Discussion on efficient exploitation technology of tight glutenite reservoir in Daqing

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Abstract. In XuShen gas field, due to the big lateral change of reservoir, accurately find the glutenite reservoir dessert area is difficult, Reservoir density and physical property is poor. Vertical Wells are the main wells in developed gas Wells, Inconsistent activity appeared in the process of mining action: high Shut-in pressure. low gas well production and poor stable yield ability. In urgent to tackle key problems are capacity breakthrough. long-term stable process and techniques of high economic benefit. By carrying dual branch horizontal well development, successfully realized effective use of reservoir and high-efficient development of gas field.

1. Development status of deep conglomerate
The company has obtained certain understanding and achievements in horizontal gas well fracturing completion. Since 2008, 21 horizontal wells have been deployed. For deep volcanic rocks, some experience and understanding have been obtained, and the open flow rate of some gas wells that have completed fracturing and gas testing has reached more than \(100 \times 10^4\) m\(^3\). However, for glutenite reservoir, it has been explored for more than 10 years, and no breakthrough has been made. Based on the statistics of reconstruction scale of glutenite reservoirs in the fourth member of Ying formation with different well types (39 vertical wells and 5 horizontal wells) in the past 10 years, the influencing factors of initial effect and long-term stable production capacity are analyzed. The well with good effect will increase the scale of reconstruction and the effect after fracturing will increase. Therefore, in order to speed up the evaluation and production step of tight glutenite reservoir, double branch well completion and large-scale fracturing technology are used to develop deep tight glutenite reservoir and improve single well production.

2. Well bore structure design of double lateral horizontal well
In order to realize the effective production of glutenite reservoir, large-scale fracturing technology for dual branch horizontal wells is carried out. Through individualized design, the completion technology of branch horizontal well with multiple sets of thin and poor layers can be developed, large-scale volume fracturing of upper and lower branches and separate layer production can be
carried out. For the first time in China, the fourth stage double branch open hole staged fracturing completion is realized, and the safety and reservoir protection during the construction process are ensured.

2.1. BHA and bit series for increasing drilling speed
Through the optimization of BHA and bit, the rotary steering + PDC bit in the inclining section and the high temperature and low speed motor + cone bit combination drilling technology in the horizontal section is formed. Through optimization, it is 139.7% higher than before.

2.2. Wall mounted suspension system
After the completion of the recovery of the deflecting combination, the down wall hanger and the guide elbow will lead the cementing liner string into the upper branch hole. The guide device of branch hole is pre installed and recovered after fracturing of upper branch hole.

![Figure 1. The working principle diagram of main hole guide and branch hole guide](image)

2.3. Completion and open hole staged fracturing technology
The cementing technology is innovated by cementing the deflecting section and re entering the later drilling to realize the window sealing.

1. Preset branch hole guide and liner rubber plug to ensure the implementation of cementing technology at the interface.
2. (3) Cementing protection measures shall be taken for the guider, coupling barrel and temporary plugging tools to ensure the guide device to be taken out and the fracturing and completion tools can be re entered.
3. (4) Liner hanger and top cementing packer improve the reliability of completion tool suspension and sealing, and meet the requirements of safe production.
2.4. Chemical and mechanical temporary plugging technology
(1) Using PERFFLOW temporary plugging fluid can effectively protect the reservoir and save 500 m$^3$ of conventional completion fluid.
(2) The DB temporary plugging packer and fracture disk are designed to temporarily plug the lower branch hole to ensure the smooth implementation of the upper branch completion fracturing technology.

2.5. The production string has triple seal protection
(1) The triple seal protection includes downhole safety valve, production packer and two insert seals to ensure the safety and reliability of the string.
(2) Selective combined mining or separate mining. By switching the sliding sleeve and putting the plug in, the gas well can be separated and combined production.

3. Scale design and field implementation effect of reservoir reconstruction
Based on the optimization technology of large-scale volume fracturing scheme for tight pore and intergranular fracture cavity type glutenite, the corresponding operation parameter optimization design method and field diagnosis and control technology are established, and the "three-dimensional" transformation of glutenite dual branch wells in the fourth member of Ying formation is realized.
(1) Combined with the actual drilling lithology, physical property changes and plane sand body prediction, the personalized design of upper and lower branches realizes "three matching" (matching of fracture distribution and sand body, matching of artificial fracture and structure, matching of construction parameters and physical properties), pursuing the goal of maximizing reconstruction volume, and reasonably optimizing the number of fracturing sections and reconstruction scale. Through the simulation, the optimal number of fracturing sections in the lower branch is 15-16, and that of the upper branch is 12-13.
(2) In order to improve the fracture efficiency and reduce the cost, the design method of three-dimensional staggered fracture arrangement is studied to prevent the upper and lower branches from channeling and ensure the reservoir to be fully volume reformed.
(3) Aiming at the tight porous glutenite reservoir in the lower branch, a volume fracturing design method with high density fracture distribution and large-scale sand addition has been formed to expand the fracture contact area. Compared with the previous wells in this block, the number of fracturing sections is increased by 4-5 times, the sand content of single section is increased by 11.1%, and the
liquid volume of single section is increased by 73.5%. According to the structure and physical properties, the construction parameters such as sand adding program and pre fluid ratio are optimized to ensure the long-term effect after compaction.

(4) Aiming at the upper branch intergranular fracture vuggy reservoir, aiming at effectively communicating micropores and intergranular fractures and realizing long-term effective support at nodes, the sand ratio is reasonably optimized to improve the effective fracturing volume. The upper branch adopts the mode of high preflush ratio, low sand ratio and multi-stage plug and sand adding to realize the long-term effective support at the corner node.

4. Conclusion
(1) For the first time, the branch hole interface construction of branch horizontal well has been successfully implemented, which includes fishing the main hole deflector, leading the cementing pipe string into the upper branch hole, setting the wall hanging hanger to the deviated section of the branch hole, and so on. The whole construction process involves more than 20 kinds of downhole tools, realizing continuous construction, and the success rate of technology is 100%.

(2) The drilling cycle of single branch is shortened by more than 30 days, and the gas testing after fracturing is up to 1.05 million m$^3$/d, which has achieved a breakthrough in the production of tight glutenite reservoir.

(3) The completion string has triple sealing protection, which meets the standard requirements of the joint stock company, and can realize the purpose of separate and combined production.

(4) The successful implementation of dual lateral horizontal wells has established a development model for optimizing the production of tight gas reservoirs with multiple thin and poor reservoirs, which provides an effective way for effective production of deep tight and difficult to recover natural gas reserves.

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