

Analysis of connectedness between oil and water wells by numerical simulation technique

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Abstract. For water flooding reservoirs, accurately identify the connectivity of oil and water wells, this is essential for designing a reasonable reservoir development program, it is also the basis for the success of oilfield development and management. Previous studies have focused on the connectivity between oil and water wells, and there is no concrete to the oil and water wells at the simultaneously shot layers. In this paper, numerical simulation technique is used to analyze the connectivity between oil and water wells, and the connectivity relationship of simultaneously shot layers between oil and water wells is also determined. Based on the fine modeling of reservoirs, the connectivity analysis was carried out by using the tracer flow simulation technique in ECLIPSE software and the results of stratified output concentration of tracer in PRT file. The results show, the method can be used to accurately determine the connectivity of oil and water wells. The oil well A in Daqing Oilfield have high water cut layer, using this method, on the 27th floor of well C with the best connectivity of target layer were screened out, the target layer is blocked for wells C, thereby the injecting water is optimized, reduce the amount of inefficient injection of water.

1. Introduction

The reservoir is a dynamic equilibrium system. The change of water injection in the well caused the oil production fluctuation is the characteristic reflection of the connection between the oil and water well, and the fluctuation range of oil production is related to the degree of connectivity of oil and water wells. At present, this field is based on this idea, qualitative judgment of oil and water wells connectivity, but the results is subjective. In addition, in the production of oilfields, each well is not isolated, and its output changes are associated with the combined action of all the water inflow wells that are connected to it, which may also enhance or weakened the signal obtained by the well.

As a general numerical simulation software, the software of Eclipse can accurately simulate the actual situation of the reservoir, and the software also provides a tracer flow simulation technology, which provides a better choice for the judgment of the connectivity between the oil and water wells.

2. Fine modeling of reservoirs

The PETREL software was used to model the blocks and import the model into ECLIPSE software for tracer flow simulation.



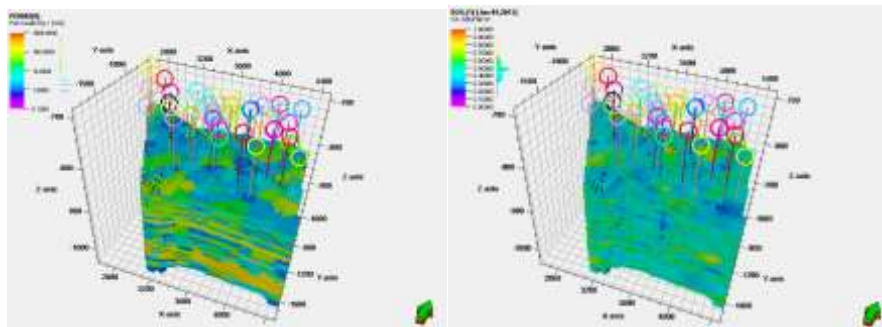


Fig. 1 The model of permeability field **Fig. 2** The model of residual oil saturation field

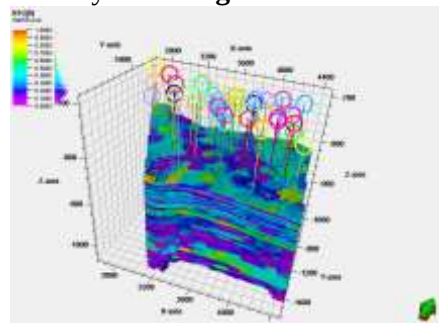


Fig. 3 The model of static ratio field

3. Judgment of connectivity of oil and water wells

3.1. Judgment of connectivity between oil and water wells

In the actual production, the method of using tracer in oil field is: by detecting the concentration curve of the tracer concentration in the production wells, reflecting the information about the characteristics of the reservoir, observing the producing characteristic of tracer in the oil wells, such as the parameters of breakthrough time, the size and number of peaks and corresponding injection of total fluid, which can further study and understand the movement law of injection fluid and reservoir heterogeneity. For numerical simulation technology, the tracer can be injected from the early stage of the oil field development without the limitation of the time of injection tracer. The tracer output curve cannot be explained without the interpretation error. Real - time analysis of water. The incoming water of oil well can be detected in real time.

Taking the in Daqing Oilfield as an example, there is a high water level in, a total of six water wells are located around the oil well A. Analysis of the tracer output curve of oil well a shows that the main water direction of a well is different at different times. At present, the main water supply direction of oil well A is water well C and E.

