Prediction Method of Well Pattern Infilling Effect in Ultra-low Permeability Reservoir of X Oilfield

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Abstract. In this paper, firstly, the introduction of well pattern infill in ultra-low permeability reservoir is analyzed in detail, and then combined with the change law of well pattern infill in ultra-low permeability reservoir and the prediction process of well pattern infill in ultra-low permeability reservoir, the prediction results of well pattern infill in ultra-low permeability reservoir are summarized.

Keywords: X oilfield, ultra-low permeability reservoir well pattern, infilling effect, main form.

1. Introduction

In order to ensure the development quality of X oilfield, detailed exploration and research should be carried out according to the actual situation of ultra-low permeability reservoir and the dynamic effect after infill adjustment, thus providing basic theoretical basis for oilfield development and scheme planning. At the same time, through detailed exploration on the well pattern infill effect of ultra-low permeability reservoir in X oilfield, technicians further clarify the change law of production increase and main influencing factors.

2. Introduction to well pattern infilling in ultra-low permeability reservoir

During the implementation of ultra-low permeability reservoir wells in X Oilfield, its infill effect has become the core adjustment area in the oilfield development process. At this stage, there are relatively few technical methods of parameter prediction that affect the basic effect of well pattern infill. Including: empirical method and information simulation calculation method, in which empirical method is relatively subjective in the implementation process, and its information prediction is not accurate. Although the information simulation calculation method is accurate in the actual operation process, it is relatively complicated in both calculation flow and calculation mode. Therefore, it is necessary to build an encrypted prediction information model which is suitable for different reservoir characteristics and accurate in information prediction.

First, because the ultra-low permeability reservoir in X Oilfield has abundant basic reserves, it is generally necessary to use nine-point basic well pattern operation system in the initial stage of technical development. And comprehensively adjust and encrypt the basic well pattern structure within a suitable development period [1].

Second, after detailed analysis of the structural change characteristics after structural adjustment of X oilfield reservoir infill, the change law of basic effect of stimulation is further clarified. Secondly, in order to further understand the actual situation of the reservoir and carry out data calculation samples, it is necessary to use stepwise regression technology to construct a suitable oilfield structure. This provides a basis for the development planning of ultra-low permeability reservoirs.

3. Variation law of well pattern infilling in ultra-low permeability reservoir

(1)Main forms of well pattern encryption

Based on the prediction technology of well pattern infilling effect of ultra-low permeability reservoir in X Oilfield at present, the actual development status of X Oilfield is fully combined. According to the operation characteristics of the oil field and the distribution law of the remaining oil, the detailed exploration and research are carried out, and the data simulation technology is used to encrypt the well pattern management form, which can further clarify the specific position between the original water injection well row and the oil production well row. Inject the original well pattern angle, in which the external form of well pattern is mainly changed from 300×300m square to square inverted nine points, and the angle of wellhead side-by-side direction is mainly NE 90 degrees, and then it is changed to NE45 degrees.

(2)Encrypted yield change result

Detailed exploration and technical analysis are carried out according to the basic idea of improving the acquisition efficiency in X Oilfield. Technicians need to select

representative construction area modules and actively carry out the whole encryption data adjustment experiment. Therefore, this experiment needs to select a certain representative experimental area for collection dynamic analysis, and conduct well pattern encryption at an appropriate time, and the well pattern is adjusted to the inverse nine points of the square with small well spacing [2].

4. Well pattern infilling prediction process of ultra-low permeability reservoir

(1)Modeling process

Because there are relatively few basic production and dynamic information data collected in the oil field, it is impossible to effectively meet the basic conditions of different types of oil reservoir exploitation by using the general longer technology, and make accurate information prediction according to the encryption effect of the basic conditions. Therefore, this study mainly analyzes and explores the basic ecological dynamics of typical construction areas in X Oilfield in detail, and constructs data parameter models that can reflect different reservoir conditions and environments. Based on this, the output data of oil quantity with different information models and adjustment time can be calculated in detail.

