

The Three Cement Slurry System Cementing Technology in SUBEI Oilfield JI2-41 Well

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Abstract

JI2-41 well is a directional development well located on Yunshuzhuang block structure in Dongtai Depression on SuBei basin of the SuBei oilfield. JI2-41 well is a normal development well which with the longest isolation section of SuBei oilfield. The design depth is 3481m, but actual depth is 3455m. The well is cemented with Ø139.7mm casing and the casing length is 3450m, required cement slurry return height more than 2500m. Because of this well reservoir section long, span large leads to there are many water layers between oil layers, borehole like a gourd, these factors which brought a lots problem to cementing. Author analysis the difficulty of cementing and advise to use three cement slurry system technology. It received cementing 93.1% with high quality when this technology applied on site operation. It solved the problem of cementing in SuBei oilfield.

Keywords

SuBei oilfield; Three cement slurry system; Long production interval; Cementing technology; Cementing quality.

1. Introduction

JI2-41 well is a directional development well located on Yunshuzhuang block structure in Dongtai Depression on SuBei basin of the SuBei oilfield. JI2-41 well is a normal development well which with the longest isolation section of SuBei oilfield. The purpose of this well is to develop improve capacity of Fusan and Dainan. The design depth is 3481m, second open used Ø215.9mm bit drill to the depth of 3455m. Followed by drilling Dongtai group, Yanyi group, Sanduo group, Dainan group, Funing group, the most inclination is 19.87°. The well is cemented with Ø139.7mm casing and the casing length is 3450m, required cement slurry return height more than 2500m. The well condition is complex, finishing drilling by using cement slurry with density 1.25g/cm³, cementing by using 1.60g/cm³, 1.86g/cm³ and 1.88g/cm³ three cement slurry systems. It received cementing 93.1% with high quality when this technology applied on site operation. It solved the problem of cementing in SuBei oilfield.

2. Cementing difficulty

Long production interval. This well isolation section up to 955m and actual cement return height more than 1000m which is the longest isolation section normal production well of SuBei oilfield. So this well had risk of instability of cement slurry and promoted the risk of construction.

Stratum structure complex. It has thirteen oil layers of isolation section in 3402m-2850m. Because of multi-reservoir which span up to 600m, especially the main oil layers 3400m to 3300m, 3140m to 2850m have large spacing between each other, there are four water layers between oil layers, it had lead to logging tool sticking when logging in layer of 3385m and 3300m.

Irregular borehole. Borehole instability and irregular of isolation section is a serious problem. Especially the hole shrinkage in 2750m to 2810m resulting in difficulty of cementing promoted which increased resistance and reduced displacement efficiency when casing running.

Difficult in choosing suitable slurry system. When second section stated, there were active water layers which lead difficult in preventing oil and gas channeling after losing weight of cement slurry. When cement slurry loss of weight, it became difficult to keep layers stability which made low cementing quality.

3. Solution

Choose three cement slurry system. According to cementing difficulties, we optimized cement slurry formulation. By using three cement slurry system, we sealed oil and water layer, to ensure stable oil layers and ensure the quality of cementing. To make the process of cementing leakage does not occur which is $P_a \leq P_f$ and keep formation fluid stability after loss of weight at the same time, we used high density three cement slurry system when cementing to achieve the goal "stability of three pressure"^[1-2]. Three cement slurry were designed to cementing these sections as follows, well bottom up to 3300m which cementing have used high density cement slurry(1#), 3300m up to 2850m which cementing have used high density cement slurry(2#), 2850m up to 2500m up to return height which cementing have used low density cement slurry(3#). The additional cement sealed the upper isolation section. 1#, 2#, 3# cement slurry designed as follows,

Table1 Cement slurry pressure design list

Depth (m)	Medium	Fluid column pressure/(MPa)		Equivalent drilling fluid density/(g.cm ⁻³)	Pressure after loss of weight/(MPa)		Equivalent density after loss of weight (g.cm ⁻³)
0-2250	Mud	27.6	27.6	1.25	27.6	27.6	1.25
-2500	Pad fluid	3.7	31.3	1.28	31.3	31.3	1.28
-2850	3#Cement slurry	5.5	36.8	1.31	3.4	34.7	1.24
-3300	2# Cement slurry	8.2	45.0	1.39	7.1	41.8	1.29
-3450	1# Cement slurry	2.8	47.7	1.41	1.5	43.2	1.28

Obviously, cementing actually injected cement slurry more than designed. Because of there were heavy slurry upper, it could keep formation stability.

