OPTIMIZATION OF THE PERFORATION SKIN EFFECT IN CASE ZEVARDA FIELD OF UZBEKISTAN

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ABSTRACT

Performation skin effect can be defined as any reduction in near wellbore permeability which results from drilling, completion, production, injection, attempted stimulation or any other well intervention. In the majority of completions, once the reservoir has been drilled, production casing or a liner is run into the well and cemented in place. To provide the communication between the reservoir and the wellbore, it is necessary to perforate through the walls of the cemented casing or a liner and penetrate into the formation. Currently horizontal well bores completed with extensive perforation are conducted as several clusters along the well bore. (1.08)

Keywords: perforation technology; perforation process; status; development prospect; face direction perforation; Kashkadarya, Zevarda field.

INTRODUCTION

Perforation can lead to skin damage, and impair the well productivity. Zevarda field is one of the huge reservoir and new invented field of Kashkadarya region. Compound perforation technique uses composite propellant in the perforating gun, to supply secondary energy, based on energy-gathered perforation. While energy-gathered perforating charge makes connection path between reservoir and casing, the composite propellant will be lighted to generate gas of high temperature and high pressure, the gas is released through the discharge hole on the perforation gun, and flow into the perforated path immediately, thus effectively fracturing the reservoir. Through such process, extended fracture network will generate in near wellbore area, improving fluid conductivity in near wellbore area substantially. Years of field operation experience indicates that the compound perforation technique can at least double the single well production capacity. In recent years, big progress has also been made in technology updating. Through systematic basic theory & testing technique research, gunpowder gas control research, gun body material & loading capacity research and gunpowder charge structure research, the original one stage charge structure generally has evolved gradually into two stage and three stage charge structure (Fig. 1), which increases the compound perforation power capability (2.29).

MODELLING

The average fracture length in simulated target practice nearly increased by one time compared with the previous structure. In addition, based on delayed ignition technique and conflagration control technique, multi-stage pulsed compound perforation has been developed and applied to oilfield development. This kind of perforation further improves the perforating effectiveness through controlling multi-stage powder working time.

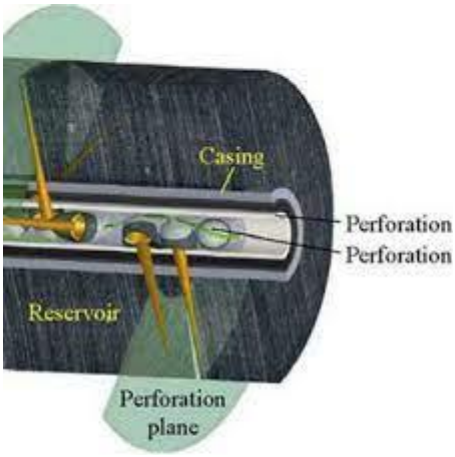

Figure-1

From history till nowadays many researchers researched and collected detail about optimizing perforation skin effect of oil fields and gas fields. Effective researchers Karakas and Tariq (1988) have presented a semi analytical solution for the calculation of the perforation skin effect. They divide into components: the plane flow effect S_H The vertical converging effect S_V and the well bore effect S_{wb}, the total perforation skin effect is

$$S_p = S_H + S_V + S_{wb} \quad (1)$$

Figure-1 gives all relevant variables for the calculation of the perforation skin. These include the well radius r_w, the perforation radius r_{perf}, the perforation length l_{perf}, the angle of the phase θ, and very important, the distance between of the perforation, h_{perf} (perf), which is the inversely proportional to the perforation density. Below the method of the estimating the individual components of the perforation skin is outlined.

