface system and downhole tools. These unsafe factors directly affect the actual production. This paper analyzes how to achieve high efficiency production by reducing pressure and increasing injection technology.

2. Interpretation of low permeability reservoir production operations

In the current oilfield exploitation, the number of low permeability reservoirs is gradually increasing, because with the development of petroleum resources, people have a deeper understanding of reservoir development. Fracture-vuggy reservoirs are mostly low permeability reservoirs, showing the characteristics of diversification and deep burial. The underground oil reservoir space is large cave, reservoir heterogeneity is strong, and the relationship between oil and water and fluidity is complex.

Under this trend, high-pressure water injection development becomes the main technology of oil exploitation. Current regional oil development shows the characteristics of the several problems: (1) reservoir physical property is poor, in the long existing in the development of "three highs" and "four low", the contradiction of the specific performance is high water injection pressure and injection-production well ratio is high, but the actual deficit is high also, in addition "four low" embodied in the low permeability and low productivity and other characteristics; (2) The continuity of the reservoir is poor, and the pressure relief of the oil layer is relatively fast in the development process. The water volume of water injection can not keep up, and the energy of the formation can not be supplemented in time, resulting in the phenomenon of insufficient energy, leading to the low productivity of the oil well. (3) low permeability reservoirs, the actual infiltration inefficient, pore is slightly fluid storage or stay region, but also the most fully contact with the formation water and the status of fouling in the most likely to occur, due to long-term under the influence of the reinjection sewage and homework workover job, cause of formation of suspended solids invasion, all sorts of bacteria, such as the stranded in the Wells. ④ The water quality of injection is poor. According to the water quality survey, the content of various substances in the water is relatively high, which affects the stability of water quality. The dissolved oxygen, oil content and bacteria content of water outside the station are relatively high. On the whole, all indicators are the main factors that restrict the water quality to reach

the standard. (5) Secondary pollution of the reservoir is relatively serious, because impurities and related substances in the process of water injection production of low permeability reservoir are easy to form precipitation in the formation, resulting in blockage and secondary pollution to the formation [1].

3. Reducing pressure and increasing water injection process

3.1 Use surfactants

Because most of the domestic oilfield drilling for oil are taken injection, but according to the above content, and actual situation, the long-term serious influence to the actual production of high-pressure water injection technology, declining water injection after water injection pressure, lead to reservoir owe note, this phenomenon directly affect the actual production, so you need to take reasonable measures to reduce the injection pressure, increase injection The water injection effect was also significantly improved, which greatly improved the actual recovery [2]. Surfactants are generally used to reduce the starting pressure and injection pressure. In the mechanism of action, the relationship between pressure difference and flow rate is:

$$\Delta p = \frac{Q\mu \ln R_e/R_w}{2K_w h \Pi}$$

In the formula above, if Q、Re、h、μ、Rw is parameters are certain, In this case by increasing Kw Can reduce the Δp, And one of Kw=KxKrw, The following table describes the parameters and their meanings:

Table 1 Parameter meanings

KW	Effective penetration of injected water into the formation
K	The absolute permeability of the formation
KRw	The relative permeability of injected water in the formation

In the above formula, increasing the relative permeability and absolute permeability can make the injected water permeability. In terms of the tension and relative permeability of the oil-water interface, when the interface decreases, the relative permeability of oil and water will increase.

Surfactants reduce adhesion, in terms of technology, by reducing the tension of the oil-water interface and the adhesion of crude oil to the rock surface. Surfactants can dredge the formation, open up the network pores to increase the capillary number, enhance the flow performance of crude oil, thus reducing the water injection pressure, to achieve the purpose of increasing water injection. The use of surfactants to reduce the pressure of oil interfaces, increase the number of capillaries, and reduce or neutralize formation capillaries can reduce the amount of adhesion work required during oil recovery. On the other hand, the adhesion work of crude oil is reduced by improving the lubricity of rock