First, build an information and parameter model structure that can effectively reflect the characteristics of the reservoir. Second, clarify the selection range of key parameters. Third, make full use of professional response surface to design and calculate the scheme. Fourth, the calculation results of the scheme are summarized in detail, and the relationship between the output increase range and influencing factors is preliminarily analyzed, so as to fundamentally ensure the level of model establishment. Fifth, according to the actual situation of model establishment, step-by-step regression calculation method is used, and finally, the model of constantly adjusting information prediction parameters under different influencing environments and factors is obtained.

(2)Modeling parameters

In the process of parameter calculation, it is necessary to make full use of Eclipse data information to simulate the well pattern adjustment effect predicted by the oil parameter model in the software structure. The grid calculation size parameter in different directions is almost 20m, and the grid size parameter in z direction is 3m left and right. Therefore, it is necessary to use the anti-nine-point hormone method to establish a well pattern, in which the distance from the oil collection wellhead needs to be about 300m [3].

Because the well pattern infill adjustment model is basically the same as the actual reservoir well pattern adjustment parameters, it is necessary to use a small distance wellhead to form an anti-nine-point well pattern. Taking full account of the actual reservoir characteristics and development technology mode of X oilfield, technicians need to fully study the basic encryption effect under different reservoir conditions and different well pattern adjustment periods. Therefore, after fully considering the core key parameters and parameter range, they need to actively adjust the well pattern, well spacing, thickness, water cut efficiency, etc. As shown in Table 1, the design results of the prediction scheme.

Table 1 Forecast scheme design results

Computational scheme	Response surface parameter design					Calculation result	
	Permeability ratio crude oil viscosity/(mPa.s)	Permeability ratio crude oil viscosity/(mPa.s)	Water cut (timing of well pattern adjustment)/%	Well spacing/m	Effective thickness/m	Forecast time/a	Yield increase multiple
1	5.5	4.5	60	250	15	1-9	1029-1211
2	5.5	8	40	350	22.5	1-9	1047-1227
3	8	4.5	80	350	22.5	1-9	1017-1141
4	5.5	4.5	40	450	22.5	1-9	1035-1120
5	3	4.5	60	350	15	1-9	1005-1069
6	5.5	8	60	250	22.5	1-9	1038-1243
7	5.5	1.5	60	350	30	1-9	1074-1356
8	3	4.5	80	350	22.5	1-9	1009-1059
9	5.5	4.5	60	350	22.5	1-9	1025-1188
10	5.5	1.5	80	350	22.5	1-9	1009-1126
11	5.5	4.5	80	350	15	1-9	1006-1009
12	5.5	4.5	60	350	22.5	1-9	1025-1188
13	8	1.5	60	350	22.5	1-9	1069-1302
14	5.5	4.5	80	350	30	1-9	1008-1134
15	5.5	4.5	80	250	22.5	1-9	1014-1185
16	5.5	4.5	60	350	22.5	1-9	1025-1188
17	5.5	1.5	60	450	22.5	1-9	1028-1169
18	3	4.5	60	250	30	1-9	1040-1228
19	5.5	4.5	60	350	22.5	1-9	1025-1188
20	5.5	4.5	80	350	22.5	1-9	1002-1054
21	5.5	1.5	60	350	22.5	1-9	1140-1409
22	5.5	8	80	350	22.5	1-9	1009-1070
23	5.5	4.5	40	350	15	1-9	1074-1262
24	3	4.5	40	350	22.5	1-9	1154-1344
25	5.5	8	60	350	30	1-9	1017-1184
26	8	4.5	40	350	22.5	1-9	1175-1434
27	5.5	4.5	40	350	30	1-9	1246-1516
28	5.5	4.5	60	350	22.5	1-9	1026-1191
29	5.5	4.5	60	250	30	1-9	1158-1428

