

Adjustment and Application of Well Test Interpretation in The Development of W-zone of Ji Plateau Oilfield

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Abstract: Oilfield development well test is an important means to correctly understand the reservoir and improve the recovery rate, which is of great significance in slowing down the decreasing production of the oilfield and formulating an effective development plan. [1] Jiyuan oilfield W area of ultra-low permeability reservoir production accounted for a large proportion of the (52.1%), After the reservoir enters into the middle water content period, the contradiction of water-driven development is highlighted, and the difficulty of effective and stable production is increased, in order to achieve the whole process management of the development of the research area, and to enhance and improve the effect of reservoir development, By analyzing the test well interpretation results in the past three years and classifying the test well curves statistically with the actual field conditions, the test well interpretation model is optimized; at the same time, the multi-interpretation of the test well interpretation results is systematically analyzed, the causes of multi-interpretation are analyzed, and the test well interpretation model suitable for the ultra-low permeability reservoir is preferred, and ultimately, in conjunction with the history of the development of the reservoir, the dynamics of the reservoir is combined with the data from the secondary interpretation of the test wells to deepen the understanding of the dynamics of the reservoir. [2].

Keywords: Well test; ultra-low permeability reservoirs; multiplicity of solutions; well test interpretation models.

1. Introductory

Jiyuan oilfield W area well test interpretation work is carried out much, the results of well test interpretation deviate from the actual situation in the field, and cannot reflect the real situation of the formation. The main well test methods in the first three years include unstable well test (pressure recovery test, pressure landing test), stratification test, hydrostatic pressure test, spot test and other well test methods. In the past, there were many problems in the whole process of interpreting the test well data with Saphir software, from raw data acceptance to the selection of the interpretation model. In order to reflect the real situation of the reservoir, the test well data of the W zone of Ji Plateau Oilfield were interpreted with Swift software for the second time. In order to reflect the real situation of the reservoir, the secondary interpretation of the test well data of W zone of Ji Plateau Oilfield was carried out by Swift software. The solutions were proposed in the whole process from the acceptance of raw data, the input of basic parameters, the selection of the interpretation model and the diagnosis of the model, so that the results of the test well interpretation were closer to the real situation of the formation.

2. Secondary Interpretation Model for Well Testing

The results of well test interpretation can truly reflect the reservoir fluid seepage condition and formation physical parameters, and provide a reliable basis for the formulation of later development measures. [9] Therefore, the selection of the test well interpretation model is also an important work in the study of the oilfield to carry out the theoretical process, according to the test well interpretation model combined with the current situation of oilfield production, the theoretical research results used to solve the actual problems in the field, the oilfield development and production services of great significance. Through the analysis of 400 well test data in the

study W area it is concluded that the study area is mainly dominated by the fracture model (60%), and there are four main types of interpretation models suitable for the study area, namely, the homogeneous model, the infinite inflow vertical fracture model, the composite model, and the finite inflow vertical fracture model.

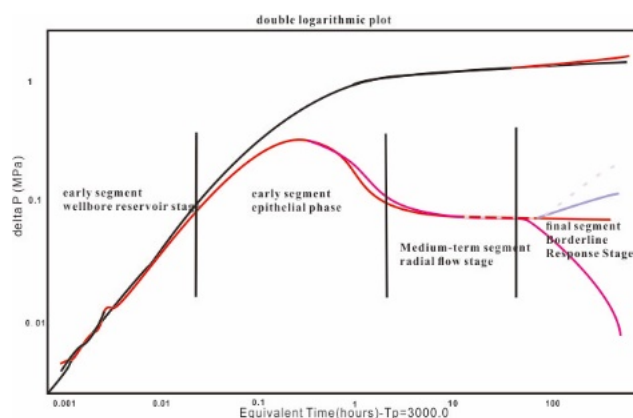


Figure 2-1. Well test interpretation model

Stage division of the test well interpretation model: Stage I is called the renewal section, which refers to the stage when the oil flow flows into the borehole after the well is shut in, and the pressure and inverse are combined into one, and this stage is also called the wellbore storage section, and the larger the wellbore storage coefficient is, the longer the duration of this section is. Reflects the pressure change of the fluid being compressed process in the wellbore when the pressure is restored during the early shut-in of the test. Because in the early stage of well shut-in, although the wellhead is shut-in, the formation fluids far downhole continue to flow towards the wellbore, and these fluids enter the wellbore, causing the fluids in the wellbore to be compressed and re-accumulating elastic energy is pressure build-up. Stage I includes the pure

