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Journal of Chemical and Pharmaceutical Research, 2013, 5(10):130-133

Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Study of reasonable flowing pressure base on peak output of oil

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ABSTRACT

With the continuous development of oilfield, bottom hole pressure is much lower than the saturation pressure, near the bottom of the oil well serious degassed, this will reduce the relative permeability of oil phase. In the process of production, after the production flow pressure drop to a certain limit, with the loss of the flowing pressure and the production to reduce instead, and it is no longer in line with common output prediction method, So by analyzing Daqing oilfield production data, it is concluded that the functional relation of reasonable flowing pressure and the peak production.

Keywords: Reasonable flowing pressure; Peak production; Permeability; Oil field production.

INTRODUCTION

In the lifting process, usually by adjusting the relationship within the wellbore pressure system, realize the well supply and mining coordination, in order to give full play to the oil well productivity, reduce the lifting system energy consumption. One of the basis of well supply and mining coordination is the determination of reasonable flowing pressure. The field application is generally Vogel equation and generalized IPR method, but Vogel equation has a hypothesis: When the flowing pressure is higher, the relationship of $k_0/\mu_o B_o$ and the pressure are the straight line, so this method in flow at high pressure prediction and actual coincided basically with the test values. But this method is contrary to the actual situation of the low permeability oil field production, appeared in the scene production to reduce instead of increase after flowing pressure, and improve the production does not drop but increases after flowing pressure phenomenon[1-3].

To this end, we carried out the reasonable flowing pressure of low permeability oilfield research work, study of low permeability oil field oil well flow pressure and production change, find out the change rule, to determine reasonable well flow pressure, to guide the adjustment of low permeability oil field oil Wells supply and mining connections, to achieve the goal of give full play to the oil well productivity, increase production of oil Wells[4-7].

1. OUTPUT OF SEVERAL COMMON FORECASTING METHOD

Oil production prediction is the basis of oil well lifting equipment design, is also the largest oilfield development benefit basis. In the process of predicted oil well production, in turn, the following several main methods are proposed.

1.1 MASKAT PRODUCTIVITY INDEX METHOD

Maskat, through a study of the "rigid oil extraction" (that is, the flowing pressure is higher than the saturation pressure of water injection oil extraction) find that the output of oil Wells is proportional to the production pressure differential.

That is:

$$J_O = \frac{Q_O}{p_r - p_{wf}} \tag{1}$$

It can be seen from the type, the relationship between the output and production pressure differential is a linear relationship. Under the condition of the oil production index Jo were obtained through the test, you can accord to formation pressure p_r to obtain the production of arbitrary flow pressure p_{wf} .

When the rigidity of oil was extracted with Maskat method, the productivity index is simple and easy method to predict the well production. But for dissolved gas drive or flow down to the saturation pressure of water injection flooding reservoir, the calculation error is bigger.

1.2 GILBERTINFLOW PERFORMANCE

In the face of the problems of Maskat's productivity index method, through the study Gilbert find the relationship between solution gas drive reservoir production and flow pressure, the relationship between the Solution gas drive reservoir production and flowing pressure is not a straight line, but a quadratic curve. Different flowing pressure, oil production index are also different. Although Gilbert made a great discovery, for the prediction of the output under different flowing pressure, there is certain difficulty.

1.3 VOGEL DIMENSIONLESS METHOD

On the basis of Gilbert`s research, Vogel presented for dimensional production and the concept of dimensionless flow pressure. Dimensionless production is well in a first-class production under the pressure of the well and the ratio of the maximum output, dimensionless flow pressure is the ratio of the any pressure and formation pressure of oil Wells. Through the research Vogel found that the dimensionless production of oil well yield and dimensionless flow pressure to follow the following formula.

$$\frac{Q}{Q_{\max}} = 1 - a\left(\frac{p_{wf}}{p_r}\right) - b\left(\frac{p_{wf}}{p_r}\right)^2 \tag{2}$$

In the same oil field, the same set of pattern, 2 type *a* and *b* can be considered the same. Although the dimensionless method is Vogel in solution gas drive reservoir research conclusion. The practice has proved that, when the flowing pressure down to the saturation pressure this method still play a role to water flooding reservoir.

2. ESTABLISHMENT OF THE INFLOW PERFORMANCE EQUATION

(1), The deduce of the formula of production According to the seepage theory, the mathematical expression of planar radial flow oil produced as follows:

$$q_o = A_o \frac{k_o}{\mu_o B_o}(\overline{p_r} - p_{wf})$$

In the formula: $A_o = \dfrac{7.08\times10^{-3}h}{\ln(r_e / r_w - 0.75 + S + Dq)}$

$\dfrac{k_o}{\mu_o B_o}$ and p is a convex type curve, as shown in figure 1. In the curve we can see, in the flowing pressure is high, $\dfrac{k_o}{\mu_o B_o}$ the relations with P is a straight line, suitable for Vogel equation.

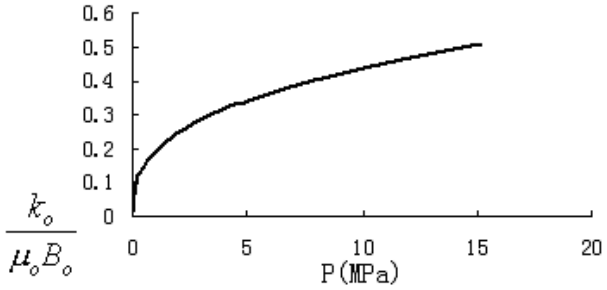

Figure 1. Relation curves with p

But it is not applicable when flowing pressure is low. In order to establish suitable for low permeability oil field oil well production forecasting formulas, make $\frac{k_o}{\mu_o B_o} p_{wf}$ relationship expressed in power exponent form, formula is as follows: $\frac{k_o}{\mu_o B_o} = a \cdot P_{wf}^{1/n}$

In the formulas a for constant, n for undetermined coefficients.