surface. After adding surfactant, the interaction force between oil and water is reduced, and the lubrication contact Angle is reduced. The smaller the contact Angle is, the greater the interfacial tension is, which reduces the speed of rock to crude oil, increases the activity, and improves the exploitation efficiency of crude oil. The use of surfactants can reduce the adhesion of crude oil to rock during water injection. In addition, by improving the diffusion ability of crude oil in water, the emulsification of oil film can be increased after using surfactant. In principle, surfactants are very good at emulsifying and dispersing crude oil, emulsifying the oil dispersed on the rock surface and making it fall off quickly. In addition, the active agent is free on the oil-water interface to remove the active components in the oil phase, so that the formation deformation, similar to the increase in the number of capillaries. There are two infiltration modes of water flooding. In this way, water absorbs water and discharges oil in the same direction in the driving process, and the force between oil and water interface is small. Therefore, the main driving force of water flooding is the self-weight of oil and water. Reverse imbibition means that water is driven in opposite directions [3].

4. Reservoir geologic analysis

4.1 Project interpretation

This project is a low permeability reservoir. The geological details are shown in the following table:

Table 2 Geological parameters of reservoir

permeability	(1~10) x10 ⁻³ μm
Shale content	16~18%
Mean pressure coefficient	1.1~1.6
Injection Wells	24 □
Single well injection pressure	30.5MPA

The geology of this oil layer is complicated, the difference between layers is significant, the interference between geological operations is also very serious, the physical property of oil layer is relatively poor, so the water injection and water injection pressure are increasing with the development of geological exploitation, especially the water injection pressure shows a trend of increasing year by year. In oilfield development, some sensitive minerals expand and migrate when they meet groundwater, which leads to the decrease of formation permeability and affects the development and utilization of oil and gas. As water injection continues, bottom water coning and operating water entering the formation, the permeability of clay-containing formations decreases and affects well production. Mentioned in this project, the 24 hole injection Wells normal pressure is 30.5 MPa, but as the work goes on, there are still part of the water injection pressure more than the specification is still not bibulous, to produce a great impact on the actual exploitation, this particular disadvantage is poor reservoir property, poor permeability, poor connectivity, poor water quality, low permeability, existence of secondary pollution.

4.2 Reducing pressure and increasing injection process

In the process measures, the conventional measures are mud acid step-down augmented injection, multiple layer composite acid step-down augmented injection, litres of gas solution plugging technology, etc., these technologies in use will cause congestion phenomenon, and underground reservoir pollution hidden trouble, leading to the benefit of the step-down augmented injection is poor, the actual effect is not ideal, so in view of the reservoir blocking phenomenon, Adhering to the construction operation mode of "reservoir reconstruction first" and then "fine water injection", this project uses the technology of expanding, reducing pressure and increasing injection, polyhydroacid deep acidification and fine filtration to make up for the defects and deficiencies of conventional technology.

(2) Technical analysis of reducing inflation, reducing pressure and increasing injection

The mechanism of reducing inflation, lowering pressure and increasing injection is as follows: Contraction after inflation appears after the formation water absorption, water loss, the main reason is because some hydrophilic minerals in the water under the influence of the adsorption of water molecules, integrating with the inhalation and exhalation of expansion and contraction phenomenon, such as minerals such as montmorillonite and illite, between cell can absorb a large number of water molecules, water molecules into the silicon oxygen tetrahedron and alumina octahedral interlayer, When water increases crystal lattice will continue to expand and cause volume expansion, when water injection increases, so that clay expansion and migration phenomenon, the use of acid to resolve blocking measures, in this link using shrinkage expansion agent, which is a chemical synthesis of polymer material. In the process of using high molecular compound biological physical and chemical reaction and clay minerals content such as lattice modified, such clay under water won't expand, and have been passed by the expansion of the lattice modified release water molecules, the volume shrink back to the original state, change the characteristics of minerals by multi-point adsorption, make geological clay together with the original mineral formation, Avoid swelling and migration conditions that interfere with actual production. The oxidizing agent ionic group will destroy the clay lattice, and after absorbing water, the clay releases adsorbed water to shrink the volume and restore the dredging performance of the stratum. The analysis of the swelling agent interacts with the water molecule, and when water is added, the hydration group binds to the water molecule. Clay particles and water in compatible contact, hydrogen bonding, electrostatic adsorption clay, near the suction and expansion agent as have enough high molecular weight, and a larger linear properties and molecular structure, can adsorption on a na soil particles, and further connected to the adjacent clay, disperses more particles together is the organization of clay, The stability of clay is ensured so as to achieve the purpose of reducing pressure and increasing injection [4].

