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# Research and Application of Low Frequency and High Amplitude Depressurization Technology in Yi 59 Block

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**Abstract:** Yi 59 block as the main block of Changchun, With the deepening of water injection development, Unstable water quality, measure, Influence of factors such as operation, increase in cumulative amount, Water injection pressure increased year by year, High pressure under injection problem increasingly significant, 19-year injection-production ratio drops to 1, Seriously restricting block development, Urgent governance. This article from the reservoir physical properties—source control—Start with daily management, the mechanism of reservoir blockage is analyzed, Preliminary demonstration of low frequency high amplitude depressurization injection enhancement technology, indoor evaluation, Field Application and Parameter Optimization, Effective management of under-injection wells, Achieved block smooth water injection, Great application prospect.

**Keywords:** Owed injection wells; Reservoir pollution; Low frequency high amplitude.

## 1. Introduction

Yi 59 block as the main block of Changchun, Started water injection development in 2013, 82 water injection wells opened so far, Daily water injection demand 1243 square, Due to poor reservoir properties in this block, Water sensitive, speed sensitive characteristics, As the cumulative injection increases, Water injection pressure increased year by year(chart 1), High pressure injection wells increasing year by year(chart2), The problem of underpricing is increasingly significant(chart1), 23 under-injection wells by 2019, 28 % of wells drilled%, Daily influence water injection volume 184 square; Among them, 13 reservoir pollution blocking under-injection wells, 57 per cent%(chart2); Urgent need to explore countermeasures, Reduce the impact of under-invoicing, Meeting geological water injection requirements.

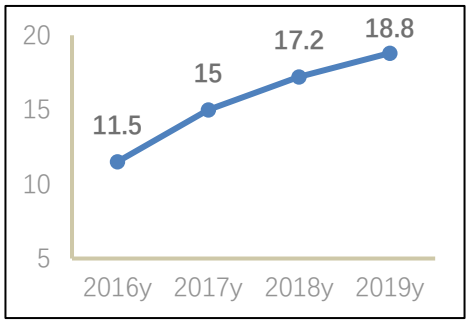



**Figure 1**. Annual variation trend of water injection pressure

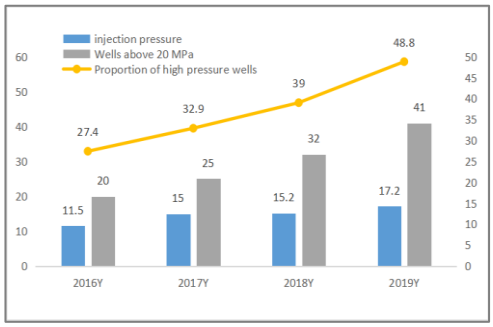



**Figure2.** Trend of High-Pressure Wells

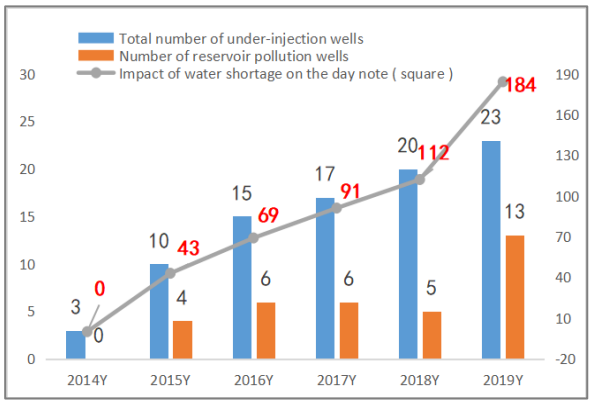



**Figure 3.** The proportion of under injection wells caused by reservoir pollution

This paper for reservoir pollution blocking class under-injection wells, targeted technical research carried out, Analysis by blocking mechanism, Pre-technical demonstration, greenhouse test, Field Application and Parameter Optimization, Effective Treatment of Reservoir Pollution Blocking Under-Injection Wells, Achieved block smooth water injection.

## 2. Analysis of blocking mechanism

From reservoir physical properties—source control—Daily management analysis, Reservoir pollution blockage mainly includes five categories :

(1) Reservoir porosity of Yi 59 block, Permeability general, strong reservoir heterogeneity, the average total amount of reservoir clay minerals is 8.8 %, Kinds of kaolinite, I / Mont mixed layer dominated, Strong water sensitivity and medium velocity sensitivity of reservoir, clay easy to expand and block;

(2) Oil well transfer is not pretreated, in the long-term oil production process near the wellbore area to accumulate resin, asphalt caused by blockage;

(3) Direct water injection without drainage after fracturing, plugging formed by accumulation of fracturing fluid residue;

(4) Suspended matter and oil in injected water enter the formation to block pore channels and cannot be injected;

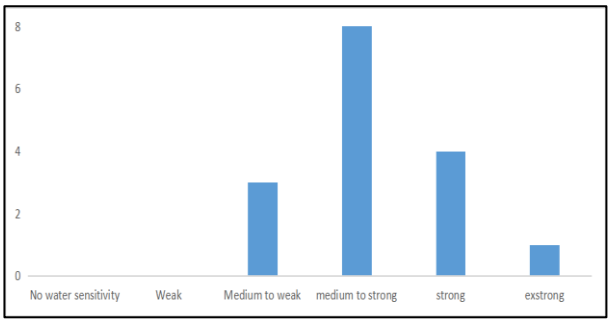



**Figure 4.** Water sensitivity evaluation

(5) The injection water quality is mixed and the corrosion is unqualified and incompatible, resulting in the corrosion products entering the formation to block the pore channel, resulting in a decrease in permeability, resulting in under injection and injection.

