

Analysis on causes and countermeasures of abnormal water injection in oilfield Wells

Xiaoyi Jiang

Institute of Geology, No.6 Oil Production Plant, Daqing Oilfield Company Limited, Daqing, Heilongjiang 163000, China

Abstract: In the process of oilfield development, water injection is a very important work content, and the reservoir exploitation quality, efficiency, are closely related. Oilfield water injection technology has been widely applied and popularized, but in the process of specific application, it will also have some influence on the oilfield, such as causing oil layer blockage. The author will focus on the application of oilfield well water injection, analyze the related reasons for the occurrence of anomalies, and put forward solutions to the abnormal phenomena one by one, so as to ensure that the relevant personnel can solve the related problems quickly when applying this technology, and achieve stable oilfield production.

Key words: Oilfield water well; Application; Abnormal cause; countermeasures.

1. Introduction

When exploiting oil field, water injection technology of oil field well has important influence. This technology can supplement energy, balance water injection and oilfield exploitation, and maintain reservoir pressure and restore reservoir pressure after oilfield exploitation. Therefore, the effect of water injection in oilfield water well largely affects the quality of crude oil exploitation. During the exploitation of oilfield, it is necessary to analyze whether there are abnormal problems of water injection in oilfield Wells in real time, clarify the abnormal causes of water injection in oilfield Wells, and effectively and timely solve and deal with the abnormal problems of water injection in oilfield Wells, so as to ensure the smooth development of oilfield exploitation.

2. Petroleum application status in China

In recent years, China's rapid economic development, the demand for oil is increasing, but the oil production is in short supply, almost 70% of the domestic oil is imported oil. The oil production in 2021 is shown in Table 1.

Table 1 Domestic oil production

Domestic oil production	Year-on-year growth	Foreign oil	Cumulative oil consumption
19898 million tons	2.1%	51293 million tons	71191 million tons

In 2021, China imported 51.293 million tons of oil, with a total value of about us \$261.4 billion. China's main oil importers are Saudi Arabia, Russia and Iraq. Table 2 shows the amount and value of imported oil. In 2021, China became the world's largest oil importer, importing about 10.43 million b/d, ranking first in the world for many years.

Table 2 Main oil importers of China

Ranking	Countries	Oil Imports (ten thousand tons)	Value of imported oil (\$100 million)	Proportion of
1	Saudi Arabia	8757	446.23	17.07%
2	Russia	7964	411.01	15.53%
3	Iraq	5708	268.87	11.13%
4	Oman	4482	228.14	8.74%
5	Angola	3916	201.57	7.63%

3. Practical significance of water injection technology in oilfield well

One of the important domestic industrial resources is petroleum, which has a close relationship with China's economic development and has a certain role in promoting it. In recent years, China's industrial development has made rapid progress, and the demand for oil is increasing. Due to the high demand for oil and the impact of the COVID-19 pandemic, the oil supply is in short supply. On this basis, domestic gradually pay attention to oilfield exploration and oilfield development

work, therefore, oilfield well water injection technology application and research, innovation and development, has a certain practical significance.

4. Causes of abnormal water injection in oilfield Wells

4.1 Administrative reasons

In the process of oilfield exploitation, some problems in production management will affect oilfield water injection. When management is abnormal, pump pressure can be extremely unstable, and water quality and well flushing quality can be poor. Among them, when the pump pressure is unstable, the pump generally stops running suddenly, or opens itself when there is no artificial opening, which affects the water injection speed and leads to uneven water injection speed. However, when the water quality is poor, the water quality will contain a lot of impurities, which will block the nozzle of water distributor, resulting in abnormal water injection speed and water volume of oilfield and well. At this point, if the permeability of the oil layer is poor, the impurities in the water basically cannot pass through the cracks in the rock layer, blocking the rock layer and reducing its permeability again. At the same time, the water pressure of the oil and water injection will increase [1]. Low well washing quality is generally manifested in poor well washing effect, or low well washing pressure, which makes the impurities at the bottom of the water injection well cannot be really discharged, resulting in blockage.

