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Tracer monitoring in HongHe density test of horizontal Wells in low permeability oilfield application

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Abstract

To improve supporting spatial-temporal dense reservoir horizontal well staged fracturing technology, to solve the HongHe oil field production decline such problems as low fast, stable, clear out of the water layer, by tracer monitoring technology at home and abroad research, optimizing tracer types, open display fluid monitoring field test and tracer monitoring result analysis, clear different interval after fracturing and pressure liquid producing capacity, the tracer test and analysis results with the results of the analysis of single well fracturing effect, the combination of production determine the main controlling factors, using the analysis results to guide fracturing design optimization, promotion of value.

Keywords

HongHe oil field; Long 8 reservoir; Horizontal well; tracer.

1. Introduction

Based on the analysis of crude oil enrichment regularity of Chang 8 reservoir in Zhenjing block and the analysis of fracturing effect of horizontal well in Honghe Oilfield [1-2] , the degree of natural fracture development is the main controlling factor for the production of Chang 8 reservoir in Honghe oilfield, how to effectively communicate more natural fractures and avoid destroying natural fractures is the key to realize high and stable production. The porosity of Honghe oilfield is 7% —17.2% , the average porosity is 11.5% , the permeability is 0.10—1.310-3 m 2, the average permeability is 0.4510-3 m 2, the Chang 8 reservoir belongs to low porosity and ultra-low permeability sandstone reservoir, the regional natural fractures are developed, the plane heterogeneity is strong, in the early stage, the horizontal well section fracturing is used, and a great breakthrough has been made to realize the production of reserves, but only part of the wells have high production after pressure, and the stable production effect is good, and most of the wells show low initial production and fast decline speed, characteristics of high water cut oil field.

Choose of the 421 horizontal wells, 331 open wells, 718.05 t/d, 10.34 m3/d, 2.33 t/d, and 78.22% water in Red River oilfield. There are 157 horizontal wells with daily oil production less than 1 T, 104 wells with daily oil production of 1 ~ 3 T, 31 wells with daily oil production of 3 ~ 5 T, and those with daily oil production less than 5 t account for 88.21% of the total number of open wells There are 76 horizontal wells with water content of 60% ~ 80% , 46 wells with water content of 80% ~ 90% , 109 wells with water content of more than 90% , and 69.79% wells with water content of more than 60% . The statistical results show that most horizontal wells in Red River oilfield are characterized by low oil production and high water cut, which seriously affects the overall development effect of horizontal wells.

2. Research on tracer monitoring technology at home and abroad.

According to research at home and abroad, currently relatively mature tracer monitoring technology, there are two main types:

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(1) Tracer ceramic proppants (including Radioactive tracer and non-Radioactive tracer, in this case non-Radioactive tracer) , the technology is to add non-radioactive Marker material to each proppant particle in the production process, up to more than 20 markers can be used for 20 horizontal well monitoring. The technique can detect the presence of proppant near the Wellbore, the spread width of proppant near the horizontal Wellbore, etc. . The detection radius can reach 0.3-0.5 M. This technique requires neutron logging as the baseline before fracturing operation.

(2) Liquid indicator, which is designed for different reservoirs in a stratified, segmented fracturing process, different kinds and different amounts of liquid indicators (YTJ series indicators) were selected to separate, analyze, purify and process the liquid indicators with the flow in and out of the reservoir and the information of the reservoir, the related reservoir information, such as productivity (contribution rate) , productivity status and drainage status, can be obtained. At present, this technology can be used to monitor up to 12 horizontal wells.

Table 1 Comparison of two tracer monitoring processes

Monitoring Reagent	advantages	disadvantages
Tracer proppant	①Monitoring proppant distribution near wellbore ②judge the fracture shape and the starting position	It is impossible to judge the production capacity of each layer directly Neutron logging is required as the baseline before testing
Liquid indicator	judge the production capacity of each layer in different time Make sure the discharge rate of each layer after pressing	It is impossible to judge the distribution of fractures in horizontal wells

Comparing the advantages and disadvantages of the two tracer monitoring techniques, combining with the current horizontal well cementing and fracturing techniques in compact reservoirs in south Hubei, under the condition that the cementing quality is guaranteed, the location of fracture initiation and the distribution of fracture in horizontal wellbore are obvious. It is of little significance to monitor the location of fracture initiation. At present, the problem is that there is no obvious liquid discharge capacity in each section after pressure and the liquid production capacity in different layers should be monitored. Therefore, the liquid indicator is optimized to carry out the production monitoring test of each zone in horizontal well [6] , in order to ascertain the fluid production capacity of each zone after fracturing, and to provide a basis for the optimization of subsequent fracturing design and the optimization of the drainage system.

