Study on the ambulatory monitoring and optimization measures of the Gas wells in block A

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Abstract. The analysis of the Gas well is the core work and accompanying with the whole process of gas field development. The dynamic monitoring technology of gas well is an effective way to provide theoretical basis for dynamic analysis. Now there are 3 normal production gas Wells in the production test area of block A. In the process of production, pressure recovery, hydrostatic pressure and corrosion monitoring were carried out for the changes of production, pressure, fluid physical properties and underground surface engineering.We know the fluid accumulation, the corrosion of the downhole string, the reservoir characteristics, the reservoir physical parameters by these monitoring activities. So we guide the reasonable production of gas Wells timely and effectively, in order to better provide a basis for gas well production management and scientific decision-making.We should carry out rectification and strengthen management to problematic gas Wells and loopholes in dynamic monitoring, and provide better assurance for the development of gas fields.

Key words: Development of Gas field; Ambulatory Monitoring; Corrosion Monitoring.

1. Introduction

Block A of the oilfield is located in the south of the Nose structure belt of Q oilfield, namely the No.1 trap.This fault-nosed structure is formed by the no. 8 fault cutting the Pu Nan nose-shaped structural belt.The Hei Di Miao oil layer is developed in the 3rd and 4th member of Nen formation, the 4th member of Nen formation is group H Ⅰ, and the 3rd member of Nen Formation is Group H Ⅱ.According to the rock cycle and section structure, the fourth member of Nen formation can be divided into six cycles, and the third member of Nen formation can be divided into four cycles.The reverse cycle of Hei Di Miao reservoir is characterized by the lithology changing from fine to coarse and from bottom to top.The bottom of the cycle is the stable distribution of mud stone, and the upward is mud silt, silt, silt-sand, fine sand, sometimes visible the middle sand.And the dark mud stone segment gradually thinned from bottom to bottom.The effective porosity of the reservoir ranges from 28.1% to 40.1%, with an average of 33.9%.Air permeability ranges from 80×10-3μm2 ~ 9427×10-3μm2 with an average of 1736×10-3μm2. The clastic material in the oil layer has a low grain size, and is generally silt grade.The rock type belongs to feldspar lithic sandstone.The quartz sand ranges from 23.0% to 25.0% with an average of 25%.The feldspar ranges from 28.0% to 34.0% with an average of 31.0%.The detritus ranges from 27.0% to 38.0%.The average particle size (Mz) is 0.082mm,the standard deviation (σ1) is 1.711,the sorting is poor,and the mud content is 9.8%.

According to the development stage and actual situation of gas field in block A ,Production Wells are mainly monitored.The main content of dynamic monitoring includes pressure, temperature, production, underground surface engineering, fluid properties and composition, etc.The system has been optimized and improved through practical application, which basically meets the needs of dynamic tracking analysis and production management of gas field development.

2. Analysis of Dynamic Monitoring Effect in Test Area

2.1 The Test of Flow Temperature, Flow Pressure, Static Temperature and Static Pressure

In order to understand the variation law of formation pressure and well bore fluid in the test area.Pressure-temperature gradient tests were carried out for single production Wells and grasp formation pressure change of gas reservoir timely and accurately. So in the future, dynamic reserve calculation, reasonable production allocation of gas well and evaluation of gas reservoir development effect play an important role.

a well

Combined with pressure-gradient test results from the well in 2009 and 2019, the fluid density in the wellbore is

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roughly evenly distributed in the shut-in state, and there is no fluid accumulation in the manometer measuring point depth to the wellhead.The test data show that the flow pressure gradient is slightly greater than the static pressure gradient, indicating that the water and recombination produced in the well opening state are mixed with the flow. After shut-in, water and recombination are subsiding and there is pure gas column in the wellbore (Figure 1-Figure 2).