Calculated the production calculation formula is:

$$q_o = A(\overline{P}_r - P_{wf}) \cdot P_{wf}^{1/n}$$

In the formula: $A = \alpha A_o$ Assuming that the well water in a period of time for a certain value, we can get a reasonable measure of the produced fluid and oil well flow pressure formula, that is:

$$P_{wf\_reasonable} = \frac{\overline{P_r}}{n+1}$$

$$q_{l\max} = An(\frac{\overline{p_r}}{n+1})^{\frac{n+1}{n}}$$

By the formula (3), as long as know the single well flow pressure of two groups of oil production can be obtained the value of a and n, when there is only a set of oil flowing pressure, we can use first Gore formula to get two sets of data, and with the type to calculate the value of a and n. Figure 2 is the flowing pressure and production relation curve, you can see the production has a peak point, the turning point is just for maximum yield production.

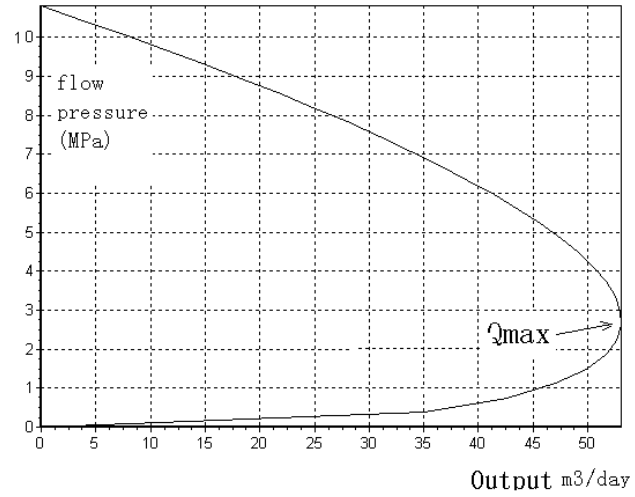

Figure 2. Flowing Pressure and Production Relations

3 INTO THE DYNAMIC EQYATION OF CALCULATION EXAMPLES

To test and verify the accuracy of inflow performance equation, according to different flow pressure values we chose 7 wells in for flowing pressure adjustment in experimental zone, as shown in table 1.

It can be seen from table 1, the well of flowing pressure slants little after the flow pressure is turned up the output increase in production (stable 1), after flowing pressure slants down the well flow pressure yield increase, after the well with reasonable flowing pressure slants down it will be declining production. Predicted the coincidence rate was 85.7%. no matter from the output of change trend or error, show that this method agreed with the actual production, it compared with the traditional way to more practical.

Table 1 Actual Yield and Calculating the Flow Pressure Adjusted Contrast

No.	Well No.	Reference	Reasonable flowing pressure	Flowing pressure （MPa）		Fluid producing （t/d）			Error	
		(min^{-1})	(Mpa)	Before adjustment	After adjustment	Before adjustment	After adjustment	Calculation	Absolute %	Relative %
1	27-17	9↓6	5.31	2.42	2.91	10.4	12.3	11.2	-1.1	-9.8
2	35-19	6↓4	4.92	1.88	2.59	6.0	5.4	6.7	1.3	19.4
3	33-15	9↓6	4.76	2.09	2.24	7.9	9.1	8.3	-0.8	-9.6
4	35-18	6↑9	7.76	6.22	4.02	25.3	22.7	22.7	0	0
5	31-15	4↑6	4.90	4.48	3.49	14.8	13.9	14.3	0.4	2.8
6	25-21	6↑9	4.38	7.59	3.88	23.6	29.1	29.2	0.1	0.3
7	27-20	6↑9	4.74	8.7	2.62	20.7	26.4	24.5	-1.9	-7.8
Average			5.25	4.77	3.11	15.5	17	16.7		

CONCLUSION

1) The production pressure difference can't be infinitely enlarged; It can be seen from the above calculation of IPR curve, IPR curve of each well has production peaks. As a result, production pressure differential amplifier is not the bigger, production is the better, there is a reasonable production pressure difference of the larger problem.

2) The principles for dig potential is it has the potential to dig or not. Since the well production of IPR curve has peaks, in the flow in the whole process of the pressure drop is not flowing pressure is lower yield is higher. As a result, the well in the future in daily production management, we should pay close attention to each well at any time, we should see whether their production in the best section of the IPR curve. If the production of oil Wells are under the output of the IPR curve the peak point, we must be timely make the production parameters down, because now big parameter is useless, moreover, because of the low sinking through, machine screw pump by load is bigger, easily lead to rod, tube breaks, adverse to reduce pump inspection rate. If it is at the peak point above, we have to think about whether can take measures to increase production, in order to make formation ability get maximum play.

3) Keep the stable basic way is to keep formation in high pressure; Both from the view point of formation, and from the view point of the normal work of the pump, they are all required to maintain wellbore pressure. Therefore, to enlarge production pressure and higher yield, we must improve the formation pressure.

Acknowledgement

The authors gratefully acknowledge the projects' support of National Key Technology Support Program of China (Contract No.2011BAA02B00-01) and the Science and 2014 Year Technology Research Project of Heilongjiang Province Education Department (Name: Beam Pumping Unit and Motor Coupling Operation and Reasonable Matching Theory Research).

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