well storage effect stage and the partial well storage effect stage, while the latter reflects both the pressure in the wellbore and the pressure change of the formation near the bottom of the well, so the contamination and blockage of the formation at the bottom of the well, and the perfection of the well, etc., directly affects the length of its action time. Based on the shape of the curve at this stage it is possible to make a qualitative judgement on the perfection and clogging of the well. [3] Phase II is the transition phase. The pressure shows a smooth transition, the derivative appears to peak and then slopes downward, the peak height depends on the value of the combination of epidermal factors C_{De}^{2S} , the larger the value of C_{De}^{2S} , the higher the peak, and the more delayed the appearance of the peak. Stage III radial flow section, when the pressure in the wellbore reaches a certain value, the formation near the bottom of the well begins to recover, and the test gradually transitions from a partial well storage effect to the end of the well storage effect, and a planar radial flow stage of the formation occurs. This section satisfies the pressure recovery equation and is an effective semi-logarithmic straight line section whose slope magnitude is directly related to the seepage characteristics of the formation. [4] A good permeability of the formation results in a small slope and vice versa. When the formation at the bottom of the well produces lateral inhomogeneity due to phase change, the slope of the semi-logarithmic straight line changes, and the slope changes from small to large, indicating that the permeability of the formation has changed from good to poor, and vice versa, the permeability of the formation has changed from poor to good. Stage IV is called the boundary influence section, the early and late appearance of this section and the test well drainage and drive area tubing, drainage and drive

area is large, the boundary influence section appeared late, otherwise appeared early. [5] Theoretically, the boundary influence section reflects the pressure characteristics of the apparent phase, so that the pressure tends to a constant value and the curve is asymptotically horizontal. If it is a closed reservoir boundary, the semi-logarithmic straight line will buck. If it is a new well on production next to the test well and the formation is well connected, the test well pressure will drop due to inter-well interference.

3. Analysis of Secondary Interpretation of Well Testing

In this paper, through the secondary interpretation of 400 well test data in the study area with Swift well test software, measures are given to potential wells through well test interpretation model fitting and model analysis. Firstly, the fitting of well test interpretation model is carried out to analyze the reasonableness of the data of one well test interpretation, preprocess the data, select the model through the dynamic data of reservoir development, and analyze the parameters such as skin coefficient, permeability, well storage coefficient, formation pressure and so on to end the fitting when they are suitable values, if the parameters are particularly far from the formation characteristics, it is necessary to re-fit the model. Test well interpretation model analysis, according to the test well interpretation of fracture half-length, formation pressure and other parameters and production dynamic data through horizontal and vertical comparison of the study area seepage law, water repulsion law, pressure repulsion analysis of the law, to provide a theoretical basis for the selection of wells for the measures. [12]

