Numerical Simulation Study on Injection and Production Parameters of Oil - Water Well in Carbonate Reservoir

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Abstract

For the multi-crevice-connected carbonate reservoir, after the natural energy development, water flooding can be carried, which can supplement the reservoir energy, improve the recovery rate and increase the economic benefit. Firstly, the mechanism of water flooding and the water injection model were discussed. Secondly, the parameters of water injection flooding are optimized, including the relative position of injection and oil well, and the low injection is better than high injection. The method of injection by fracture is better than that of injection by cave; It is optimized for the selection of rotary oil wells, the timing of pouring and the amount of water injection.

Keywords

Carbonate reservoir; Water flooding; Numerical Simulation.

1. Introduction

Carbonate reservoirs account for a larger share of world oil and gas reserves. The main features of the carbonate reservoirs is that the complex geological structure, the distribution of matrix in the reservoir, cracks and caves, substrate permeability is low, cracks and cave distribution is irregular, the formation of energy failure faster and the development is more difficult. In view of the above problems, multi-fractured-type carbonate reservoirs can be used to supplement the formation energy by water flooding to expand the volume and increase the recovery rate and increase the economic efficiency [1-2].

2. Mechanism and mode of water flooding

2.1 Water flooding mechanism

(1)With the injection of water into the cave, play the role of supplementary energy, can increase the oil production capacity ;(2) With the injection of water into the cave, under the action of gravity, oil and water differentiation, the injected water acts as a longitudinal displacement; (3) Water into the process of the corrugated hole can play a role in the role of lateral oil displacement;(4) After the water is injected into the fractured element, the formation pressure of the reservoir is increased, can inhibit the flow of bottom water [3-4].

2.2 Water flooding mode

(1)Time. At the beginning of the development, it was important to clarify the relationship between injection and production of oil wells, so the use of water injection to clear the relationship between oil and water wells; after clear the relationship between oil and water wells, to supplement the formation of energy and different directions of oil as the main purpose, so to moderate water injection; after a while, according to the dynamic characteristics of the production and injection wells, dynamic adjustment of the working system of oil and water wells to prevent water injection channeling, has a negative impact on reservoir development [5];

(2) Vertical development mode. according to the distribution characteristics of different multi - crest reservoirs in the longitudinal direction, development principle is a low injection and high mining, sewing hole mining, improve the water drive some fluctuations in the volume, reduce the horizontal water channeling.

(3) Plane development method. First, the description and division of the fractured hole of the crevice type carbonate reservoir are carried out, in the description and di. During the whole development process, the change of the connectivity of the oil and water wells is emphasized, the tracer test, the analysis of the relationship between the oil and water wells, and so on, so that the oil and water wells can be adjusted in time.

3. Study on Parameter Optimization of Water Injection and Flooding

After the analysis of the necessity of water flooding in the fractured-type carbonate reservoir, the optimal design of water injection and flooding parameters is carried out.

3.1 Relative position of injection and production well

According to the relative position of the oil and water wells, the injection and production methods of the well group are divided into two types: low injection and high injection. Injection and production ratio use 1, daily water injection of 20 m3 / d. The simulation results show that the development effect of low injection and high mining is better, and the development effect of low injection and low mining is poor.

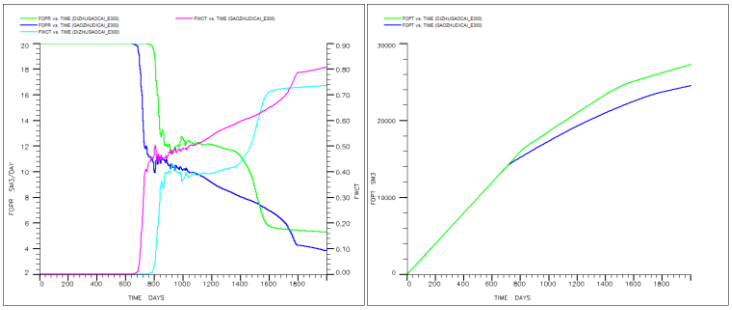

Fig.1 Curve changes in different relative positions of oil and water well

Comparison of the two programs can be seen, low injection and high mining can be seen along the time of production wells, low injection of high water time in May 2019, high injection of low water time in June 2018.