The principle of selecting well:

For the injection Wells with high clay quality and significant water sensitivity and speed sensitivity in the block; Or the oil and water well communication performance is good, the injection production process is more obvious; You can also choose Wells with no problems in initial exploitation, but secondary pollution in later period; After acidizing treatment, it has a good effect in the initial stage, but the actual pressure rises quickly and the injection-production period is short. In addition, there is a good well without sleeve change and sleeve leakage.

(2) Deep acidification of polyhydroacid

This technology is through the use of acid to remove the alternating injection reservoir blocking phenomenon, dissolve well layer to improve the physical properties of formation of minerals, on the mainland, in the subsequent acid of the expansion agent for formation of clay particles, forming new channels, in addition to reduce acid acidification efficiency filtration, can improve the permeability of the ground near wellbore, overall improve the water absorbing capacity of injection Wells in mainland layer. The use of this technology is characterized by the release of heat energy under the condition of removing pollution, remove the blockage phenomenon; Secondly, organic plugging agent can relieve the plugging phenomenon of polymer compounds to achieve cooling effect. The hydrochloric acid in the formation is removed when the pre-acid is injected to prevent the interaction between the hydrofluoric acid in the later stage and the calcium fluoride produced in the formation to precipitate. Organic soil acid is used to remove soil content and underground zone pollution near the well, which has the effect of deep acidification. Under the action of the construction equipment and the condition of not pressing open the stratum, the overall pump displacement should be improved as far as possible, and the water injection operation should be carried out without discharging residual acid. The low-damage, slow-moving acid in the acid has an impact as it enters the formation, extending the life of the acid and increasing the actual treatment radius. (3) Fine filtration technique

Principle of this technology is a deep filter together with the metal film surface layer separation mechanism, developed the oil field water injection terminal filtration equipment, in the concrete work to flow through the filter of fine fiber to the suspended particles in the water and oil and other substances to intercept, block large particles, after a two-stage filter to get clean water. The overall shape of the filter equipment is cylindrical, and the combined filter element can be operated. The filter element can be disassembled at any time, and the filter material can be used again after cleaning, with strong operability [5].

4.3 Process effect

The technology of expanding slurry injection is introduced into practical production, and the obvious effect of reducing pressure and increasing injection is achieved. Through the analysis of the target well, find out the cause of the well owe note, targeted to carry out the reduction of step-down augmented injection technology,

with the use of the technology, the site construction injection pressure on the overall decline in 7 mpa, water injection increases 36 cubic meter a day, normal oil pressure normal stability after water injection, step-down augmented injection effect is obvious, and the failure of increase yield significantly. At the scene of the project, according to the actual circumstances of the oil Wells, selection pressure multistage acid acidification technology of construction, choose according to the actual circumstances of the oil well acidizing measure, when conventional acidification technology cannot change the character, depending on the production performance of oil Wells, demonstration and analysis, in the construction of plugging agent to reduce the overall water injection pressure, injection solution using deep hydrogen acid acidification technique, development efficiency significantly, It has the value of promotion. In addition, through the use of fine filtration technology, the overall efficiency of water injection is improved.

5. Conclusion

To sum up, in combination with the current oil exploitation situation, the application of pressure-reducing and injection increasing technology in oil Wells has achieved very significant effects. Specifically, the technology can be selected according to the actual situation of oil Wells to extend the service cycle of equipment and achieve breakthroughs in oil well exploitation technology. For the industry as a whole, the technology can be scaled up and applied to the entire industry as it achieves the desired benefits in target Wells.

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