Scholars Journal of Engineering and Technology (SJET) **ISSN 2321-435X (Online)**
Sch. J. Eng. Tech., 2014; 2(4B):557-560 **ISSN 2347-9523 (Print)**
©Scholars Academic and Scientific Publisher
(An International Publisher for Academic and Scientific Resources)
www.saspublisher.com

Research Article

The Research of Well Pattern in Horizontal wells and Vertical Wells Based on Numerical Simulation

Zhao YANG *, Han GAO
Department of Petroleum Engineering, Northeast Petroleum University, 163318, Daqing, China

***Corresponding author**
Zhao YANG
Email: aayzyz@sina.com

Abstract: Based on detailed geological modeling of block M and the result of Numerical Simulation, the paper optimized the best well pattern in twenty-two well patterns between 5-spot well Pattern、Invert 7-spot well Pattern and Invert 9-spot well Pattern. The results show that: based on the principle of optimization well pattern, the WP1、WP7、WP15 are better. Considering the Production rate and time, Invert 9-spot well Pattern has a higher Production rate; but 5-spot well Pattern can enhanced energy supplement to improve the oil recovery. Considering the formation pressure and oil recovery, 5-spot well Pattern is the best well pattern in all. Reasonable Well Pattern can help improve oil recovery and keep formation pressure, which has great influence on development effect. In the process of developing low permeability reservoir, vertical wells combines with Horizontal Wells are widely used. Based on detailed geological modeling of block M and the result of Numerical Simulation, the paper optimized the best well pattern in twenty-two well patterns between 5-spot well Pattern、Invert 7-spot well Pattern and Invert 9-spot well Pattern. And choose the best well pattern, which will have leading guidance on developing M block.
Keywords: Low Permeability Reservoir; Optimization of Well Pattern; Horizontal Well; Numerical Simulation

INTRODUCTION

Fine Geological Modeling

Using Petrel software to build up the Geological Modeling [1-2]. Taking reservoir heterogeneity, the work area, formation thickness, well spacing density and other factors into consideration the Geological Modeling adopts 1189×1010×5 grid system. The plane grid is 0.5 meters to describe the planar distribution characteristics; the vertical grid is 5 meters to tell the sandwich. Using facies controlled modeling building the POR model、permeability model、NTG model and So model.

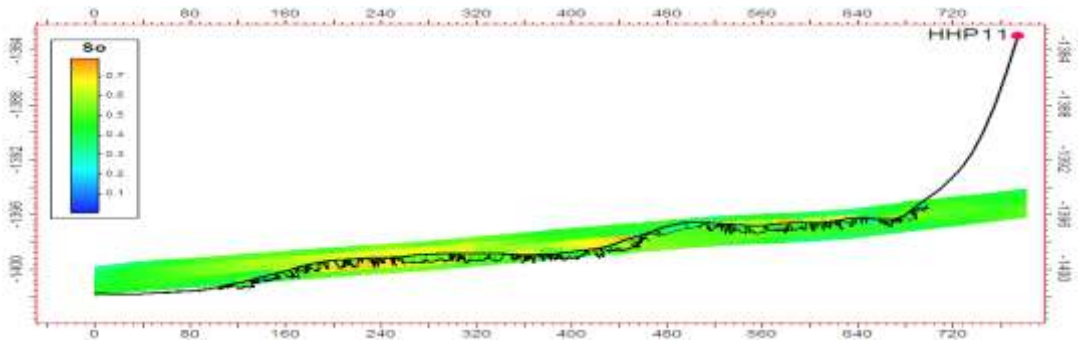


Fig. 1: Well HHP11 too well profile permeability distribution

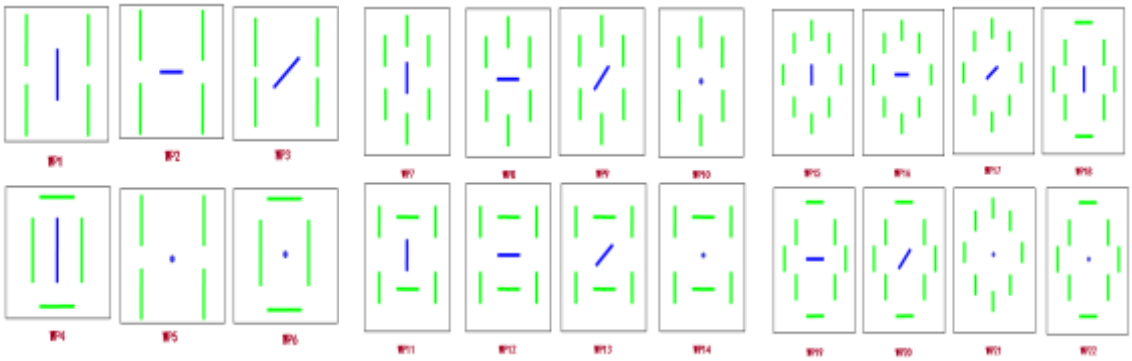
As shown in Fig.1, HHP11 wells located in the southwest block modeling. Relatively flat low-lying area of the top surface. The well overall porosity and permeability properties better, overall oil-rich region located. Through the comparison of the model with the actual drilling well path trajectory, the well trajectory basically meet the requirements, the actual geological conditions of property distribution agreement with M block, the next step can be carried out to optimize the calculation.