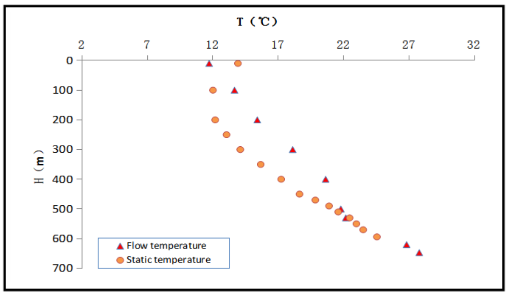

Figure 1. Comparison of flow temperature and static temperature of well a in block A

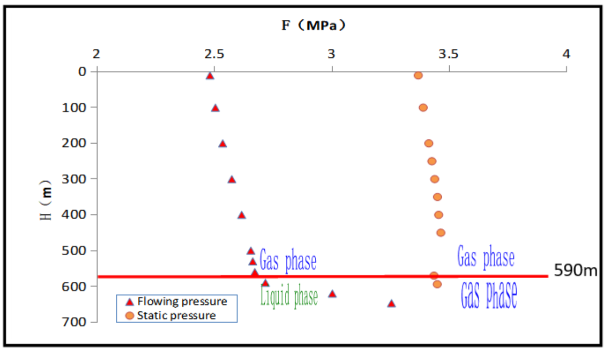

Figure 2. Comparison of flow pressure and static pressure of well a in block A

(2) b well

After the geological scheme, engineering design and all field work for pressure - temperature gradient test of well b, there is no influence of wellbore fluid accumulation in well b in both open and closed state (Figure3).

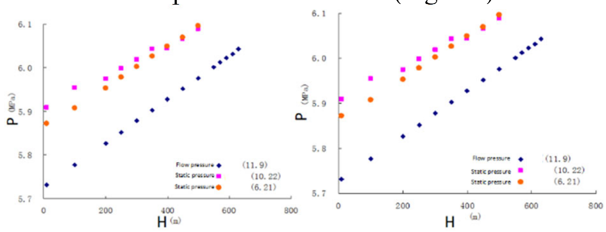

Figure 3 Distribution diagram of wellbore flow temperature, flow pressure, static temperature and static pressure in well b

c well

After the geological scheme, engineering design and all field work for pressure - temperature gradient test of well c,there is no influence of wellbore fluid accumulation in well c in both open and closed state (Figure4).

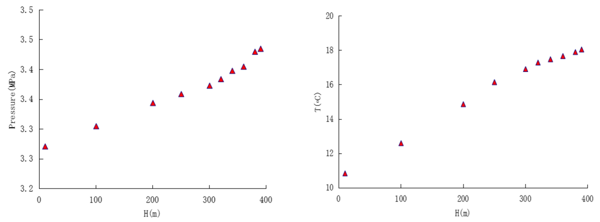

Figure 4. The distribution map of flow temperature and flow pressure in well c wellbore

Through the test of flow temperature, flow pressure and static temperature and static pressure, it can be concluded that there is no influence of wellbore fluid accumulation in the opening state of three gas Wells. The small change of pressure indicates that the gas reservoir has good gas supply capacity.

2.2 Buildup Test

In order to understand the gas well pressure recovery situation, study the reservoir characteristics of gas reservoirs, determine reservoir physical parameters and single well gas supply range and the reservoir pollution near the bottom of the gas well. So well b is selected for pressure recovery test (Figure5-Figure8).

The gas pressure will change regularly and propagate in all directions like water waves When the gas well is shut in for pressure measurement. In the range of ripples, pressure sweeps the micro and macro structure of gas layer at each point. According to the scanning information , the macroscopic characteristics and the parameters of the gas layer within the scanning range can be judged. Therefore, pressure recovery test data and other information was used to measure many characteristics of the test zone and well.

