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Application and Analysis on Sand Control Technique for Unconsolidated Sandstone Formation

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Abstract

For unconsolidated sandstone formation, sand control problem is very important. Packing sand control materials into unconsolidated sandstone is a good idea to improving the flow conditions and stabilizing sand of down hole formation. Some application and analysis on sand control technique for unconsolidated sandstone formation are introduced in this paper. A simplified model for sand control material's application has established. Some sensitivity of prediction and production-increasing effect are analyzed. Good conclusions are found. This technique is fit for light oil reservoir. The ratio of water reducing will decrease with the thickness of sand control materials decreasing and the oil viscosity increasing.

Key words: Sand control materials; Application effect; Simplified model

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INTRODUCTION

The production will be ill influenced by the water content increasing and heavy sand production problem in unconsolidated sandstone reservoir. Packing sand control materials into unconsolidated sandstone is a good idea to improve the flow conditions and stabilize sand of down hole formation. The evolution of this technique has been investigated from the following several aspects: Sand control material[1-3]; evaluation for physic performance[4]; the theory of water reducing[5]. The results from these research have clearly shown that the water content of oil well can be well controlled, the skin factor of sanding control can be decreased and the down hole flow condition can be improved. However, based on these research results, the deeper problem is how to quantitatively describe the application effect. So, in this paper, a simplified model for sand control material's application has established, and some sensitivity of prediction and production-increasing effect are analyzed .

1. MODEL FOR SAND CONTROL MATERIAL'S APPLICATION EFFECT

After the sand control material was injected into the formation, the permeability nearby well bore would be redistributed. Doing some necessary assumptions under the premise that can satisfy the practical needing precision and making the problem solved. The influence of quartz sand on down hole flowing should be neglected. And the sand control material should be looped along the origin well bore. As shown in Figure 1.

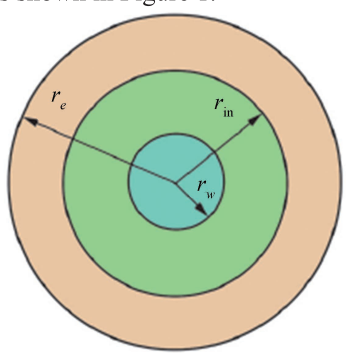

Figure 1
Diagram of Bore Hole Formation After Injecting the Sand Control Material

r_{in} is the equivalent radius; r_w is the bore hole radius; r_e is the edge radius of oil well.

So the well bore formation can be divided into two regions: One is origin formation, another is he equivalent formation filled with sand control material. The equivalent radius can be described as Formula 1.

$$r_{\text{in}} = \sqrt{\frac{I_g}{\pi\varphi} + r_{\text{so}}^2} \ . \qquad (1)$$

r_{in} is the equivalent radius, m; r_{so} is external diameter of well screen; I_g is dense gradient of sand control material, m^3/m; φ is the coefficient.

Water content before injecting sand control material can be calculated:

$$f_w = \frac{1}{1+\frac{\mu_w}{\mu_o}\times\frac{k_{\text{of}}(S_w)}{k_{\text{wf}}(S_w)}} \ . \qquad (2)$$

Water content after injecting sand control material can be calculated:

(a) The oil production after injecting sand control material:

$$Q_o = \frac{2\pi L}{\mu_o}\frac{p_e \quad p_w}{\frac{1}{k_{\text{of}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}+\frac{1}{k_{\text{og}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}} \ . \qquad (3)$$

(b) The water production after injecting sand control material:

$$Q_w = \frac{2\pi L}{\mu_w}\frac{p_e - p_w}{\frac{1}{k_{\text{wf}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}+\frac{1}{k_{\text{wg}}(S_w)}\ln\frac{r_{\text{in}}}{r_w}}. \qquad (4)$$

(c) Water content after injecting sand control material:

$$f_w' = \frac{Q_w}{Q_w+Q_o} = \left[1+\frac{\mu_w}{\mu_o}\frac{\frac{1}{k_{\text{wf}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}+\frac{1}{k_{\text{wg}}(S_w)}\ln\frac{r_{\text{in}}}{r_w}}{\frac{1}{k_{\text{of}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}+\frac{1}{k_{\text{og}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}}\right]^{-1} \ . \qquad (5)$$

(d) Water content comparison before and after injecting sand control material:

$$\Delta f = f_w - f_w' = \frac{1}{1+\frac{\mu_w}{\mu_o}\frac{k_{\text{of}}(S_w)}{k_{\text{wf}}(S_w)}} - \left[1+\frac{\mu_w}{\mu_o}\frac{\frac{1}{k_{\text{wf}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}+\frac{1}{k_{\text{wg}}(S_w)}\ln\frac{r_{\text{in}}}{r_w}}{\frac{1}{k_{\text{of}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}+\frac{1}{k_{\text{og}}(S_w)}\ln\frac{r_e}{r_{\text{in}}}}\right]^{-1} \qquad (6)$$

To analyze sand control effect, a coefficient P_r is defined as equivalent production capacity, that indicates the ratio of production after and before sand control application[6,7]. If P_r is more than 1, that means the oil production was increased after injecting sand control material. The mathematical expression was given by Zhangqi in 2006.

$$P_r = \frac{(\text{PI})_{\text{sc}}}{(\text{PI})_p} = \frac{\ln\frac{0.472r_e}{r_w}+S_p}{\ln\frac{0.472r_e}{r_w}+S_p+S_{\text{sc}}} \ . \qquad (7)$$

S_p is the skin factor, S_{sc} is the additional skin factor after injecting sand control material.