Cementing slurry system analysis[3]

Laboratory condition

temperature: 85°C; pressure: 42MPa; heating-up time: 35min.

1#Cement slurry formulation: 1#cement+fluid loss additive + dispersing + water + retarder + foam suppressant

2# Cement slurry formulation: 2#cement+ fluid loss additive + dispersing + water + retarder + foam suppressant

3# Cement slurry formulation: 3# cement + fluid loss additive + dispersing + water + retarder + foam suppressant

Table 2 Cement slurry thickening time

Tips	Density/(g.cm ³)	Cement mortar/cm	Thickening time/min
1# Cement slurry	1.88	22	97
2# Cement slurry	1.86	22	160
3# Cement slurry	1.60	24	226

By taking segmented grout cementing need to add retarder when adjusted for thickening time, it took short transition time and without foam. This three cement slurry system adapted to Ji 2-41 cementing well and this system with good liquidity, good compatibility with the drilling fluid.

The main supporting technical measures

Borehole preparation^[4-5].(1)Before running casing , we used the original drilling tools going in bottom. To those borehole shrinkage and instability, we reamed down all the tight points and cycled with displacement more than before. The whole well used thick slurry to carry sands which could ensure borehole stability and without sands.(2)After running casing, used small displacement to cycle rocks, then gradually increasing the displacement cycle and wash well with large displacement cycle over two loops. To ensure cementing quality we must concentrate on pump pressure change and keep borehole clean.

Improve the displacement efficiency^[6-8].(1)Centralizer placement. According to the requirements placed centralizer, each one casing installed an elastic centralizer on section 3450m-3324m and 3140m-2850m, every two to install an elastic casing centralizer on section 3324m-3140m, every 2-3 casing installed an elastic centralizer on section 2850m-2500m. Install hydro cyclone on the points 3404m, 3370m, 3000m.(2)Using reasonable replace displacement.Using displacement with 2.1m³/min ,to make annular return velocity at 1.10m.s⁻¹ .Improve the displacement efficiency.

4. Site operation

First, we strengthened borehole preparation and make sure drifting measure the Ø139.7mm casing running to place safety. Then we pump with small displacement to start and cycled normally with big displacement to normal pressure. At last, we started cementing operation after dealing with drilling fluid adjustment performance.

Casing without leakage under exerting pressure 20MPa.Injected pad fluid 8m³ with average displacement 1.0m³/min, density 1.00g/cm³.Then injected low density cement slurry 8m³,controlling the density between 1.55 and1.65g/cm³,injected dispersing cement slurry 12m³, controlling the density between 1.85 and 1.88g/cm³, injected quick setting cement slurry 20m³,controlling the density between 1.88 and 1.92g/cm³ and average displacement 1.0m³/min, injected after pad 3m³ and average displacement 1.0m³/min and density 1.03g/cm³,mud pump replacement mud 33m³ which average displacement 2.1m³/min and density 1.26g/cm³,cement car replacement mud 3.7m³.Bump plug clear with pressure 15MPa,then cycling water normally, opened pressure WOC.The whole construction process of continuous normal, safe and stable.After WOC 48H,VDL/CBL curves show that Cementing parameters to meet the requirements,100% pass rate,93.1% with high quality, it provide a reliable basis for the subsequent downhole.

5. Conclusions

(1)Aiming at the long production interval and weakness of borehole status, we used three cement slurry system to solve the technology problems of long production interval in normal production well. These methods were applied to the field of good and cementing quality better than other wells, it also accumulated experience for future cementing operation.

(2)According to the oil and water layers active, big span of the reservoir oil layer, formation structure complex of the well ,it obviously promoted cementing quality of the isolation section and it also

effectively ensure the process without leakage when cementing and waiting-on cement by using three cement slurry system and designing cement slurry structure rationally.

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