30	3	4.5	60	450	22.5	1-9	1001 - 1015
31	5.5	4.5	60	450	30	1-9	1002 - 1112
32	5.5	4.5	60	450	15	1-9	1003 - 1008
33	8	8	60	350	22.5	1-9	100- 1150
34	5.5	8	60	350	15	1-9	1080 - 1278
35	8	4.5	60	450	22.5	1-9	1026 - 1191
36	3	4.5	60	250	22.5	1-9	1035 - 1198
37	5.5	4.5	60	350	22.5	1-9	1026 - 1091
38	5.5	1.5	60	350	15	1-9	1034 - 1108
39	8	4.5	60	350	30	1-9	1078 - 1315
40	8	4.5	60	250	22.5	1-9	1109 - 1158
41	8	4.5	60	350	15	1-9	1003 - 1158
42	3	8	60	350	22.5	1-9	1005 - 1060
43	5.5	1.5	40	350	22.5	1-9	1262 - 1531
44	3	1.5	60	350	22.5	1-9	1057 - 1531
45	5.5	8	60	450	22.5	1-9	1003 - 1006
46	5.5	4.5	40	250	22.5	1-9	1275 - 1568

(3)Regression model establishment

In the process of establishing the regression model, the basic idea of stepwise regression technology is to guide the basic variables to the information data model structure. Therefore, it is necessary to check each guided explanatory variable in detail, and analyze and explore the selected explanatory variable parameters in detail. Among them, when the original explanatory variables are guided from the back by the later explanatory variables, it is necessary to reduce the overall deletion processing, so as to ensure that the introduced new variable regression equation contains significant variables. Because this operation mode belongs to the repeated operation process, the stability of the foundation is needed for this parameter calculation, and all explanatory variables are optimized [3].

①Data processing

In data processing, it is necessary to design according to the response plan, and then construct the corresponding response plan. The model of reservoir condition parameters is clear, and well pattern encryption is carried out according to the basic water cut efficiency of the reservoir under the plan. Therefore, at least 92 reservoir models must be built in the process of model building. In the process of establishing the reservoir information model, the well pattern is mainly square inverted nine points, and the external encryption form of the foundation is mainly square inverted nine points with small well spacing, which is consistent with the oil field. After information model calculation and data statistical encryption processing, the cumulative output of a single well can be calculated [4].

②Improve the data model

In the aspect of centralized data processing, the abnormal location points mainly refer to the observation points of the principle data center, so the data model is called outlier. Among them, the strong influence points mainly refer to the observation positions that greatly influence the predicted results of regression equation parameters in centralized data information processing, so technicians need to further optimize the information data model by eliminating abnormal positions and strengthening the influence points. In this technical exploration, the difference value is used to further judge the actual situation of abnormal location points, and the abnormal location points and strong influence points are visually checked with the help of the regression diagnosis structure diagram. After the abnormal information data is eliminated, the regression processing is carried out again. At the same time, the residual diagram is used to further verify whether the data model is established.

5. Prediction result of well pattern infilling in ultra-low permeability reservoir

During the exploration of well pattern infill prediction results of ultra-low permeability reservoir, technicians need to substitute the parameters and information calculated by the data model and the remaining one-third of the test data into the optimized information model for summary, and finally get the prediction results through model calculation. Then calculate the data error between the actual increase level of oil volume and the prediction, and predict the error caused by the well pattern infilling effect of ultra-low permeability reservoir in X oilfield at this stage [5]. When the relative error is less than 1%, the maximum parameter can't exceed 2%, which further shows that the coincidence efficiency between the predicted values of system parameters and the actual measured values is relatively high, and the information model established by stepwise regression analysis system can increase the basic oil production and permeability efficiency higher. Furthermore, according to the comprehensive index of response surface regression equation, a detailed comparison is made between the predicted output increase range and the actual oil output increase service, which further shows that the fitting accuracy of the regression equation is high.

6. Conclusions

It can be seen that the detailed analysis and exploration of the actual development dynamic information of the reservoir at the present stage will further clarify the main influencing conditions and core factors affecting the development quality of the reservoir. Therefore, the technicians further put forward the operation mode of increasing the production multiple, and further indicated the technical effect of increasing the production after the reservoir infill adjustment. The application of the actual production effect further shows that increasing the production parameters can effectively reflect the variation

law of the core key dynamic parameters of the reservoir, and then provide a reliable basis for reservoir production planning.

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