3. Performance and technical index of liquid indicator

3.1. Performance and technical index of liquid indicator

The YTJ series of liquid indicators used to track and monitor the effect of oil and gas well layering (section) reconstruction have the following properties:

(1) non-toxic, non-radiation, no pollution to the formation, no harm, safety and environmental protection;

(2) highly concentrated liquid with less amount used, the field operation is convenient, the mixture with the fracturing fluid has the high compatibility, has no influence on the performance of the fracturing fluid (see figure 5-1, figure 5-2) ;

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(3) the thermal stability is good, the chemical stability is good, the acid, the alkali resistance, the oxidation resistance, the formation adsorption is little (≤5%) ;

(4) no chemical reaction, precipitation or isotope exchange with the reservoir fluid;

(5) anti-interference, compatibility is good, indicators do not affect each other, easy to identify and distinguish, monitoring sensitivity is high, operation is simple, convenient and time-consuming;

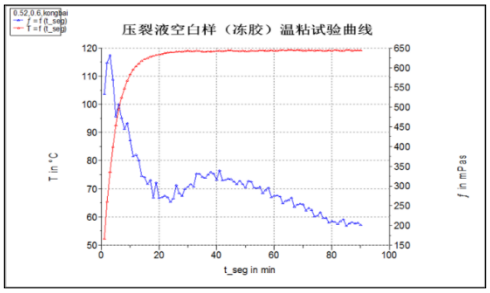

Fig. 1 Viscosity-temperature curve of blank sample (GEL)

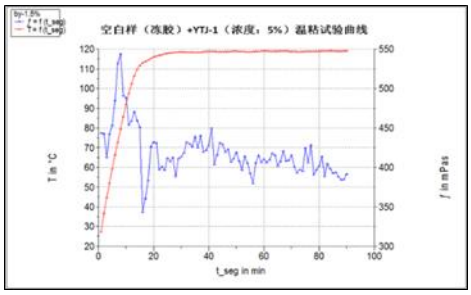

Fig. 2 Viscosity-temperature curve of blank sample + YTJ-1(5%)

3.2. Technical specifications for liquid indicators

(1) Heat resistance: 200OC;

(2) Shear Resistance: 60-90min at 120-153 °C, 170S-1 rate, and apparent viscosity at 100mpa. . S and above;

(3) Detection concentration: ppb level, add concentration: 0.01 ~ 0.015% ; (4) Ph value: 3-11; (5)Indicator validity: ≥500 days.

4. Test in Field

In order to further understand the effect of sectional reconstruction of Horizontal Wells and analyze the production situation of each interval, field tests were carried out in Chang 8 reservoir of Red River Oilfield to monitor 6 fractured intervals, and the production capacity of each interval was determined by tracer monitoring, the influencing factors of producing liquid capacity at the initial post-compression stage were preliminarily clarified.

4.1. Analysis of tracer monitoring and evaluation

The HH36P96 well is a development horizontal well located in HongHe 36 well area. The horizontal section of the well is drilled in Chang 8 reservoir with a horizontal section of 405m, from the view of segmentation (see figure 3 and Table 2) , the physical properties of the 1st and 4th member reservoirs are poor, the 2nd, 3rd, 5th and 6th member reservoirs are good, and the 6th member develops natural fractures.

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4.2. The case of fracturing operation

In this well, the open hole packer sectionalized fracturing technology was used to complete the 6-section fracturing successfully. The fracturing operation parameters are shown in Table 2 and the operation curves are shown in figure 4. The amount of tracer added to each section is about 10:1 and the amount of single section is 10-20.