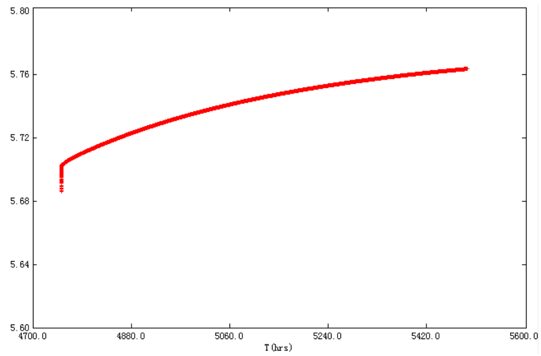

Figure 5. The pressure recovery curve of well b

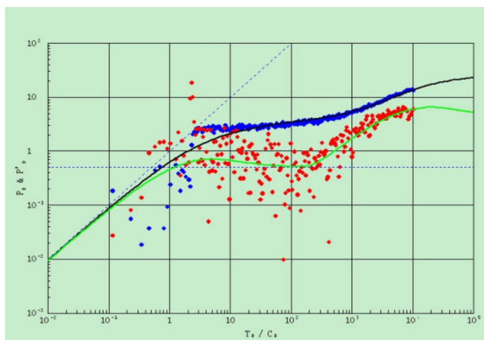

Figure 6. The double log fitting curve of well b

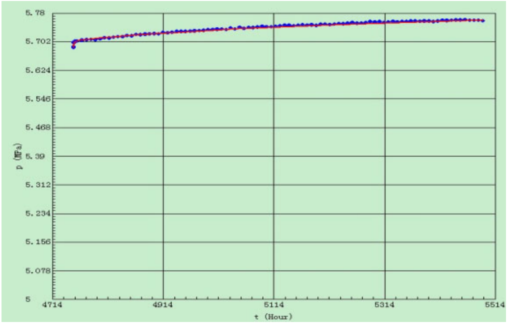

Figure 7. The history fitting curve of well b

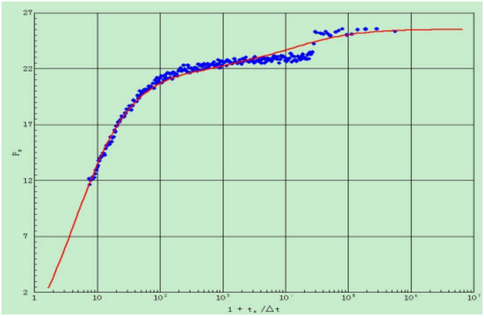

Figure 8. The Horner Dimensionless test curve of well b

By means of pressure recovery well test, combined with geological dynamic and static data, the formation parameters of well b are obtained by using variable well reservoir+radial coincidence+infinite formation. The flow coefficient is 158.23 μ m² .m.Effective permeability of formation was 0.20μm².The skin coefficient was -4.25. And the detection radius was 2224.15. The production status of the well was analyzed through the study of various parameters. The skin coefficient of the well decreased from 30.08 in 2011 to -4.52 at present. It shows that the pollution degree of the well has been effectively improved (Table1,Figure9).

Table 1. Pressure recovery well test data sheet of well b

model	Variable well reservoir + radial coincidence + infinite formation	
Average formation pressure	5.8058	MPa
Permeability k	0.1977	μm^2
Flow coefficient kh/μ	158.228	μm^2 •m/mPa•s
Formation coefficient kh	2.0165	μm^2 •m
Fluidity k/μ	15.5126	μm^2 •m/mPa•s
Well store constant C	257.417	m^3/MPa
Well bore skin factor Sw	-4.2529	
mobility ratio	8.299	
storativity ratio	10.643	
Interface radius r	315.943	m
radius of investigation ri	2224.152	m

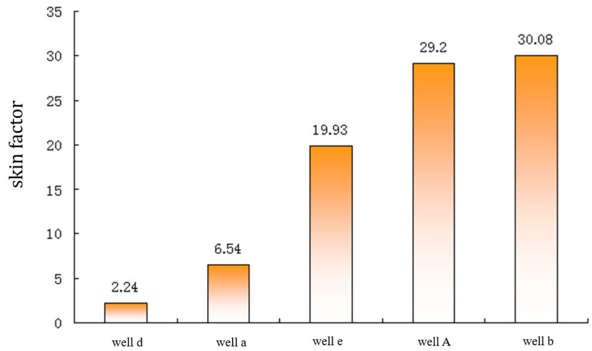

Figure 9-Skin coefficient distribution diagram of gas well test stage in block A

2.3 The Corrosion Monitoring of Gas Well

Now, the corrosion monitoring of gas Wells is mainly carried out by electrochemical method. temperature and pressure are important related factors of corrosion rate For gas well corrosion monitoring. But corrosion rate is also affected by humidity (or partial pressure of water vapor), flow rate, etc.

Corrosion monitoring showed high corrosion rates in all five Wells. The corrosion rates ranged from 0.05mm/a~0.1543mm/a.The corrosion degree is moderate and severe according to the standard of NACE RP-0775-91 stipulated by the American Society of Corrosion Engineers (NACE)(Table 2).

