

# Research on Comprehensive Treatment Technology of Casing Returning Well in XM Oilfield

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## Abstract

**With the continuous deepening of waterflooding development of oilfields, some old oilfields have experienced casing leakage, and the workload of casing return treatment has been increasing, which has caused the contradiction between safety and environmental protection risks and production and development to become increasingly prominent. Based on the understanding of the root causes of casing return in oil and water wells in XM Oilfield, this paper analyzes and studies the detection technology of casing return leakage, and develops the treatment technology of different types of leaked wells, and proposes the prevention technology of oil-water casing return to provide technical support for safe and stable oilfield production.**

## Keywords

**Oil and water wells, casing damage, diagnosis, treatment.**

## 1. Introduction

The casing return phenomenon of oil and water wells refers to a series of reasons such as loss of casing due to corrosion, loosening of casing threads, unqualified cementing quality, plugging wells, and failure of abandoned wells due to corrosion during oilfield development. Sewage with impurities such as mud and rock cuttings returns to the ground through the gap between the casing of the oil well or water well and the well wall [1-2]. Since the water injection development of Jilin Oilfield in 1973, due to special complex geological conditions and long-term water injection development, the casing deformation phenomenon has been serious. The casing deformation rate in the whole area is as high as 22%, and it is increasing at a rate of more than 100 wells every year [3]. The wellbore is aging and leaking, threatening the surrounding environment [4]. Among them, the loss of casing returning to the well has caused great safety and environmental protection hazards. In recent years, casing corrosion and perforation have shown a concentrated outbreak, which has seriously affected the sustainable development of the oilfield. For the treatment of leaky wells, the packer blocking technology was used in the early oilfields, but this method has drawbacks, such as the blocking effect is not obvious, the layered water injection process is complicated, etc., and its time effect is short, and the symptoms are not cured[5] Therefore, it is urgent to form a set of comprehensive adjustment technology in order to quickly and accurately deal with the current casing damage problem in the oil field. Therefore, it is necessary to analyze the causes of casing return, apply scientific diagnosis methods, and accurately find out the source and leakage point of casing return; on this basis, adopt flexible treatment technology to quickly and thoroughly cure casing return; Effective preventive measures, controlling the occurrence of casing return, and forming an effective comprehensive treatment strategy for casing return are the core of the current research on casing return technology.

## 2. Set back-to-source diagnosis

The casing return power comes from the water injection well. The casing return of oil wells, open hole well casing return, earth return, etc. are all the results of the release of energy from the formation. Necessary conditions [6].

(1) Dynamic analysis method to judge the casing return of first-line oil and water wells

The main body of casing return in oil wells is divided into two aspects. One is the casing return of the well, which is manifested by the moving liquid level at the wellhead, and the casing return volume is reduced when the casing gate is opened; the casing returns when the liquid level returns to the wellhead under abnormal conditions of the oil well; The casing is obviously broken and returned with high liquid level; mud or mudstone block has been returned with high liquid level seriously. The second is the return of the external water jacket, which is manifested as the moving liquid level is not at the wellhead and there is no power source for the return of the jacket.

The main body of casing return in water wells is also divided into two aspects. One is the casing return in this well, which is manifested as casing return after casing pressure and water injection pressure drops; with casing pressure, the injection-production relationship is not effective; injection pressure of water injection wells with casing pressure Long-term low. The second is the return of external water jacket, the cementing quality is qualified, and there is no casing pressure at the wellhead.

Take the well M65 as an example (Figure 1). The well was nested in May 2016. The diagnosis step is that the water injection pressure of the well dropped from 14.5MPa to 14.0MPa; the well uses a compression packer and the casing pressure is 13.8Mpa ; When the casing gate is opened to relieve the pressure, the amount of fluid returning outside the casing is reduced; the return material of this well is mainly water before the injection is stopped, and the oil is returned after the injection is stopped. To sum up the diagnosis results: the casing leaks and returns water.

Take oil well M65 as an example (Figure 2). The well was nested in December 2020. The diagnosis step is that the well was nested, the working fluid level is 938 meters, the line water well has no pressure drop, and the return is clean water. The diagnosis result is This well is not a casing return.



Figure 1 Case leakage point in M63 well      Figure 2 Case leakage phenomenon in M65 well

(2) Isotope finding

Isotope leak finding is to judge the location of the leak point by the change of the amplitude value before and after the isotope (Figure 4). The curve measured before the isotope has a small amplitude value, and the curve measured after the isotope has a large amplitude value and there is channeling. Similar to this is the sound amplitude curve leak finding technology (Figure 5). A large amount of sound energy is absorbed by the cement ring formation after cementing, and the measured curve amplitude is low; the cementing is not good, the channeling is not good, and the cementing quality is not good. The sound energy cannot be absorbed by the cement ring stratum or very little, and the curve amplitude is high.