Table 2 Statistics of fracturing segmentation and fracturing operation parameters of HH 36P96 well

Stage	Length m	Fracture slip position m	fracturing operation				
			Displacement m^3/min	Ground inflow m^3	Sand addition m^3	Average sand ratio m^3	Tracer dose m^3
1	83.13	3015.76-3020.76	2.5	103.3	14.8	26.7	10
2	68.75	2942.65-2947.65	3.0	150.2	25.3	28.3	15
3	75.1	2867.66-2872.66	3.5	201.9	31.3	27.0	19
4	77.56	2792.82-2797.82	3.5	187.7	31.5	27.1	20
5	65.53	2738.12-2743.12	2.8	162.5	24.7	28.2	15
6	54.36	2648.69--2653.69	2.5	107.2	15.0	27.6	10

4.3. Analysis of tracer monitoring effect

Based on the results of 32-day tracer monitoring after well fracturing in HH36P96, it is found that the recovery rate of the 5th, 6th and 3rd sections is higher, and the production capacity is stronger during the period of blowout and at the initial stage of fluid drainage. At the 4th, 2nd and 1st Stage, the liquid-producing ability is relatively low, and the liquid-producing ability of the 2nd stage is stronger than that of the 4th and 1st Stage, while the liquid-producing ability of the 4th and 1st Stage is worse than that of the 2nd stage.

Based on the analysis of fracture location, fracture scale and reservoir physical properties, the location of fracture section, reservoir physical properties and the scale of fracturing operation all have influence on the post-fracturing fluid production capacity, the physical property of the fractured reservoir has the greatest influence on the post-fracturing fluid production ability, and the location of the fractured section (the closer the fracturing section is to a target, the stronger the fluid production ability) , but the influence of the construction scale is relatively small.

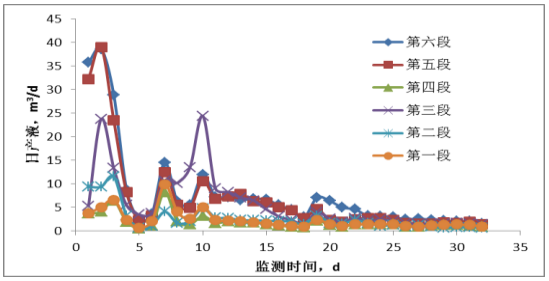

Fig 3 Tacer monitoring production curve

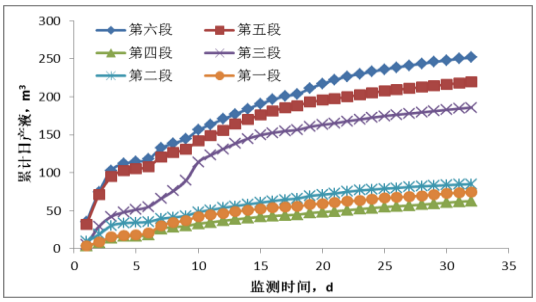

Fig 4 Tacer monitoring cumulative production curve

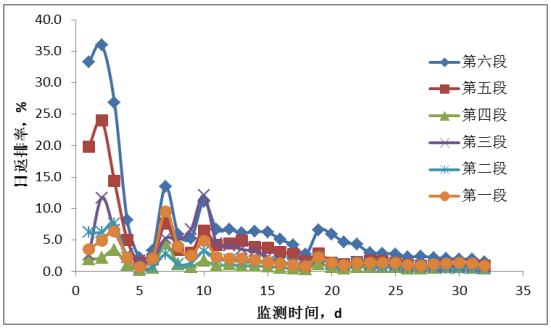

Fig 5 Daily return rate curve of tracer monitoring

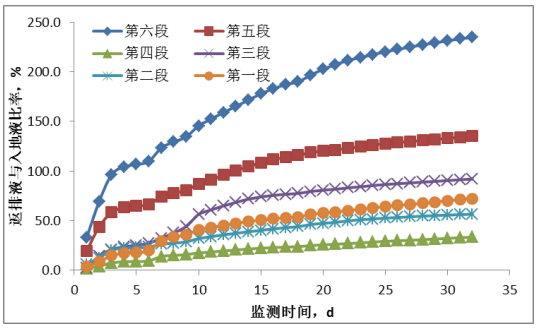

Fig 6 Cumulative backflow rate curve for tracer monitoring

5. Summary

(1) Through the field test results of liquid indicators, we can see that this technique can accurately monitor the fracturing backflow situation, and through the liquid indicators test, we can know the backflow situation of each layer of horizontal well in different periods.

(2)According to the test results, the location of the fractured section, the reservoir physical properties and the scale of fracturing operation all have an effect on the initial post-fracturing fluid production capacity, and the reservoir physical properties of the fractured section have the greatest effect on the post-fracturing fluid production capacity, secondly, the location of fracturing section (that is, the closer the fracture section is to a target, the stronger the fluid production ability) , but the effect of construction scale is relatively small.

(3) According to the influence of the indicator pressing on the productivity, it can provide a certain research direction for further adjusting and optimizing the fracturing operation parameters.

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