Well Options

The Block M geological models into numerical simulation software create a numerical simulation

model [3]. Total mesh model is 146 × 164 × 5 = 86920, grid step is 15m × 15m × 0.6m (X × Y × Z), simulated geological reserves of 159 × 10^4t.

For geological features M block, through comprehensive research and extensive research, Design a 5-spot well Pattern, Invert 7-spot well Pattern, Invert 9-spot well Pattern of 22 kinds of well pattern, WELL schematic diagram shown in Fig. 2. 22 kinds of well Pattern are divided into horizontal wells - vertical wells and water mix well Pattern Hirai well Pattern types. 5-spot well Pattern: flat note flat production well four kinds (WP1, WP2, WP3, WP4), direct injection flat production well two kinds (WP5, WP6); 7-spot well Pattern: flat note flat production well six kinds (WP7, WP8, WP9, WP11, WP12, WP13), direct injection flat production well two kinds (WP10, WP14); Invert 9-spot well Pattern wells Patterns: flat production well injection flat six kinds (WP15, WP16, WP17, WP18, WP19, WP20), direct injection flat production well two kinds (WP21, WP22).



5-spot well Pattern 7-spot well Pattern Invert 9-spot well Pattern

Fig. 2: Schematic well pattern optimization programs

RESULTS

Insufficient fluid supply of the well pattern

WP5 of the 5-spot well Pattern, WP10 of the 7-spot well Pattern, WP21 of the Invert 9-spot well Pattern, the three direct injection flat productions well for lack of a serious solution. From the formation pressure versus time curve (Fig. 3), we can see that the lower average reservoir pressure of these three wells net, end of the decade the average pressure in the formation between 8.15 ~ 9.57MPa. As can be seen from the injection ratio versus time curve , three injection wells Patterns than is generally low, less than 1. All three belong to the well Pattern was inadequate for the well Pattern. WP5 well Pattern 10 at the end of the degree of recovery reached only 5.67%, moisture content reached 42.95%. So these three wells net wells can not be fully liquid mining capabilities, strengths as well Pattern is not suitable.

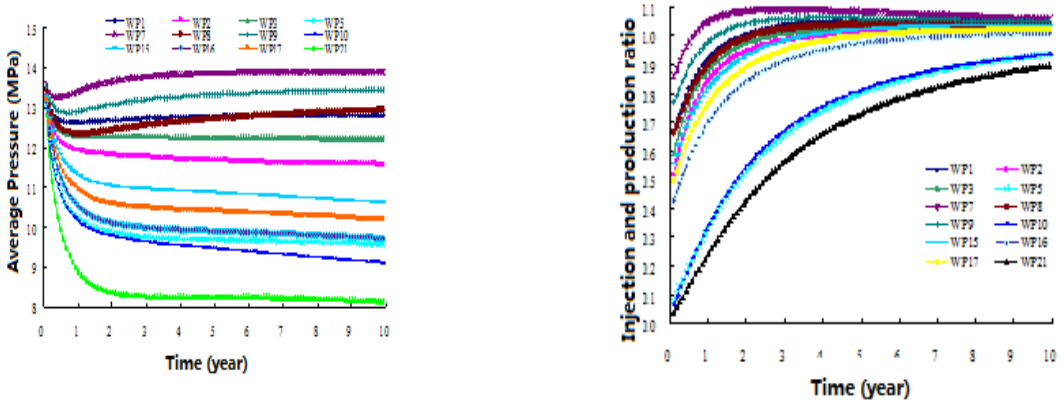
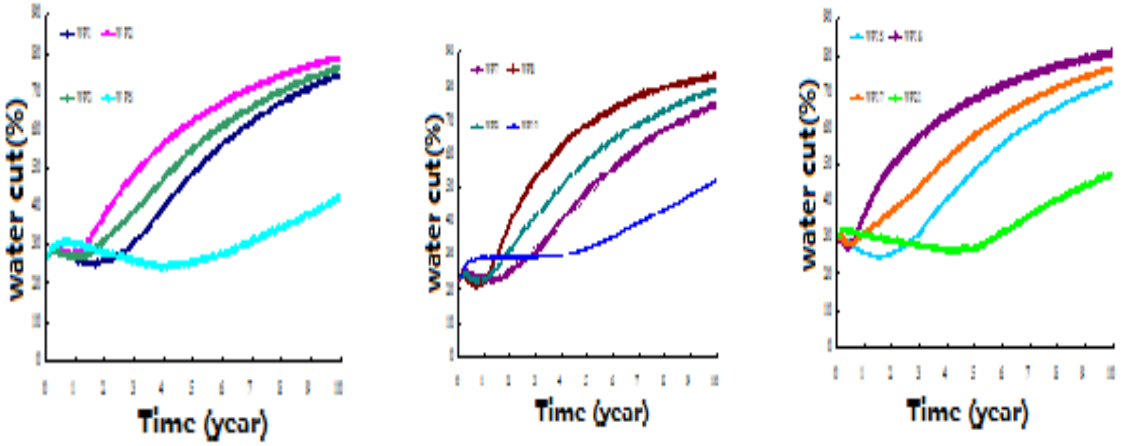