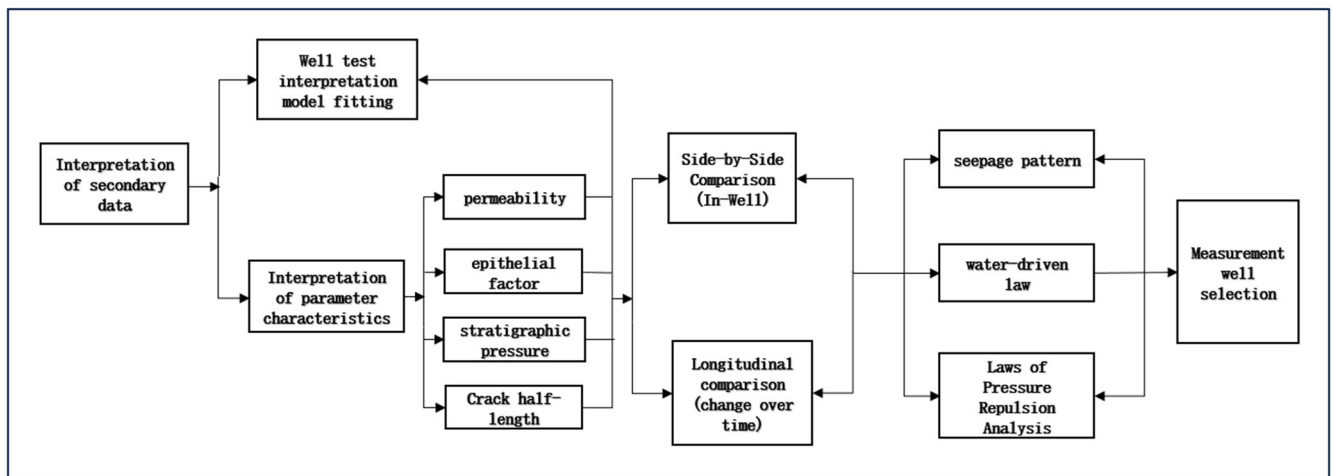


Figure 3-1. Flow of analysis of secondary interpretation of well test

In this paper, through the statistics of one and two test well interpretation model percentage, the statistical results show that the primary test well interpretation is mainly based on the homogeneous model (72%), according to the analysis of the reservoir production characteristics are mainly based on the fracture linear flow primary test well interpretation does not

meet the real situation of the formation. The coverage rate of secondary well test interpretation reaches 89%, and the proportion of secondary well test interpretation model in W area is 60% for fracture model, 21% for homogeneous model and 19% for composite model.



Figure 3-2 Comparison of the results of primary and secondary interpretation of test wells

W zone is mainly dominated by infinite conduction vertical fracture model, followed by finite conduction vertical fracture model, indicating that fractures are commonly developed in reservoir reservoirs. Layer-by-layer analysis as a whole is dominated by homogeneous model, composite model and

infinite conduction vertical fracture model, and there are differences in different layers, with homogeneous and infinite conduction vertical fracture model dominating in Chang 6 and Chang 8, and no obvious difference in Chang 4+5.

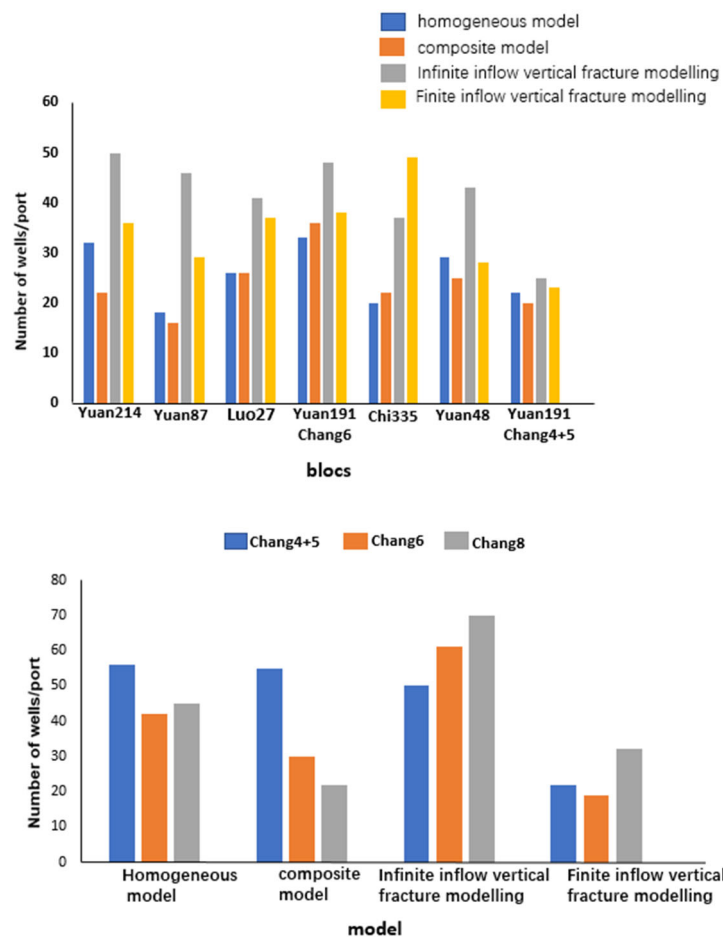


Figure 3-3. Interpretation model distribution of test wells (sub-reservoir, sub-layer)

4. Application of the Results of The Secondary Interpretation of Well Tests

Through the secondary interpretation of 400 wells test well

data, in-depth excavation of reservoir geological data, combined with production dynamics to analyze the pattern of change of seepage flow in oil and water wells, to optimize the single-well development plan, and to provide a theoretical basis for the selection of pressure measurement and selection of wells.

4.1. Polymer Microspheres Integral Tuning Drive

According to the results of the second interpretation of the test wells, the comprehensive management idea of "injection-drive-extraction" system engineering in the early stage of W

area, it is recommended to support the dissection and drive, the specific approach is "PEG-1 gel single well dissection + regional polymer microsphere drive". Among them, 8 single wells are mainly carried out in the east, and 30 polymer microsphere drives are implemented in the centre in 1/3 ratio.

