The discussion of Well Selection and Layer Selection Method on Polymer Flooding Fracturing in Class II Reservoir

Zhang Yingying
Address: Geological Brigade, No. 3 Oil Production Plant, Daqing Oilfield Co., Ltd., Saertu District, Daqing City, Heilongjiang Province, 163113

Author brief introduction: Zhang Yingying engineer, graduated from Daqing Petroleum College in 2008, majoring in petroleum engineering, engaged in tertiary oil recovery and development. E-mail: Zhangyingying0825@126.com,

Abstract. The main purpose of oil well fracturing is to alleviate the intra-layer contradiction and tap the remaining oil at the top of the thick reservoir for the primary reservoir. Aiming the problem such as long polymer injection interval, several layers, serious heterogeneity in plane and vertical in Class II reservoir, the main purpose of fracturing is to alleviate the plane and interlayer contradiction and tap the remaining oil at the edge of the buried river channel and at the position of inter-river variation. Because of the differences in geological characteristics and fracturing purposes, the method of selecting wells and layers for the primary reservoir has some inadaptability in the application of the Class II reservoir. In order to improve the fracturing effect of polymer flooding in Class II reservoir, it is necessary to explore the method of well selection and layer selection, in order to suitable for polymer flooding in Class II reservoir.

1. Well Selection Method for Polymer Flooding Fracturing in Class II Reservoir

1.1 Determining Fractured Wells by Using Geological Research Achievements

1.1.1 Optimizing wells with high oil saturation and good reservoir physical properties
As the material basis, whether the target wells enrich the remaining oil is directly related to the fracturing effect. Through statistical analysis, with the increase of oil saturation, daily increment of oil tends to increase. Statistics prove that permeability is above 0.25μm², formation coefficient is 1.19-4.108μm².m and oil saturation is over 48%, such reservoir has good fracturing effect. It is difficult to form effective conductive fracture even if enough sand is added in fracturing operation for poor permeability and low formation coefficient. However, the fracturing effect of wells with excessive formation coefficient is not ideal because the permeability of wells with excessive formation coefficient is relatively high, flooding is serious and oil saturation is low.

1.1.2 Optimum selection of wells with large proportion of sand body connectivity
Following the classification criteria for the fracturing effect of polymer flooding in the primary reservoir, wells with daily increase of oil up to 15t in the initial stage are defined as efficient wells, 5-10t as effective wells, less than 5t as inefficient wells and non-increasing wells as ineffective wells. Analyzing the relationship between daily oil increment and sand body connectivity before and after fracturing in 8 wells, the result shows that the larger sand body connectivity ratio, the more daily oil
increment after fracturing, the better the effect. Oil production wells with sand body connectivity ratio greater than 50% are all effective wells after fracturing, and those with sand body connectivity ratio greater than 83% are efficient wells after fracturing.

1.1.3 Optimizing the Central Production Well of Thick Injection and Thin Production Well Group

According to the corresponding classification criteria of injection-production relationship, we classify the well groups into four types: thick injection-thick production, thick injection-thin production, thin injection-thick production and thin injection-thin production. Statistical analysis of the fracturing effect of 17 fractured wells shows that the six central production wells with thick injection-thin production in succession layers have the best fracturing effect. After fracturing, the daily increase of fluid is 49t, and the daily increase of oil is 13.3t; secondly, the six of the thick injection-thick production wells have the best fracturing effect. The core production wells increase fluid by 41t and oil by 7.9t per day after pressure, and five central production wells of thin injection thick production group increase fluid by 30t and oil by 6.8t per day after pressure.

1.2 Determining Fractured Wells by Analyzing Dynamic Change Characteristics

Adequate formation capacity is the fundamental guarantee of fracturing effect, and it is also the main index to evaluate the fluid supply capacity of oil wells. Some polymer flooding wells in the second type reservoir show the characteristics of rapid rise of formation pressure, drop of flowing pressure and large drop of fluid production, which shows that although the well has a strong fluid supply capacity, it has a large flow resistance. The analysis shows that the near-well pollution of the production wells and the formation energy can not be released during the development process. Optimizing well fracturing with high formation pressure, large production pressure difference and small production index is beneficial to achieving better fracturing effect.

1.3 Determining fractured wells by means of unstable well test data

1.3.1 Optimize wells with large skin factor

Skin factor is used to indicate the degree of perfection near the bottom of a well. Choosing wells with large skin factor, i.e. fracturing wells with low bottom-hole perfection, can effectively improve the seepage conditions near the well bore zone and achieve better fracturing results. According to the statistics of 5 wells with well test data from 17 wells, the bigger the skin factor before pressure is, the more the oil increment after pressure is.