Tab.1 The incoming water list of well A

Oil well	water well	The percentage of incoming water (%)
A	B	4.16
	C	42.29
	D	1.24
	E	18.9
	F	3.59
	G	0.51

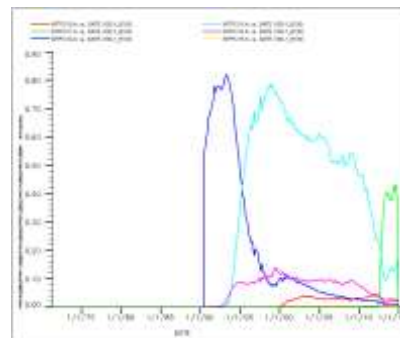


Fig. 4 Variation curve of tracer concentration of well A

3.2. Connectivity judgment of simultaneously shot horizon of oil and water wells

According to the tracer flow simulation results, combined with the results of stratified tracer output concentrations in the Eclipse results file, it is possible to judge the simultaneously shot horizon connectivity of the oil and water wells.

According to the A well tracer output curve, combined with the use of the Eclipse results file in the A well stratified tracer output concentration, the 27 layers in simultaneously shot horizon of well A and well C is the best connectivity layer.

WELL	LOCATION	WELL-WELL	PRODUCED	WELL	LOCATION	FLUID	WATER
NAME	(I,J,K)	TYPE-CTRL	TRACER	NAME	(I,J,K)	RES.VOL.	CUT
		MODE-CONCENTRAT		OR GRID		SM2/DAY	
FIELD			0.2170	FIELD		105.2	0.926
GROUPA	A GROUP		0.0458	GROUP13	GROUP	27.1	0.923
A	07, 14	PROD-DEAT		A	07, 14	75.5	0.937
BLOCK	07, 14, 1		0.0000	BLOCK	07, 14, 1	2.0	0.926
BLOCK	07, 14, 2		0.0000	BLOCK	07, 14, 2	2.2	0.930
BLOCK	07, 14, 11		0.1594	BLOCK	07, 14, 11	10.0	0.902
BLOCK	07, 14, 20		0.0024	BLOCK	07, 14, 20	9.5	0.904
BLOCK	07, 14, 26		0.1951	BLOCK	07, 14, 26	6.4	0.921
BLOCK	07, 14, 27		0.3913	BLOCK	07, 14, 27	30.0	0.923
BLOCK	07, 14, 28		0.1446	BLOCK	07, 14, 28	5.2	0.926
BLOCK	07, 14, 29		0.1430	BLOCK	07, 14, 29	7.0	0.925

Fig. 5 The output stratified tracer Concentration of well A

Fig. 6 Stratified liquid and water cut of well A

4. Verification of results

According to the judgment results, the 27th layer is a reservoir with water cut of up to 98.8%, which is the perforation of the oil well, the main water direction of the layer is C wells. Profile control work for the 27 layer in the C well, oil production is basically no change (from 4.74 t / d to 4.50 t / d), water cut decreased by 3.7%. Reduce the amount of inefficient injection of water, and achieved a better development effect

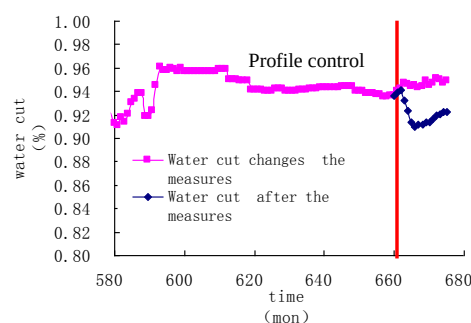


Fig. 7 The correlation curve of water cut before and after measures

5. Conclusion

(1) For water drive reservoir, accurate identification of oil and water well connectivity is not only for the design of a reasonable reservoir development program is essential, but also the oil field development and management of the success of the foundation;

(2) The tracer flow simulation technique can be used to analyze the connectivity between oil and water wells;

(3) Based on the fine modeling of reservoirs, the connectivity analysis of oil and water wells was carried out by using the tracer flow simulation technique in ECLIPSE software and the results of stratified output concentration of tracer in PRT file;

(4) Based on the method adopted in this paper, the C wells will be blocked at the target level, the water cut can be reduced by 3.7%, reduce the low injection rate, and obtain good development effect.

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