Fine Mining Technology for High Water Cut Reservoir

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Abstract. The oil production rate is slow in Oilfield, Low recovery degree, the difficulty of improving oil recovery by chemical flooding. Combined with formation heterogeneity characteristics and production dynamic situation, according to the distribution characteristics of remaining oil, adopting new drilling and Fine stratified water flooding technology. The region with high thickness of selected oil layer and high residual oil content is deployed to deployment the completely penetrating well and the infill well, straight well taking into account two layers, horizontal well is based on single layer, Fine layered inverted nine spot water flooding pattern development. After the implementation of newly drilled well, perforations adding, fracturing and separated layer water flooding, The predicted oil field has add up 1286.98 million tons of oil production by 2035, ultimate recovery factor 33.78%, water ratio97%, the formation pressure is always between 18 and 19MPa,the whole effect is better.

At present, most oilfields at home and abroad have entered the later stage of development, The comprehensive water ratio of oil field is high, oil recovery rate is slow, The degree of reserve recovery is generally low. In view of oilfield development, Due to environmental protection and the development of economic costs and other reasons, It is not effective to carry out chemical flooding to improve oil recovery ratio. Large displacement liquid extraction technology can improve oil production rate to a certain extent. However, the processing cost of produced liquid is higher, bailing oil recovery technique can reduce the cost of mining, but the oil recovery rate is slow, the economic benefits are not good. In this paper, combined with formation heterogeneity characteristics and production dynamic situation, developing new drilling and fine layered water injection technology. It can effectively improve oilfields recovery ratio, yield prediction is better, the overall benefit is considerable.

Reservoir Status

The reservoir is located in the Middle Jurassic strata, lithology is a sandstone, argillaceous sandstone and siltstone dominated sandstone, most of the particles are turbinate and semicircular particles, the main reservoir bed include 5# and 6# layers, the interlamination interlayer is obvious. The buried depth of the reservoir bed is about 2100m,the formation thickness is between 26 and 45m, simple anticline structure, the faults are agenesis, The effective thickness of reservoir bed is between 5 and 15m, porosity averaged 0.2,the mean permeability is 86mD. in layer heterogeneity is powerful, the coefficient of permeability variation was 0.91.The initial formation pressure is 18MPa, the petroleum pool temperature is 68℃, the formation water salinity is higher.

The oil field has been put into development for more than 50 years, current nissan oil 460t, the composite water cut is 92%, cumulative oil production of 728 million tons, the degree of reserve recovery is 18.6%, the recovery rate of recoverable reserves is estimated to be 45%. Comprehensive analysis of the oil field shows that the oil well pattern is not perfect, the comprehensive recovery degree is low, and the water content is generally high.

Adjustment Scheme

Production Analysis of Input Well. In recent years, the oil field shows that the wells with daily production of more than 10 tons in the new production well account for 28% of the total number of newly put into production wells,
the Wells that produce the oil between 5 and 10 tons of oil account for 18% of the new total well, the Wells that produce the oil between 1 and 5 tons of oil account for 46% of the new total well, wells with daily production of less than 1 tons account for 8% of the total number of newly put into production wells. The average daily oil production of the new well is 8.26t, and the average water content is 58%, the effect is better, which laid a good foundation for the adjustment of the new well. As a whole, horizontal well integrated moisture content is lower than straight well, and the yield of single well is obviously increased, and the horizontal well advantage is obvious, indicating the direction for the new well deployment, see Table 1

Table 1 Data comparison between horizontal and vertical wells

Nissan oil (t)	Horizontal well			Vertical well		
	Well number ratio （%）	Single well oil production (t)	Water percentage （%）	Well number ratio （%）	Single well oil production (t)	Water percentage （%）
＞10	58	22.0	18	20	19	26
5～10	14	6	21	20	8	43
1～5	26	3	81	46	3.2	82
< 1	2	0.6	95	14	0.5	94
Total	100	14.24	35.32	100	6.94	64.68

Fine Stratified Water Flooding Technology. Reservoir water drive use degree is low, the reservoir has high longitudinal heterogeneity, experiencing long term water flooding, the water injection is obvious in single or high permeable layer, early ten annual water absorption profiles show that the longitudinal reserves of reservoirs vary greatly, range from 24.4 to 93.7%, with an average of about 43%.The water injection profile of individual injection wells shows that the difference of water absorption between layers is obvious due to general flooding, the internal water out is uneven, and some of the target layers are completely non absorbent. See Fig 1.Therefore, it is necessary to implement separate layer water injection to improve reservoir production.