4.2 Equipment

Because the exploitation of oilfield needs to be applied to more equipment, therefore, equipment problems, will also affect the effect of oilfield water injection. Water injection generally requires pressure gauge, the use of pressure gauge, accurate detection of oilfield water injection pressure, in order to effectively control water volume. However, the pressure gauge is extremely susceptible to the influence of the surrounding environment, resulting in abnormal operation of related functions, and there is a certain uncertainty for the overall water quality.

4.3 The geological reasons

In the process of oilfield production, the parameters of oil well will change to some extent, and the pressure well will have a certain influence on the pressure, resulting in the imbalance between oilfield water injection and oilfield production, resulting in more water injection. In addition, because the geology of the reservoir contains clays and minerals, if the reservoir is affected by water injection from the field or water well, it can move or spread, which can clog, reduce permeability and increase water injection pressure.

5. Oilfield well water injection treatment countermeasures

5.1 To master the plugging mechanism of oilfield water injection reservoir

5.1.1 The clay swelling

There is usually clay interlayer in sandstone oil layer, and some clay also exists in rock cement. Clay swelling will affect injection well technology to a certain extent. In general, clay swelling is more likely to occur when injected with fresh water than salt water, but clay swelling is less likely to occur when injected with normal surface water.

5.1.2 Sediment

During water injection, there will be low iron content in water injection source, purification source water station and outlet of water injection station. However, iron content increases when the pipe reaches the bottom of the injection well, which indicates that the injected water corrodes the pipe and the wall [2]. In addition, when the injected water contains bacteria, it can also react with the iron, corroding the pipeline.

5.1.3 Bacteria

If the bacteria in the water will affect the water injection system and have a negative impact on the formation. At the same time, there are too many bacteria in the water, which can multiply and clog the oil layer. Injection water and bacteria into the oil layer at the same time, bacteria will multiply in the oil layer, its metabolites will make the oil layer blocked seriously. This phenomenon can occur both on the well wall and near the well.

By understanding the cause and mechanism of water injection blockage in oilfield Wells, the staff can effectively avoid the blockage problem. By preventing the blockage problem in advance, the overall normal operation of water injection in oilfield Wells can be ensured, the work efficiency and quality of water injection in oilfield Wells can be improved, and other related links of oilfield exploitation can be orderly carried out.

5.2 Improve oilfield production management

First of all, regarding the phenomenon of unstable pump pressure, it is necessary to pay attention to whether the cooperation between various departments is tacit and coordinated. Then, when water injection is carried out in oilfield and water well, the pump should be stopped or started uniformly to effectively prevent the phenomenon of stopping or backpumping [3]. In addition, the staff should pay attention to the change of pump pressure in real time and check whether the pump pressure is within the standard value range from time to time to ensure the normal pump pressure and the normal implementation of water injection in oilfield and water well.

Secondly, in view of the abnormal causes of poor injection water quality, the staff can strictly control the water quality to ensure the quality of oilfield water injection. At the same time, it is necessary to carry out strict water quality test management, set specific time to test the water quality of oilfield Wells, so as to meet the relevant requirements of oilfield Wells.

Finally, in view of poor well washing quality, it is necessary to ensure that the technical level and professional ability of the staff meet the standards. Regularly organize and carry out training activities or assessment, strengthen the sense of responsibility of the staff, urge them to continuously improve their technical level, and ensure the smooth progress of oilfield and water injection work. In addition, the well washing work is supervised, a special supervision group is set up, the responsibility system is implemented, the division of labor is clear, the supervision is standardized, through the supervision of the well washing work is in place, so as to ensure that the quality of the well washing is up to standard.

5.3 Pay attention to oilfield production equipment maintenance

In order to effectively ensure the normal operation of all instruments or instruments in oilfield exploitation, accurate numerical values and integrity of ground pipelines, it is necessary to constantly strengthen equipment maintenance and management. If during the operation of the equipment, the staff finds fault with the equipment, they should repair the equipment in time. If the equipment cannot be repaired again, they should directly replace the new equipment to ensure the normal operation of the equipment to ensure the quality of water injection in oil fields and Wells. If the staff finds that the pipeline is damaged when checking the ground pipeline, they should wrap the pipeline with insulating tape in time or replace the pipeline to ensure the integrity of the pipeline and ensure the safety of personnel. If the downhole tool is found to be failing, it is necessary to test the tool to know the current status of the tool and determine whether the tool is failing. For the failed downhole tool, it should be replaced in time.