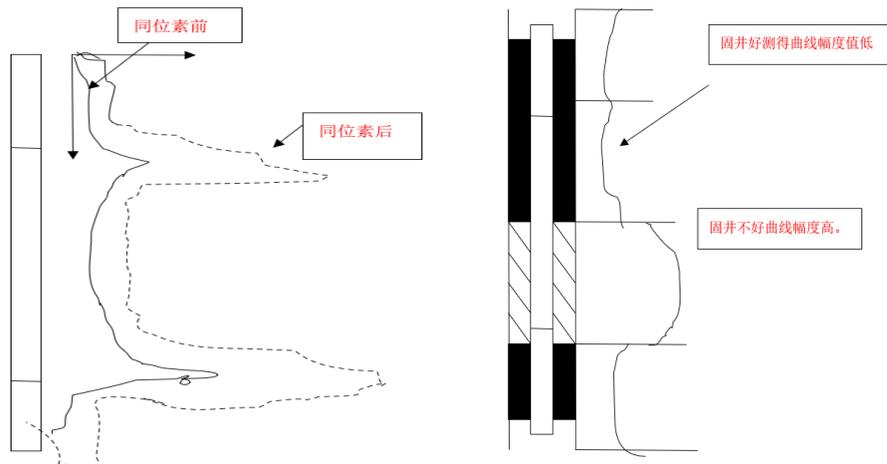


Figure 4 Leakage finding curve for isotope Figure 5 Leakage finding curve for sound amplitude

### 3. Comprehensive treatment technology for casing return well

#### (1) Technology of exchanging sets

Conventional overhaul and replacement of casing treatment includes conventional pressure-resistant casing perforated well overhaul and replacement of casing. Before drilling and overhauling the casing, the casing should be straightened first, and high-pressure oil wells and water injection wells should be replaced by blowout-proof plugging well overhaul. [ 7]. Where the casing leakage point is above 200m, the method of replacing the casing shall be adopted. The specific methods are as follows: one is to mill the cement ring and part of the rock around the casing; the other is to remove the casing damage point and the appropriate parts above the casing by cutting or inverting; The connector is repaired and the damaged casing is replaced; the fourth is to re-inject cement outside the casing to cement the well. From 2016 to 2020, the technology was used to treat 42 wells with casing return, and 31 wells with casings were replaced (Figure 6).

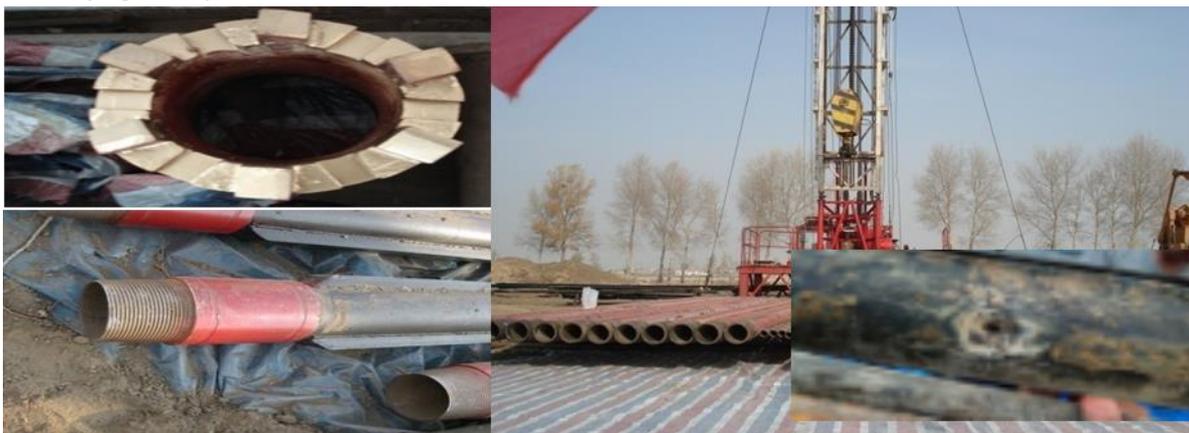


Figure 6 Schematic diagram of the oilfield sleeve replacement process

#### (2) Cement plugging technology

Deep casing leaks, overhauling the casing operation capacity is not available or the upper stratum collapses and casing milling is unable to operate the well. For wells with serious mud return, test high-strength plugging agents to improve the success rate of treatment. The specific method is to squeeze the cement slurry into the leak-breaking casing, leave a certain length of cement plug in the casing, and then drill through after setting, and the pressure test meets the requirements.