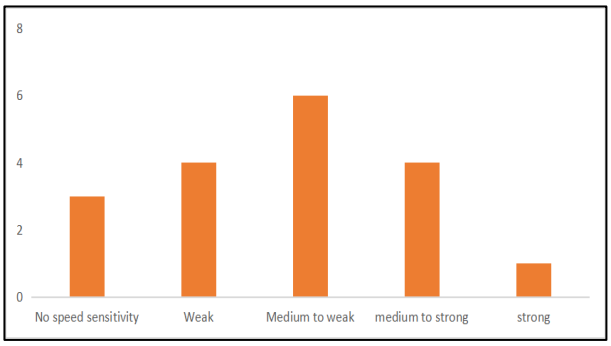



**Figure 5.** block speed sensitive evaluation

**Table 1.** Blockage composition analysis data sheet (wt %)

| well | CaCO3 | Fe2O3 | FeCO3 | FeO | FeS | SiO2 |
|---|---|---|---|---|---|---|
| ****1 | 30.2 | 0.02 | 4.6 | 16.39 | 45.09 | 3.7 |
| ****2 | 8.67 | 9.8 | 23.61 | 3.13 | 51.96 | 2.83 |

After comprehensive analysis of the blockage, we have clarified the technical idea of reducing pressure and increasing injection with descaling, oil removal and shrinkage and expansion as the main body, and carried out indoor evaluation and field test on the technology.

## 3. Low frequency high amplitude depressurization injection technology

(1) engineering philosophy

The technology uses low frequency high amplitude vibrator, Using Thousand Type Pump Variable Displacement Pumping Neutral Plugging Scale Inhibitor Permeability Removing Agent. Simultaneous physical vibration of the fouling injection layer. Plugging agent to play a role through high displacement (HQ) high pressure (HP) construction technology, Uniform distribution of plugging removal fluid to produce plugging removal effect, recovery and improvement of near wellbore conductivity.

(2) Indoor experimental evaluation

Through a series of evaluation experiments such as indoor scale dissolution and washing oil, the pharmaceutical ratio was optimized: 10 % composite acid + 5 % descaling agent + 2 % viscosity reducing oil washing agent + 1 % bactericide + 2 % swelling agent, As a working fluid。 The scale dissolving rate of working solution is 91.8 %, and the washing oil rate is 99.3 %.

**Table 2.** Scale dissolving experiment table of working solution (normal temperature and pressure, Y59-*-*scale sample)

| formula | 1# | 2# | 3# | 4# | 5# |
|---|---|---|---|---|---|
| compound acid, % | 5 | 5 | 10 | 10 | 15 |
| detergent% | 2 | 2 | 5 | 5 | 10 |
| )sity reducing oil washing ag | 1 | 2 | 1 | 2 | 2 |
| germicide% | 1 | 1 | 1 | 1 | 1 |
| swelled clay shrinkage agent | 2 | 2 | 2 | 2 | 2 |
| TIME, min | 360 | 360 | 360 | 360 | 360 |
| scale dissolution rate, % | 75. 6 | 78. 2 | 89. 6 | 91. 8 | 91. 9 |



**Figure 6.** Comparison of Wash Oil Experiments (Saturated oil sands, 80°C)

## 4. Field Test and Parameter Optimization

(1) pre-experiments

Well selection principle: reservoir physical properties, connectivity is good, the initial injection pressure is low, cumulative injection time is long, there are blocking factors in the injection process, the current day less than 5 parties;

Test well selection: typical well 1, the well is injected with CO2 for a long time before injection, it is judged that there is a problem of heavy component retention, resulting in rapid increase of oil pressure after water injection, and a long time in a state of suspension and under injection.

Construction parameters: initial design processing radius 2m (vibration frequency: 20-40Hz, amplitude: 3-10MPa, working fluid Q = πr 2 hφ, 48m2).

Construction effect: the implementation of low frequency and high amplitude depressurization injection technology, oil pressure drops 13 MPa, recovery day water injection 17, to meet the injection allocation, proved that the technology is effective, can further carry out field test.

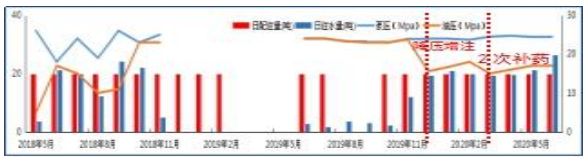



**Figure 7.** Typical well 1 water injection production curve

(2) parameter optimization

Processing radius optimization: typical well 1 well in the test after 3 months, the oil pressure rises, 2 dosing, (working fluid 15 square processing radius of 1.5 m), the second treatment effect is obvious, the effective time is long, so adjust the processing radius of 3.5 meters.