Table 4-1. Block W PEG-1 Gel Conditioning Treatment Wells

serial number	pound sign	Well group development conflicts	Purpose of implementation	
1	T92-90	Entering the medium water-bearing stage, accelerating the rate of rise of water content	water control and oil stabilization	
2	T86-94	High water content stage, low extraction	Reduced water content	anatomical and driving parameters
3	T94-90	Strong vertical non-homogeneity, uneven profiles, and well flooding in well group oil wells	water control and oil stabilization	PEG-1: grain size: 100-300µm
4	T92-92	Well group wells flooded with uneven suction profiles	water control and oil stabilization	Injection concentration: 0.3%
5	T90-92	Strong vertical non-homogeneity, uneven profiles, and well flooding in well group oil wells	water control and oil stabilization	injection volume: 2000m ³ Injection Volume: 1.0-1.2m ³ /h
6	T90-90	Entering the medium water-bearing stage, accelerating the rate of rise of water content	water control and oil stabilization	Microsphere: 50nm Concentration: 0.1%
7	T88-92	Strong vertical inhomogeneity and uneven profiles	improved water drive	injection volume: 6000m ³ Injection volume: Equal geological injection
8	T86-94	Strong vertical non-homogeneity, uneven profiles, uneven water injection effects	Scaling up for results	
Subtotal (8 ports)				

After the treatment, the average daily oil increase of a single well is 0.55t, and after the implementation of PEG-1 gel dissection measures, the seepage condition of the reservoir has been significantly improved, the water-control capacity has been significantly strengthened, and the oil production capacity has been greatly increased.

4.2. Evaluating the effectiveness of single-well measures in measure wells

According to the results of the second interpretation of the

test wells and the production dynamic data, the 18 oil recovery wells in the W zone were divided into three categories, A, B and C, and measures were recommended, and a total of 18 potential wells were mapped out. The statistical interpretation results showed that the differential pressure and derivative curves were mostly glued together, and the reservoir properties were poor, the thickness of the sand body was large, and the fracture was developed, and measures such as repetitive fracturing, temporary plugging of the fracture, and oxidization were adopted.

Table 4-2. Well Selection and Recommendations for Measures in Zone W

classify	curve characteristic	Corresponding well number	Reservoir characteristics	dynamic characteristic	Reservoir characteristics	Recommendations for measures
Category A	Test well curves characterized by shanks, presence of fracture closure	T98-89 T89-100 T82-85 T56-101	Poor storage materiality	Medium and high pressure low yield	Sand body thickness, good connectivity, high formation pressure, reservoir micro fracture development, imperfect injection and extraction, strong non-homogeneity	Repeat fracturing
Category B	No humping at the end of well storage	J85-102T95-96 T93-96T92-95 T91-88T84-95 T83-89T59-101	Poor storage materiality	high pressure, low yield	Sand body thickness is large, non-homogeneous strong stratigraphic pressure is high, multi-directional see water	temporary plugging of fracking
Category C	Humping at the end of well storage	T99-98 T97-85 T85-94 T76-93 T57-103	Presence of inter-well interference	high pressure, low yield	Sand body thickness is large, single sand body is complex, conventional acidification measures body fluid effect is poor	acidification

5. Summary

In this paper, through the Swift well test software fitting analysis, the reservoir seepage model is dominated by fracture linear flow, the oil well reservoir model mainly shows single direction linear flow characteristics, the reservoir overall mobility is poor, and the pre-test well interpretation PPD curve is mostly glued together. According to the classification of oil and water wells in the study area of test well secondary interpretation curve morphology, there exists the phenomenon of shutting down wells without radial flow in W area, and it is recommended to extend the time of shutting down wells. For the fracture type has multi-well interference, fracture linear flow, low speed non-Darcy characteristics obvious oil wells corresponding to water injection wells combined with chemical dissection, improve the efficiency of longitudinal upstream water oil drive; homogeneous, impermeable model, water injection wells reservoir model to multi-well interference is dominated by multi-well model in the area more indicates that the area by the strong body of water neighboring wells have a greater impact on the production system of the multiple wells interfere more.

Generally speaking, the interpretation of the second test well is more reasonable than that of the first test well, and the interpretation results are more in line with the real condition of the formation.

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