ISSN: 2688-8645

Study on Comprehensive Control Technology of Uncased Hole in Yanchang Oilfield

Ming Zhang[1]

[1]Xi'an Shiyou University, Xi'an 710065, China.

Abstract

Yanchang oilfield belongs to the "three low" oil deposit with ultra-low permeability, extra-low production and low pressure. The uncased hole has seriously restricted the development effect of the oilfield. In this paper, according to the development of the region, the development status and causes of uncased hole are summarized.; combining with the technology of oil extraction, reasonable control measures are discussed for different uncased holes. Practice has proved that uncased hole's management has made significant benefits, while providing further experience to improve the development effectiveness.

Keywords

Uncased hole, Development effectiveness, Govern ance strategy.

1. Introduction

The main oil-bearing layer in Yanchang oil zone located in the eastern part of the northern Shaanxi Slope Belt in the Ordos Basin is Chang-6 layer of Yanchang and the stratum structure is gentle west-dip monoclinic structure. Chang-6 layer is shallow buried (80-850m) with poor physical properties (average porosity is 7-9%, average permeability is 0.3-0.5mD), serious failure of stratum pressure, typical shallow burial, ultra-low permeability, extra-low porosity, low-pressure lithology oil deposit. In the early stage of development, oil wells' completions focused on uncased hole. With the deepening of exploration and development, uncased hole development has seriously restricted the overall development effectiveness of the region. In order to improve the level of oilfield development in this area, combining with the regional geological characteristics and development experience, the article analyzes the existing problems in the development of uncased hole in the study area, makes reasonable control strategies and gives full play to the potential of uncased hole.

2. Current Status of Uncased Hole Development

The uncased hole in Yanchang oilfield is mainly distributed in the Foguyuan District and Yangqi District. The main oil-bearing layer is the Chang-6 layer of Yanchang, which is an oil deposit of elastic-dissolved gas-driven lithology. It started exploring and developing in 1985 and adopted rolling exploration and development. The current proven area is 141.45 km2 and the proven reserves are 5476.5×104t, which have been fully utilized. In the study area, there are 4000 oil production wells in total, of which 3734 are uncased hole. The average single-well oil production is 0.10t/ d and the comprehensive water content is 35.2%. The oil production rate is 0.20%, and the oil production degree is 3.82%.

3. Analysis of Problems Existing in Uncased Hole Development

According to the data of core analysis, statistical results show that the porosity of Chang-6 layer is 7~13% with an average of 9.27%; the permeability is mainly distributed between 0.20×10-

ISSN: 2688-8645

^{3}μm^{2} and 0.9×10^{-3}μm^{2} with an average of 0.45×10^{-3}μm^{2}, which is ultra-low porosity and ultra-low permeability layer. Due to the low porosity and permeability, small pore throat radius and large hollow billet resistance, it leads to that the starting pressure gradient and the displacement pressure gradient become larger, so that the formation pressure drops rapidly and the output decreases rapidly in the early stage of development.

After years of development, the energy deficit in stratum in the uncased hole region is serious, and the stratum energy cannot be effectively supplemented. The contradictions among the stratums are prominent and the single-well productivity is low.

Due to the development of regional wellhead pressure control device, and it cannot achieve reasonable control of production pressure. With the decrease of stratum pressure, oil well production index and oil production index decreased (Table 1).

Table 1. Formation pressure maintenance level statistic

Area		Middle section of layer (m)	Oil layer	Original formation pressure (MPa)	Current formation pressure(MPa)	Pressure maintenance level (%)
Uncased hole field	Foguyuan district	380	Chang-6	3.85	0.345	9
	Yangqi district	450	Chang-6	3.79	0.508	13
Casing well field	Dongtai district	720	Chang-6	4.51	1.045	23

4. Discussion on Comprehensive Control Countermeasures of Uncased Hole

4.1. Communication Seepage Channel

According to the geological data of this region, the distributary channel sandstone in this area is the main layer with an average pore diameter of 50-150μm, and the throat diameter is mainly distributed around 0.40-2.40μm with an average of 0.34μm, which is mainly a small pore fine throat. In order to change the seepage channel of layers, the uncased hole that the layer with better physical properties and higher initial yield was selected to implement fracturing of small bearing section and hydraulic blast-fracturing. When test hydraulic blasting fracturing in the White-59 well, it reached the highest daily oil as 4.15t in the first week after the measure, and accumulated oil amount was 44t.