5.4 Master oilfield geology

In the oil field exploitation, the staff needs to have a comprehensive knowledge of the oil field geology. When the stratum dynamic changes, it is because the pressure in the bottom decreases that the water injection volume in oilfield Wells increases. When such situation is found, the staff should first collect relevant geological data, analyze geological parameters and data, and put forward relevant solutions to ensure the work quality of oilfield water injection [4]. If the clay and minerals move in the formation and block the soil space, technical preventive measures should be taken. Before water injection in oilfield Wells, anti-swelling agent solution should be added to effectively protect the oil layer and ensure the stability of water injection in oilfield Wells.

5.5 Introduce advanced technology to deal with high water cut period actively

At present, all walks of life introduce advanced technology to promote technological development. Therefore, the oilfield water well water injection technology should also continue to absorb advanced technology, enhance the technical level, promote the development of oilfield water well water injection technology, to ensure the quality of oilfield exploitation. It can strengthen oilfield well related detection technology, quickly detect oilfield well water injection abnormal problems, speed up the staff to solve oilfield well water injection abnormal problems, and promote the long-term development of oilfield. At the same time, related monitoring technology can also be introduced to monitor the status quo of water injection in oilfield and well in real time to ensure its normal operation.

In high water cut period, traditional strong production and strong irrigation should be avoided. If you want to improve the efficiency of oilfield water injection, it is necessary to strengthen reservoir management technology, use this technology to increase the amount of oil development and effectively improve the economic benefits of enterprises [5]. It should be noted that when applying this technology, the staff should formulate specific development plans in advance to ensure that the implementation period is supported, the implementation direction is clear, and relevant problems are dealt with efficiently. Secondly, the tacit understanding between the staff should also be strengthened, so that each staff give full play to their respective roles, stimulate staff enthusiasm, improve the overall work efficiency. In addition, the oil work needs to establish information transmission system, through the collection of relevant information data, real-time detection of oilfield water injection operation is normal, to ensure the quality of oilfield exploitation.

5.6 Strengthen the post consciousness of oilfield well water injection staff

In the process of oilfield water injection, besides paying attention to the technical level and professional ability of the staff, it is also necessary to pay attention to the cultivation of the staff's post consciousness, improve the staff's sense of responsibility, improve the staff's personal literacy level, so as to ensure that the oilfield water injection work is carried out reasonably and effectively, and the quality is effectively guaranteed. When recruiting new employees, relevant departments should pay attention to whether they have good quality. The recruited personnel should set a reasonable internship period, observe the practical ability, job responsibility awareness and personal quality level of new employees, and conduct final assessment before becoming regular employees, so as to ensure that the strength and moral quality of new employees pass the test. In addition, regular assessment should also be carried out on the sense of responsibility of relevant posts of senior employees. The assessment contents can include: 1) Recent implementation of relevant work; 2) Comprehensive evaluation of daily work attitude; 3) Whether the work progress is within the

requirements; 4) Whether the technology is up to standard, etc. Through these two ways, the quality of oilfield well water injection staff is well controlled, so as to effectively promote the oilfield well water injection work, ensure the quality of oilfield well water injection work, and achieve the goal of oilfield stable production.

6. Conclusion

Abnormal oil field water injection well causes more, to ensure the normal order of the oil field water injection well carried out, and the quality guarantee, you will need to make effective solutions to the problems in time, strict control of oilfield water injection well management, related equipment maintenance and related geological conditions of information, to avoid unable to solve the problem of oilfield water injection well anomalies, influence the work progress and quality.

References

1. HAN Yaotu, ZHANG Qilong, LI Jin, et al. Oil casing pressure analysis of water injection well in bohail oilfield [J]. Petroleum machinery, 2020,48(7):7.
2. Zong Tingtao. China petroleum & chemical standard & quality,2020,40(20):3.
3. Zhao Junge. Chemical Engineering and Equipment, 2020,000(1):2.
4. HUO Guodong, Yang Wu, XU Bo, et al. Research and application of acid plugging technology in Jingan Oilfield, Changqing [J].2022,000 (20).2
5. Meng Xianghai, XIA Guang, ZHAO Peng, et al. Petroleum geology and engineering, 2020,34(1):3.