1.3.2 Optimize wells with small flow coefficient

Skin factor represents the perfection of bottom hole, but it can not reflect the loss of energy and the reduction of productivity. Flow coefficient can directly give the influence of well bore resistance coefficient on productivity. Statistical results of 5 wells with well test data show that the smaller the flow coefficient before pressure is, the larger the daily oil increase after pressure is. This shows that the daily oil increase after pressure increases with the decrease of the flow coefficient before pressure.

1.4 Determining fractured wells by logging data

The liquid production profile and injection profile can directly reflect the liquid production and water absorption of each layer. When choosing fractured wells, using logging data to select wells with uneven interlayer utilization, low utilization degree and low water cut potential, good results can be achieved. For example, in well B, by comparing the production profiles before and after fracturing, it can be seen that the ratio of fracturing layer thickness before fracturing measures is only 15.6%, the relative production volume is 23.8%, the ratio of fracturing layer thickness after fracturing is 36.9%, and the relative production volume is 49.5%. For those without production profiles, we can use the injection profiles of connected injection wells to judge and analyze the production status of oil wells, such as well C. According to the analysis of injection-production relationship, the strong water-absorbing layer of injection well is the main fluid-producing layer, high aquifer and low-productivity reservoir in well C. The numerical simulation shows that the remaining oil is enriched in the low-
productivity layer, and finally the remaining oil is enriched in the poor-productivity layer. It is determined that the well is a fractured well.

2. Layer Selection Method for Polymer Flooding Fracturing in Class 2 Reservoirs

According to the principle of paying attention to reservoir conditions, combining with monitoring data and distinguishing dynamic changes of oil wells, we have determined fractured wells, and further applied fine geological research results to select fractured horizons.

2.1 Optimum selection of zones with better injection and production in plane

From the analysis of fine reservoir description results, the target layer of fracturing should have a high degree of polymer flooding control, the first type of connectivity ratio should be more than 70%, and each fracturing target layer of produced wells should be at least one type of connectivity with injection wells in more than two directions. Statistics show that wells with polymer flooding control degree of more than 60% can be effective wells after pressure, with daily oil increase of more than 5 tons, with polymer flooding control degree of more than 65%, and daily oil increase of more than 10 tons after pressure. From the relationship curve between polymer flooding control degree and daily oil increase after pressure, it can be seen that daily oil increase after pressure increases with the increase of polymer flooding control degree. Because the perfect injection-production relationship of single sand body can ensure the multi-directional effect of polymer flooding, and also can ensure that the energy of injection wells can be recharged after fracturing, so as to achieve the goal of increasing and stabilizing production.

2.2 Optimum selection of intervals with low water cut and flooding degree

Through analysis, choosing fracturing intervals with low water cut and flooding degree and relatively rich residual oil is beneficial to achieving obvious effect of water cut reduction and oil production increase after fracturing of production wells. It should be noted that when selecting fractured intervals in water cut recovery period, the distribution of remaining oil must be clarified before determining. Once the high water flooded zone is fractured, water cut will rise rapidly, and the recovery factor in water cut recovery period will be reduced to a certain extent, which will affect the overall effect of polymer flooding.

3. Optimizing the Opportunity of Polymer Flooding Fracturing in Class II Reservoirs

In order to study the fracturing effect in different stages of polymer flooding process, numerical simulation technology was used to calculate water cut changes in different stages of polymer flooding in type II reservoirs. The results show that the fracturing measures adopted in the period of water cut decline and low value of water cut are larger than that in the period of pre-effect and water cut rebound. From the results of 17 actual fracturing wells, the average daily fluid increase of 3 wells in low water cut period is 39 t, the daily oil increase is 9 t, and the water cut decreases by 2%. The average daily fluid increase of 14 wells in water cut recovery period is 30 t, the daily oil increase is 8 t, the oil increase is 1 t less than that in water cut decline period, and the water cut decreases by 3%. Therefore, we suggest that fracturing measures should be taken during the period of water cut decline and low value in the development of polymer flooding in type II reservoirs, which can achieve good results.

4. Conclusion

The shape characteristic of pressure build-up curve is a comprehensive reflection of the degree of pollution or improvement of oil wells. Therefore, fracturing well selection using pressure build-up curve is an effective method. To select fracturing intervals with high degree of polymer flooding control, perfect horizontal injection-production relationship, low water cut and water flooding can ensure good fracturing effect. The effect of fracturing in the low water cut stage of polymer flooding in the second type reservoir is better than that in the water cut recovery stage.
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