2. APPLICATION ANALYSIS

Some well in Shengli oil field of China, after injecting sand control material, a series of completion data were got, as Tables 1 and 2.

Table 2 indicates that: Water content comparison coefficient is 7.01% and equivalent production capacity P_r is 1.044, which means well effect of water precipitation reduction and oil increase. Based on these data, some sensitivity of prediction and production increasing effect are analyzed. Figure 2 demonstrates the relationship between water content comparison coefficient and the thick of sand control material. The relationship between equivalent production capacity and the thick of sand control material is displayed in Figure 3. With the thick of sand control material increasing, both water content comparison coefficient and equivalent production capacity are increasing. To enhance oil production, to increase the thick of sand control material will be an effective way.

Table 1
Well Basic Data

Parameters	Value	Parameters	Parameters
Depth/m	1,550	Thickness/m	50
Diameter/mm	241.3	External diameter/mm	168
Permeability/md	0.85	Drainage radius/m	200
Viscosity/mPa·s	300	So/%	40

Table 2
Calculation results

Parameters	Value	Parameters	Value
Sand material diameter/mm	0.5-0.7	Water content comparison coefficient/%	7.01
Tatol injection/m^3	142	Equivalent production capacity	1.044
Equivalent radiis/m	1.05		

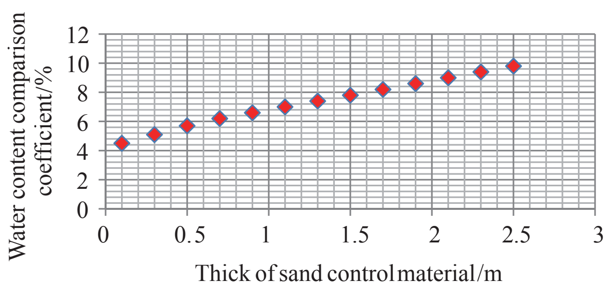

Figure 2
The Relationship Between Water Content Comparison Coefficient and the Thick of Sand Control Material

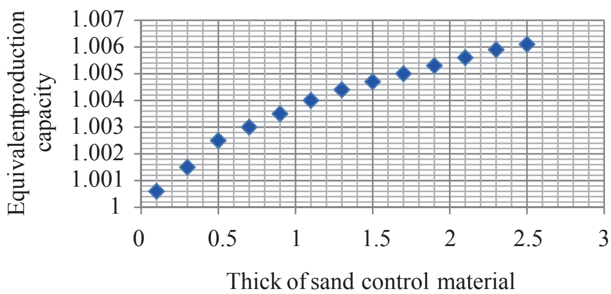

Figure 3
The Relationship Between Equivalent Production Capacity and the Thick of Sand Control Material

At the same time, the relationship between water content comparison coefficient and the oil viscosity can be displayed in Figure 4. With the oil viscosity increasing, the water content comparison coefficient however will decrease. So this sand control method based on injecting reduced water content material should be applicable to the thin oil formation.

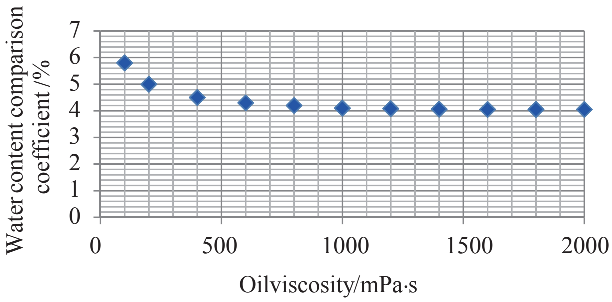

Figure 4
The Relationship Between Water Content Comparison Coefficient and the Oil Viscosity

CONCLUSION

Based on the discussing above, some conclusion can be obtained:

With the thick of sand control material increasing, both water content comparison coefficient and equivalent production capacity are increasing.

With the oil viscosity increasing, the water content comparison coefficient however will decrease.

This sand control method based on injecting reduced water content material should be applicable to the thin oil formation.

REFERENCES

[1] Zhang, G. R., & Yan, J. G. (2001). Study and application of sand control and water shutoff system technology in Gudong oilfield. *Drilling & Production Technology*, *23*(2), 69-73.

[2] Wang, F., Zhang, J. G., Yuan, S. B., Zhu, J. D., & Chu, J. (2006). The incorporate technology of water-plugging, injectivity-controlling and sand control for heavy oil wells. *Special Oil and Gas Reservoirs*, *1*(32), 65-66.

[3] Li, H. W., Dong, Z. H., & Wang, L. Y. (2008). Tudy and application of CS-1 solidification grains for sand control. *Drilling & Production Technology*, *2*(43), 106-107.

[4] Li, H. W., Shao, L. F., & Cao, Q. P. (2011). Development and application of multi-coated pre-encapsulated sand control prop pant in Dagang oilfield. *Petroleum Drilling Technique*, *3*(94), 99-103.

[5] Xie, S. Y., Ye, Z. B., & Chen, H. (2010). The mechanism study of disproportionate permeability reduction by water soluble polymer gel. *Petroleum Geology and Recovery Efficiency*, *17*(4), 52 -54.

[6] Dong, C. Y., Li, Z. F., & Zhang, Q. (2002). Integrated model for sand control well productivity evaluation and prediction. *Oil Drilling & Production Technology*, *2*(46), 45-48.

[7] Li, Y. L., & Dong, C. Y. (2014). Model study on evaluation of water reduce and sand control technique effect. *Oil Drilling & Production Technology*, *5*(36), 113-116.