Optimization of chemical formula in different regions: During the promotion process, the injection pressure of the typical well 2 rose rapidly after construction, and the pressure was flat in the later stage, through analysis and comparison, there is a great difference in clay mineral content between Yi 45 well area and Yi 59 well area, which is presumed to be the influence of clay mineral expansion. Consideration of Shrinkage in Depressurization Injection Process。 Therefore, the concentration of the expansion agent in the typical well 2

was adjusted from 2 % to 5 %, and the secondary dosing comparison test was carried out. The experimental results showed that the effect was significantly improved after increasing the amount of the expansion agent. Therefore, the concentration of the expansion agent in the water well agent system of the Yi 45 well area in the Yi 59 block was adjusted to 5 %.

**Table 3.** Basic data table of 3 wells reservoir

| well | primitive penetrance（%） | reservoir thickness（m） | Fracturing layer thickness（m） | Accumulated mining（cube） | Accumulation（cube） |
|---|---|---|---|---|---|
| ****3 | 5.6 | 32.8 | 32.8 | | 17075 |
| ****5 | 6.3 | 36.6 | 28.6 | | 10036 |
| ****7 | 5.8 | 43.4 | 34.8 | 1026 | 18181 |

**Table 4.** Total amount of clay minerals in 2 wells

| well | Sample depth1 | depth2 | horizon | mixed-layer illite（I/S） | illite（IT） | kaolinite（K） | chlorite（C） | （I/S）ratio of mixed-layer（%S） |
|---|---|---|---|---|---|---|---|---|
| ****3 | 2481.78 | 2485.46 | S2I6 | 36 | 3.7 | 39.7 | 20.7 | 25 |
| | 2616.26 | 2620.66 | S2I6 | 29.4 | 2.9 | 59.9 | 7.9 | 20.3 |
| | 2668.61 | 2661.62 | S2II4 | 26.5 | 2.8 | 52.3 | 18.5 | 22.5 |
| | 2709.92 | 2720.16 | S2II6 | 35.5 | 2.6 | 47.6 | 14.3 | 23.5 |
| ****4 | 2314.92 | 2321.68 | S2I1 | 43.2 | 3 | 39.5 | 14.4 | 29.5 |
| | 2334.48 | 2340.64 | S2I2 | 37.9 | 3.3 | 43.5 | 15.4 | 30 |
| | 2417.45 | 2426.74 | S2I6 | 39.9 | 2.7 | 38.3 | 19.2 | 30 |
| | 2607.65 | 2622.82 | S2II2 | 30.2 | 2.5 | 56.1 | 11.2 | 29.7 |
| | 2684.16 | 2688.89 | S2II4 | 37 | 2.8 | 45.4 | 14.8 | 29.4 |

(3) application effect

Up to now, a total of 10 wells have been tested in Block 59, with an average daily injection increase of 107.6 cubic meters and cumulative injection increase of 36564 cubic meters. The effect of pressure reduction and injection increase is obvious.

**Table 5.** Statistical table of low frequency high amplitude depressurization effect

| nuber | well | time | before | | before | | total days | Effective days |
|---|---|---|---|---|---|---|---|---|
| | | | oil pressure（Mpa） | daily water injection rate/t | oil pressure（Mpa） | daily water injection rate/t | | |
| 1 | ****1 | 2019.12.03 | 25 | 3 | 12 | 20 | 494 | 453 |
| 2 | ****2 | 2020.04.09 | 25 | 8 | 7.5 | 13 | 528 | 519 |
| 3 | ****3 | 2020.04.15 | 25 | 4 | 11.3 | 13 | 661 | 629 |
| 4 | ****4 | 2020.04.16 | 25 | 8 | 3.2 | 14 | 558 | 549 |
| 5 | ****5 | 2020.10.11 | 25 | 0 | 14.8 | 15 | 438 | 409 |
| 6 | ****6 | 2020.10.13 | 25 | 3 | 11.7 | 19 | 449 | 445 |
| 7 | ****7 | 2020.10.13 | 25 | 3 | 21.7 | 12 | 338 | 275 |
| 8 | ****8 | 2021.09.29 | 25 | 2 | 16.7 | 12 | 134 | 133 |
| 9 | ****9 | 2021.09.29 | 25 | 1 | 16.9 | 13 | 130 | 130 |
| 10 | ****10 | 2021.10.01 | 25 | 9 | 15.3 | 14 | 131 | 131 |
| total | | | 25 | 41 | 13.1 | 14.5 | 386.1 | 367.3 |

# 5. Conclusion

Low Frequency and High Amplitude Depressurization Injection Technology for Effective Treatment of Reservoir Polluted Under-injection Wells in Block Y59; Effectively reduce the impact of under-injection wells, improve water injection task completion rate of 0.5 %, The injection-production ratio is improved by 0.06, and the natural decline of the block is slowed down by 0.4 %. At the same time, the guidance of stable water injection is formed, which provides a reference for curbing the risk of under-injection wells and realizing stable water injection in the block.

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