ATLANTIS PRESS
Advances in Engineering Research (AER), volume 130
5th International Conference on Frontiers of Manufacturing Science and Measuring Technology (FMSMT 2017)

Discussion on Preference of Secondary Series of Primary Well Pattern at North Block 1 of Labei

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Keywords: Class II reservoir; tertiary recovery; secondary series

Abstract: To realize the efficient exploitation of tertiary recovery for the class II reservoir and guarantee the stable replacement of the output, by comparing the thickness and reserve of each series for the class II reservoir at north block 1 of Labei, the article gives preference to SⅡ13~SⅢ3 as the secondary series of the primary well pattern, meanwhile preliminarily decides the development time of secondary series, which has guiding significance on developing the secondary series at other blocks.

Introduction

From the comparison between the thickness and plan design of the actual drilling for the new well, the average sandstone thickness in the actual drilling of class II reservoir for single well is 56.9m, and the effective thickness is 42.1m, which is the same with the plan design, however, the average permeability is 0.489μm2, almost twice of the plan design. From the view of water flooding at the new well, the water flooded thickness proportion at the target stratum is 92.2%, which shows the target layer has been better used.

Table1 The comparison of each layer system between actual drilling and the design

Series	The design			Actual drilling		
	Sandstone thickness（m）	Effective thickness（m）	Average permeability（μm^2）	Sandstone thickness（m）	Effective thickness（m）	Average permeability（μm^2）
SⅡ1～3	7.5	6.1	0.293	6.8	5.4	0.462
SⅡ4～12	10.0	7.1	0.237	10.4	7.3	0.454
SⅡ13～SⅢ3	10.5	7.2	0.262	10.6	7.7	0.444
SⅢ4～10	12.7	8.3	0.261	11.8	9.2	0.579
PⅠ4～PⅡ5+6	9.2	7.3	0.222	8.7	6.2	0.508
PⅡ7-9～GⅠ4+5	8.6	7.2	0.166	8.7	6.3	0.465
Total（Average）	58.5	43.1	0.240	56.9	42.1	0.489

Table2 The flooding condition of the first layer system

layer	High flooded		Water flooded		Low flooded		Not flooded	
	Thickness（m）	Proportion (%)	Thickness（m）	Proportion (%)	Thickness（m）	Proportion (%)	Thickness（m）	Proportion (%)
SIII4+5	0.5	16.4	1.2	37.6	1.0	31.2	0.3	9.6
SIII6+7	0.6	23.2	1.0	37.3	0.6	24.6	0.1	5.4
SIII8	0.3	24.2	0.5	37.8	0.3	24.6	0.1	8.5
SIII9	0.3	28.4	0.4	40.9	0.2	19.3	0.1	7.0
SIII10	0.3	30.7	0.4	35.8	0.2	19.8	0.1	7.9
SIII4-10	2.1	22.4	3.5	37.6	2.4	25.8	0.7	7.8

Preference discussion about the secondary series

Discussion about the thickness for secondary series. In regard of the thickness of each series, that of the primary series is the top one. The average thickness of developed sandstone in a single well is 11.8m, and the effective thickness is 9.2m. The thickness of series SII4~12 and SII13~SIII3 is relatively bigger; the average developed-sandstone thickness in a single well is 10.5m, and the

effective thickness is 7.5m, approaching that of the first series.

Discussion about the reserves for secondary series. From the reserve of each series combination, the geological reserves of the primary series are 1295.0×104t. That of SII4~12 and SII13~S III3 is relatively close to that of the primary series, which is favorable for the output link-up.

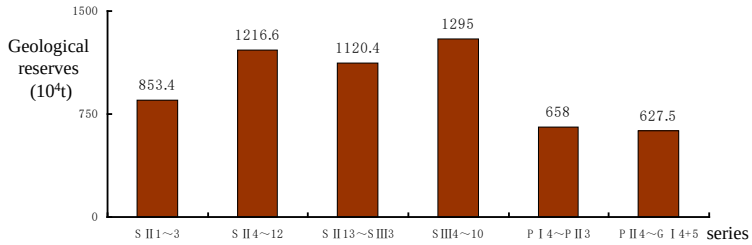

Figure1 Geological reserves of each layer

Discussion about the development effect for secondary series. Seen from the prediction result, recovery ratio can be increased above 13% at the polymer flooding stage of upward series, but that of the polymer flooding stage of downward series is relatively low. From the initial output after establishment, each series is basically of the same, however, the cumulative oil production of each has bigger difference, and that of SII4~12 and SII13~S III3 is relatively higher, which is relatively close to that of the primary series.

Table 3 Recovery degree of series of strata and recovery efficiency on numerical simulation prediction

Series	Minimum water（%）	Well network encryption enhanced oil recovery（%）	Polymer flooding encryption enhanced oil recovery（%）	Phase to encryption enhanced oil recovery（%）	The early capacity（10^4t）	The cumulative oil production（10^4t）
SⅡ1～3	80.9	2.3	13.4	15.7	14.9	134.0
SⅡ4～12	81.2	2.3	13.1	15.4	14.7	187.4
SⅡ13～SⅢ3	81.0	2.3	13.2	15.5	14.7	173.7
SⅢ4～10	79.5	2.3	14.2	16.5	15.3	213.7
PⅠ4～PⅡ5+6	81.5	2.3	11.3	13.6	13.2	89.5
PⅡ7-9～GⅠ4+5	82.3	2.3	10.9	13.2	13.0	82.8
Total（Average）	81.1	2.3	12.7	15.0	14.3	881.0

All in all, since the petrophysical property of SII13~S III3 oil reservoir is better, the reserves are evenly distributed, and the output replacement capability is the best, so take SII13~S III3 as the secondary series.

Discussion about the development time for secondary series

From the prediction result under the condition that different water content of the primary series being shifted to subsequent water flooding, when the water content is less than 95% and shifted to subsequent water flooding, the output input is higher; when it is more than 95%, the output-input ratio decreases more after being shifted to subsequent water flooding. Therefore, when the water content of the primary series reaches 94%~95%, the economic benefit of secondary series development is the best.

Table4 Different water cut subsequent water flooding mathematical model prediction results

Predictive project	Recovery degree (%)	ratio of output to input		
		oil price 2500 yuan/ton	oil price 3000 yuan/ton	oil price 4000 yuan/ton
91% of subsequent water flooding	54.53	9.44	11.33	15.11
92% of subsequent water flooding	54.98	8.59	10.31	13.75
93% of subsequent water flooding	55.36	4.27	5.13	6.84
94% of subsequent water flooding	55.57	2.12	2.55	3.4
95% of subsequent water flooding	55.68	1.13	1.36	1.81
96% of subsequent water flooding	55.72	0.33	0.40	0.54
97% of subsequent water flooding	55.76	0.21	0.26	0.34
98% of subsequent water flooding	55.80	0.12	0.14	0.11

Conclusion

(1) The situation for sandstone actual drilling of class II reservoir at north block 1 of Labei is basically the same with that of plan design; therefore, developing the series and giving preference to secondary series according to the original plan design.

(2) According to the development thickness, reserves distribution and the result of numerical simulation research of each series, it is decided to take SII13~S III3 as the secondary series of the primary well pattern.

(3) According to the current experience from the tertiary recovery and development, combined with the result of numerical simulation research, the conclusion is when the water content of the primary series reaching 94%~95%, the economic benefit of secondary series development is the best.

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