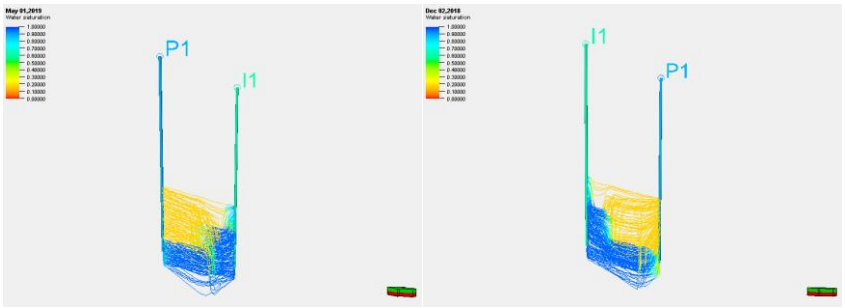

Fig.2 Variation of Water Saturation in water and oil well

3.2 Seamhole injection and production relationship

Carbonate reservoirs are mainly composed of cave-shaped reservoirs and fractured reservoirs. In the different reservoirs connected with each other, the joint - hole combination and the hole - hole combination model are taken. The numerical simulation is used to study the effect of water injection under different reservoir types under different reservoir types. Through the simulation, it is found that the increase of water content is higher and the recovery rate is higher than that of hole injection.

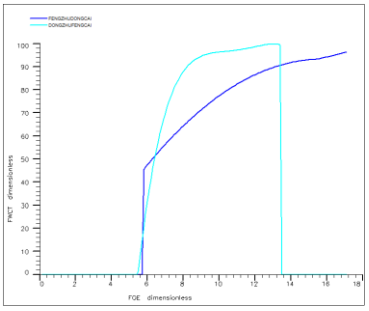

Fig.3 The curve of degree of reserve recovery and water cut in different reservoir types I

Therefore, in different reservoir wells injection method, should choose the reservoir physical properties of poor water injection, reservoir physical properties of well water production methods. This can be in the case of oil production capacity does not affect the case as much as possible to expand the effect of water injection wells.

3.3 Turn over the oil well

(1) The choice of turning well

Should be selected: ① oil production in the latter part of the performance of energy is insufficient, the output decline quickly; ② well drilling reservoir type to crack reservoirs and other reservoirs with poor physical properties.

(2)The timing of the transfer

In the target reservoir, two wells are produced. One of the oil wells has a perforated reservoir and a well is a cave reservoir. The initial production of two wells is normal. With the decrease of formation pressure, the development of the reservoir is carried out. According to the following formula: ① the original formation pressure at the injection of oil wells; ② in the ground pressure difference in the 10MPa oil wells; ③ in the saturation pressure in the 0MPa oil wells pouring; ④ formation pressure maintained at saturation pressure 90% oil wells; Maintained at 80% of the saturated pressure when the oil wells were injected. The simulation results show that when the formation pressure is close to 90% of the saturated pressure, the cumulative oil production is the best and the effect is the best. Simultaneous simulation of the case of oil production without changing the situation.

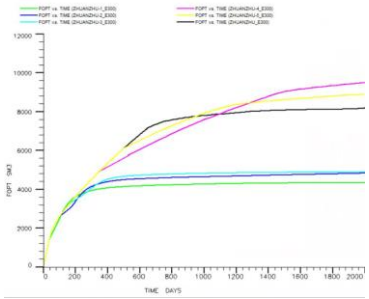

Fig4 Cumulative production curve of different injection time

(3)Injection-production ratio optimization of water wells converted by oil wells

Converting the oil wells to injection wells when the formation pressure is maintained at 90% of the original formation pressure. We designed four model of different injection-production ratio (0.5, 0.8, 1.0, 1.2), the best injection-production ratio can be obtained by compare the oil production curves and cumulative oil production curves. When the injection-production ratio is 1.2, although the formation pressure can be recovered rapidly in the initial stage, the injection water is easy to form water channeling, resulting in low recovery. When the injection-production ratio is 0.5, the formation pressure can not be recovered well, the effect of enhance oil recovery is not obvious. There was little difference in final oil recovery when the injection-production ratio is 0.8 and 1.0, and the water injection is larger when the injection-production ratio is 1.0. therefore, the best injection-production ratio is 0.8.

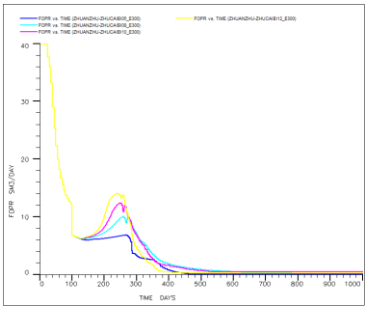

Fig.5 Oil production curve with different injection-production ratio

4. Conclusion

(1) The mechanism and model analysis of water injection flooding are carried out for fractured vuggy carbonate reservoirs.

(2) For the relative location of oil and water wells, the method of injecting low and producing high delay the water breakthrough time, and it's recovery is bigger than the recovery of injecting high and producing low method.

(3) When the oil and water wells in different reservoirs, the method of injecting in fracture and producing in cavity is better than the method of injecting in cavity and producing in fracture.

(4) For the oil wells which convert to injection wells, the convert time is saturation pressure; after oil wells convert to injection wells, the injection-production ratio is 0.8 in general.

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