Fig. 3: The injection ratio versus time curve

See the water earlier of well Pattern

WP2 of the 5-spot well Pattern, WP8 of the 7-spot well Pattern , WP16 of the Invert 9-spot well Pattern, these three kinds of injection wells and production wellbore direction vertical wells, horizontal wells because the ends of the flow velocity large, horizontal wells early water breakthrough, water rising fast. WP2, WP8, WP16 these three wells net injection level compared with other flat production well, end of the decade is the lowest level of recovery, from the relationship between moisture content and time curve (Fig. 4) can be seen, these three well time to see the

water Pattern and water rising faster than other well Pattern, WP2 see water time is only 0.66 years, reducing the anhydrous oil phase, so these three well Pattern is also inappropriate to do well Pattern advantage.



5-spot well Pattern 7-spot well Pattern Invert 9-spot well Pattern

Fig. 4 Moisture forms under different well curve

Screening results of advantage well

WP1 of the 5-spot well Pattern, WP7 of the 7-spot well Pattern, WP15 of the Invert 9-spot well pattern, these three are better, it can be seen from the relationship between the production rate versus time curve (Fig. 5), the Invert 9-spot well Pattern initial production rate well Pattern, but the 5-spot well Pattern can enhance energy supplement well Pattern to improve water flood efficiency, and ultimately improve recovery. From maintain reservoir pressure and maximize the ultimate recovery perspective, WP1 of the 5-spot well Pattern is optimal well pattern.

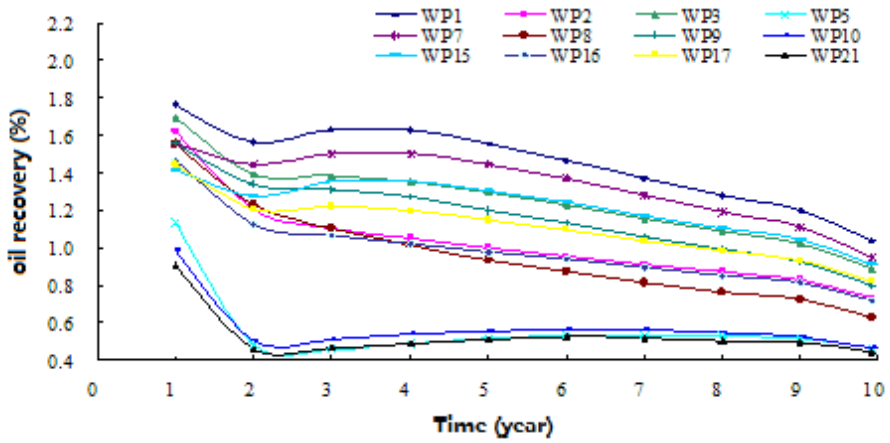


Fig. 5: Different forms of network production rate well under the curve

CONCLUSION

- In the form of straight net wells and horizontal wells combined mining, WP1 of the 5-spot well Pattern, WP7 of the 7-spot well Pattern, WP15 of the Invert 9-spot well Pattern, these three is well developed.
- From maintain reservoir pressure and maximize the ultimate recovery perspective, WP1 of the 5-spot well Pattern is optimal well Pattern. WP1 well Pattern can form the basis of the form; provide the basis for guiding pattern adjustment.
- Well Pattern parameters can be optimized on the basis of the advantages of well Pattern WP1, select the best well Pattern parameters.

ACKNOWLEDGEMENTS

This work is supported by the national special program China (No. 2011ZX05052-007-006). Furthermore the authors would like to thank all members of the research team.

REFERENCES

1. Yinan Q; Low permeability sandstone reservoir development model. Beijing: Petroleum Industry Press, 2002: 47-53.
2. Pang Zhangying, Li Lianjun, Hu Dingtang, and other reasonable well studied straight horizontal wells in low permeability reservoirs combined

mining. Oil and Gas Technology, 2008, 30 (1): 307-309.

3. Xuewen Z, Wanglong F, Mei Q; low permeability oil field development well pattern design of the system . Petroleum Exploration and Development, 2000; 27(3): 57-59.