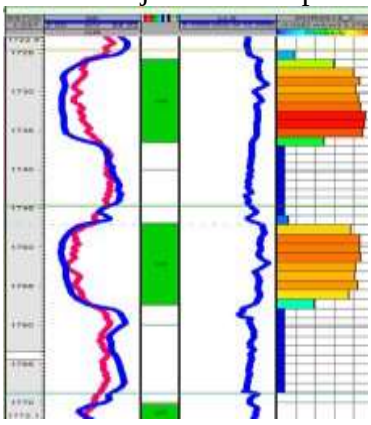

Figure 1. water injection profile

Based on the description of the remaining oil distribution characteristics, the author makes a targeted excavation and adjustment measures based on the influence factors of remaining oil, as

shown in table 2.

Table 2 Adjustment table for remaining oil production

Type	Remaining oil	Influence factor	Adjustment scheme
Horizontal plane	imperfect well pattern	imperfect well pattern	perfect well pattern
	regions with strong heterogeneity	reservoir heterogeneity	Down flow well profile control、oil well fracturing
Machine direction	microstructural high	structure	vertical Well encryption
	vertical heterogeneity	reservoir heterogeneity	Bottom profile control and water shutoff, middle and upper part perforations adding
	imperforated stratigraphic position	perforation	completeness perforation

Scheme deployment fully combines numerical modeling with reservoir engineering analysis results and production trends, Optimizing the completely penetrating well and infill well in areas deploy with large reservoir thickness and high remaining oil abundance, The vertical well takes into account two layers, and the horizontal well is based on single layer, Taking full advantage of deep well area data, the well location of the deployed well is finally determined to improve the economic efficiency of the adjustment well, The development mode still adopts low cost water injection development mode, inverted nine spot water flooding pattern, the well spacing is about 330m-410m.

Yield prediction

The geological model of the block is established and the historical fitting is carried out, and the production prediction is carried out on the basis of the model. See Fig 2 and 3 .During the prediction, the injection production ratio of the reservoir is kept at 1~1.2, the old well Keep the old history fitting to predict production, New drilling flow pressure production, the minimum bottom hole flow pressure is not less than 13Mpa, shut in well when water content is greater than 98% or daily oil is lower than 1t. The maximum bottom hole flow pressure limit of injection well is 25Mpa.

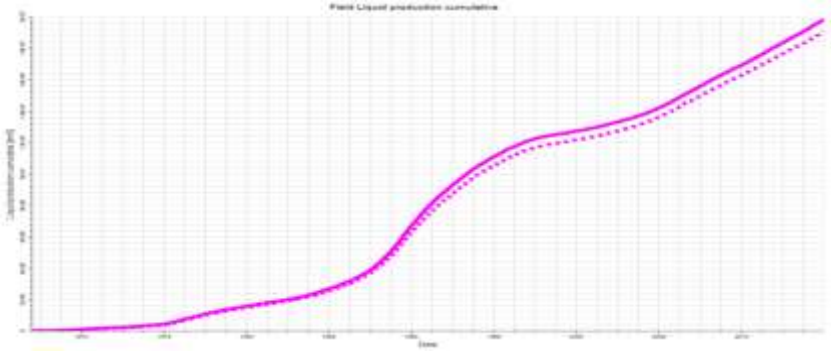

Figure 2. Reservoir history matching

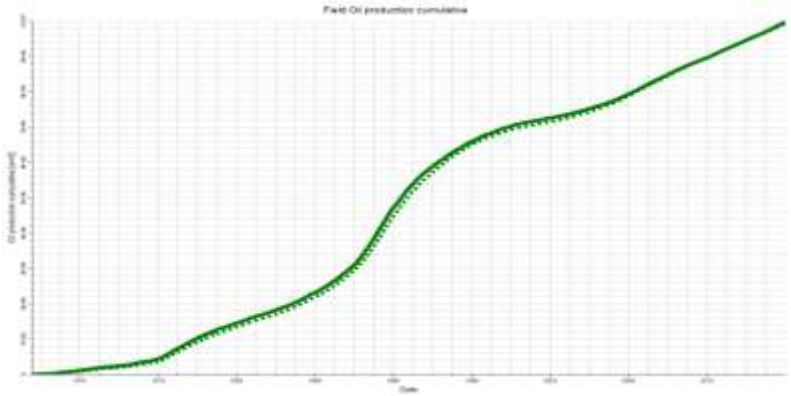

Figure 3. Reservoir history matching

In the new drilling, back layer, perforations adding, fracturing and layered water flooding development, the annual oil production in reservoir increases rapidly, and then enters the decline stage. Reservoir numerical simulation predicts that the total oil production will be 1286.95 million tons and 500 tons by 2035.Finally, the degree of reserve recovery is 33.78%, and the water content ratio is 91.4%, The formation pressure is always maintained between 18 and 19MPa, and the overall effect is preferably.

Conclusion

Through the analysis of input Wells, points out the direction for the new well deployment.

Through the fine stratified water flooding technology, distribution and mining of remaining oil to make adjustments, thus developed for remaining oil tapping the minute hand of policy.

It predicts that the oil field will produce 1286.95 million tons of oil in 2035, and the degree of reserve recovery is 33.78%

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