Table 2. The table of Asme(American Society of Corrosion Engineers) Nace RP-0775-91 Corrosion degree specification

classification	Uniform corrosion rate(mm/a)	pitting rate(mm/a)
Mild corrosion	< 0.025	< 0.127
Moderate corrosion	0.025~0.125	0.127~0.201
serious corrosion	0.125~0.254	0.201~0.308
Extremely severe	> 0.254	> 0.308

The wellbore corrosion of N80 and P110 materials is serious according to the current downhole production conditions of Wells a and c. The well life is less than 10 years based on current corrosion rate monitoring. However, partial pitting or perforation may occur in some sections. Measures should be taken to protect the parts with high corrosion rate. Periodic corrosion monitoring is used to monitor the corrosion. In the production process, corrosion inhibitor is added periodically with the corrosion monitoring method which is combined to protect the wellbore. Ensure the normal and safe production of gas Wells (Table 3).

Table 3. The table of corrosion monitoring of gas well string by electrochemical method

gas field	serial number	well number	corrosion rate(mm/a)		The depth of main corrosion well (m)
			2020Y	2021Y	
the test area of A gas production	1	a	0. 0955-0. 1751	0. 0520-0. 1462	480-630
	2	c	0. 0941-0. 1563	0. 05-0. 15	300-390
	3	b		0. 053-0. 148	520-650
	4	d		0. 05-0. 147	500-650
	5	e		0. 05-0. 1543	375-500
Total (Wells)			2	5	

3. Study on the Optimization of Gas Well Dynamic Monitoring Measures

At present, the gas production test area A of Pu Nan Oilfield is still in the initial stage of testing. The underground geological conditions of single production well are complex. And the well condition can not fully meet the needs of production dynamic monitoring. The main performance has the following aspects:
(1) The phenomenon of gas and water flowing out together and oil and gas flowing out together occurs in production Wells. All of these will affect gas well production. In view of the above problems, the analysis of geological characteristics and production dynamic characteristics should be strengthened. A reasonable production system is established for the production of single well through the study of geological conditions and rational production allocation method. So maximize resource utilization and ensure long-term stable production of gas Wells (Figure10).

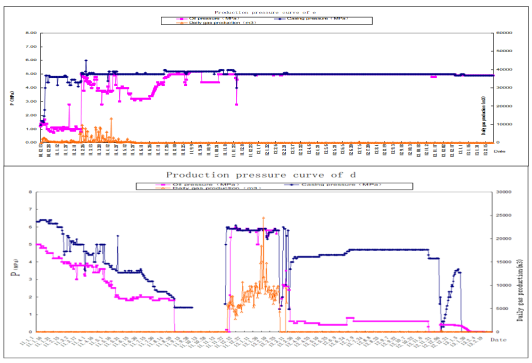

Figure10. The production curves for wells c and d

(2) The gas wells are usually low-yield industrial gas wells or middle industrial gas wells in the test area. Single-layer production capacity is difficult to meet the requirements of gas production profile testing. At present, the gas production profile test results are obvious for the single-layer daily gas production above 10,000 cubic meters. If the daily gas output is less than 10,000 cubic meters, the test results cannot be accurately accepted due to the insufficient accuracy of the test instrument. In order to provide technical support for reservoir data acquisition and analysis in the future, the study of gas production profile testing technology in middle and low pay zones was carried out for producing Wells in the experimental area.
(3)Because the perforation test technology of pipe transport is adopted in the gas well test in the test area, the perforation gun and screen tube of tubing are not lifted out after perforation. At present, the perforating gun and screen are still suspended on the wellbore tubing , and the bottom end of the tubing is sealed in some Wells. So the result of that cannot be properly tested through the tubing in some of the project's test instruments.

4. Conclusion and understanding

1.The results of dynamic monitoring show that there is no fluid accumulation at the bottom of the well and the corrosion degree is moderate or severe. And the formation parameters such as formation flow coefficient, effective permeability and skin coefficient are obtained. These results provide a more powerful theoretical basis for stratigraphic analysis. These also provide a better basis for gas well production management and scientific decision-making.
2. The analysis of geological characteristics and production dynamic characteristics should be strengthened for the problem Wells. In this way, a reasonable production system can be established for the production of individual Wells. So this method can not only ensure the long-term stable production of gas Wells but also maximize the resource utilization.
3. Downhole gun and screen should be removed by operational construction and install a bell mouth in order to test the future work smoothly. For the planned gas test Wells in the future, the perforating gun and screen pipe should be removed after the gas is discharged from the perforation. And the bell mouth should be installed. Then the system will be tested and put into production.

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