4.2. Improving Liquid Production Sector

After some oil wells in the study area were clogged, the production volume, oil production and dynamic liquid level continued to decline. For such oil wells, use PG lignin removal, CLO2 plugging and multi-frequency pulsed chemical compound plugging technology to rebuild and improve, effectively remove oil pollution caused by fracturing guar gum, polymers, bacteria and sulfides, restore the oil flow channel and relieve blockage of the oil layer. At the same time, the plugging agent improves the fluidity of crude oil in the stratum, thus increasing the single-well production. When test PG lignin plugging in the North-425 well, the first week of the month after the measure, the average daily oil increased 0.87t/ d, and accumulated oil amount was 39t.

4.3. Additional Formation Capacity

Due to the current water injection technology is mainly applied to the case hole area, uncased hole water injection technology is not mature, making serious stratum energy deficit in the

ISSN: 2688-8645

study area, protrude conflicts among layers, and low single-well productivity. In the study area, Qubao-95 well group carried out the nitrogen foam huff and puff test. Because of the fracturing times are many and artificial fractures grow in the well group, there is nitrogen gas breakthrough in the surrounding oil wells during the nitrogen injection and the stimulation effect is not obvious.

5. Effect Analysis of Comprehensive Treatment of Uncased Hole

Until now, 1596 uncased hole wells have been comprehensively implemented with technologies such as fracturing of small bearing sections, hydraulic blasting fracturing and PG lignin plugging, with a cumulative increase of 4.0341×10^{4} t (Table 2).

Table 2. Formation pressure maintenance level statistic

Governance project	2017		2018		2019	
	Well number	Increased amount of oil (t)	Well number	Increased amount of oil (t)	Well number	Increased amount of oil (t)
Fracturing of small bearing sections	462	11550	505	12625	336	8400
Hydraulic blasting fracturing	57	1652	41	859	57	1057
PG lignin plugging	32	1064	58	1728	41	1406

6. Conclusions

The main problems in the development process of uncased hole are that the release of stratum capacity is too fast, the stratum pressure is low and single-well productivity is low.

According to the development characteristics of uncased hole in different regions, corresponding measures are taken from three aspects of communication seepage channel, improving production sections and supplement stratum capacity, and achieved good results.

The next step in the study area is to carry out uncased hole injection water development test, which fundamentally solves the problems of serious deficit in stratum layer in the uncased hole area and low stratum pressure.

References

[1] Heiko Hillgartner,Wan Faisal Paino,Fahad Hadhrami, M., Integrated Reservoir Modeling for Water Flood Development in a Heterogeneously Fractured Carbonate Reservoir,North Oman, (2011),SPE-148380-MS.

[2] M.Sun.Heterogeneity Research of Chang 6 Reservoir in Luzigou Area,Erdos Basin.Journal of Chongqing University of Science and Technology:Natural Science Edition, Vol. 17 (2015) No.2,p25-28,47.

[3] J.Toth, T.Bodi, and P.Szucs, M., Determining Effective Fluid Saturation, Relative Permeability, Heterogeneity and Displacement Efficiency in Drainage Zones of Oil Wells Producing Under Waterdrive, (2010),SPE-140783-PA.

[4] Z.J.Yin,G.Y.Lu,X.Zou, et al.Heterogeneity of non-marine reservoirs and its influences on recovery factor: take Gaoshangpu and Yonganzhen oil reservoirs in Jidong and shengli oilfields as examples.Oil & Gas Geology, Vol. 27(2006) No.1,p106-110,117.

[5] H.L.Xu.Effect of Plane Heterogeneity on Herringbone Well Steam Stimulation.Henan Science, (2015) No.2,p261-264.

ISSN: 2688-8645

[6] Z.L.Fan,G.X.Zhang,G.Q.Wang, et al.Sedimentary microfacies and heterogeneity of Member 3 of Funing Formation of Biandong Oilfield.Science Technology and Engineering, Vol. 15 (2015) No.6,p164-169.