Take the M27 well as an example. From May to June 2020, it was overhauled and scraped to 877 meters. The sleeve inspection confirmed that the pressure could not be stopped between 127.13 meters and 128.13 meters, and it was confirmed that there was a leak. Try to squeeze 7 squares of clean water, return the water to the ground, continue to wash the well 3 squares to clean the channel, pour 7 squares of cement, return the cement to the ground, pour 1.2 cubic meters of replacement liquid, and leave a 27-meter cement plug at 100 meters from the cement surface. After 48 hours of setting, the plug was swept 29 meters, and the pressure test failed. Re-cement the well and drive in 3.4 cubic meters of cement, wait for 48 hours, and sweep through the plug after 27 meters. The pressure test is qualified, and the well is passed and completed (Figure 7).



Figure 7 The principle of cement plugging in the M27 water well and the construction site (3) Expansion tube subsidy technology

This technology is mainly aimed at casing wells with surface casings, deep casing leaks, and stratum collapse that cannot be used to line the casing inside the casing, plugging the casing leakage and sealing and strengthening the casing. The specific method is to reasonably select the combination of tools and drilling tools to make the channel; use the tubing to lower the expansion tubing string to the well section that needs subsidy repair; press the tubing on the ground surface, and the expansion cone pushes the tubing and tubing upward together. When the expansion cone moves upwards When the length of the expansion pipe string is exceeded, the expansion pipe completes the subsidy (Figure 8).

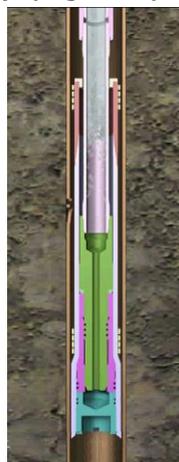


Figure 8 Expansion tube subsidy technology

Taking the M1 oil well as an example, during the overhaul operation from August to September 2018, first the sleeve inspection confirmed that the pressure could not be stopped between 468 meters and 470.23 meters, and it was confirmed that there was a leak. The lower scraper

repeatedly scrapes at the position of 460 meters-480 meters. After the subsidy tool, the subsidy tube is subsidized, the upper card point is 466.7 meters, and the lower card point is 473.9 meters. The total length of the subsidy pipe is 7.2 meters and the inner diameter is 101mm.

#### 4. Oil-water jacket return prevention technology

##### (1) Analysis of the reasons for the setback

Based on the above research, there are three main reasons for the analysis of the casing return in the whole area. The first is that the casing return is caused by external water, which mainly occurs in open hole wells and dead wells that have been sealed. The process is complicated, and the treatment method is multi-well treatment; the second is that the pressure in the well causes casing return, which mainly occurs in water injection wells and high-pressure oil wells where the casing is damaged. Meters above), the treatment method for this is: take-out treatment; third, the trapping pressure of the surface layer causes the casing return, which mainly occurs in new wells. The characteristic is that the returned material is clean water, the casing return time is short, and the treatment method is external plugging.

##### (2) Preventive measures against return

The comprehensive treatment of casing return is based on the principle of prevention first and prevention and control combined. A series of measures have been taken in the process of production adjustment and water injection development of old oilfields to prevent the occurrence of casing return as much as possible. The following preventive measures have been taken:

1) In terms of new wells: 230-meter casing for new wells, seal the third and fourth water systems to improve cementing quality; improve the casing strength, use P110 casing below the a/b limit, and use N80 casing above the limit; cement reversion Go to the ground to prevent the upper casing from leaking due to corrosion.

2) Water injection: adjust and formulate reasonable injection and production pressures to reduce casing pressure and extend service life; implement subdivided water injection, implement layered water injection plans in time, adjust water absorption profile, and balance water injection intensity

#### 5. Conclusion

(1) The current casing damage source diagnosis method in the oil field is mainly the dynamic analysis method, which can quickly and effectively determine the casing damage status of oil and water wells, but it is not possible to find leaks, and the isotope leak finding technology can clarify the location of the leaks;

(2) The comprehensive treatment technologies for casing return wells mainly adopted in the whole area include replacement casing technology, cement plugging technology and expansion pipe subsidy technology, and the application effect in the whole area is good.

(3) During the treatment of casing damage wells, the idea of "prevention first, combined prevention and control" should be adopted to prevent the occurrence of casing return as much as possible, and comprehensive supervision covers the whole process of oil and water well drilling, production and development.

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