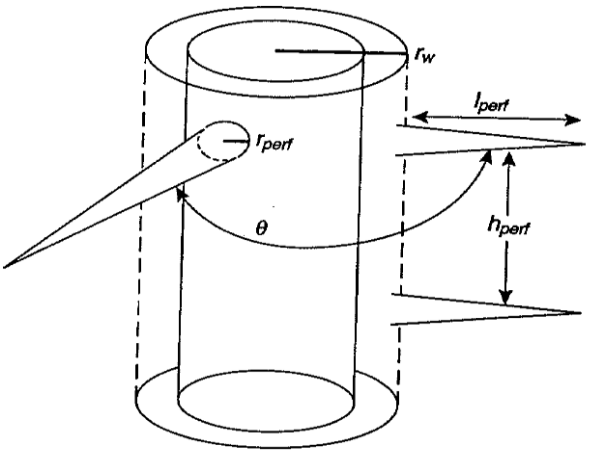

Figure-2. Well variables for perforation skin calculation (From Karakas and Tariq 1988)

Calculation of S_H

$$S_h = \ln\frac{r_w}{r_w'} \quad (2)$$

Where r_w' is effective well bore radius and is the function of the phasing angle θ:

$r_w^{'} = \frac{lperf}{4}$, if θ=0 (3)

$r_w^{'} = a_\theta (r_w + l_{perf})$, if θ≠0 (4)

The constant a_θ depends on the perforation phasing and can be obtained from table-1. This skin effect is negative, but its total contribution usually small.

Table-1. Constants for Perforation Skin Effect in Zevarda field.

Perforation phasing		a_1	a_2	b_1	b_2	c_1	c_2
0(360)	.250	- 2.091	0.04 53	5.13 13	1.86 72	1.6E -1	2.67 5
180	.500	- 2.025	0.09 43	3.03 73	1.81 15	2.6E -2	4.53 2
120	.648	- 2.018	0.06 34	1.61 36	1.77 70	6.6E -3	5.32 0
90	.726	- 1.905	0.10 38	1.56 74	1.69 35	1.9E -3	6.15 5
60	.813	- 1.898	0.10 23	1.36 54	1.64 90	3.0E -4	7.50 9
30	.860	- 1.788	0.23 98	1.19 15	1.63 92	4.6E -5	8.79 1

Calculation of S_V. To obtain S_V two dimensionless variables must be calculated:

$$h_d = \frac{h_{perf}}{l_{perf}} \sqrt{\frac{k_H}{k_V}} \quad (5)$$

Where k_H and k_V are horizontal and vertical permeabilities, respectively, and

$$r_D = \frac{r_{perf}}{2h_{perf}} (1 + \sqrt{\frac{k_V}{k_H}}) \quad (6)$$

The vertical pseudo-skin is then

$$s_V = 10^a h_D^{b-1} r_D^b \quad (7)$$

With $a = a_1 \log r_D + a_2$ (8)

And $b = b_1 r_D + b_2$ (9)

The constants a_1, a_2, b_1 and b_2 (10) are also functions of the perforation phasing and can be obtained from Table-1. The vertical skin effect, s_V is potentially the larges contributor to s_P; for small perforation densities, that is large h_{perf}, s_V can be very large.

Calculation of S_{WB}. For calculation of S_{WB}, a dimensionless quantity is calculated first:

$$r_{wD} = \frac{r_w}{l_{perf} + r_w} \quad (10)$$

Then

$$S_{WB} = c_1 e^{c_1 r_{wD}} \quad (11)$$

The constants c_1 and c_2 also can be obtained from Table-1.

Comparison with experiment and results. The annulus around the wellbore may be damaged by drilling and tectonic stresses on the openhole. Damage in the form of breakouts or washouts usually first appears in the direction of minimum stress, and drilling-induced fractures occur with their strike direction along the direction of maximum stress Zevarda field, however Kashkadarya region A pilot hole for horizontal drilling was drilled through a moderate-porosity—10 to 15 p.u.—shaly sand interval. The operator's objective was to determine natural fracture orientation and understand tectonic stress direction. Shear-wave energy anisotropy—the minimum and maximum cross-component energy difference—is the most obvious indi-cation of anisotropy. Large energy differ-ences, when the minimum stays low, indicate significant shear-wave splitting and signal zones of interest in Zevarda and other fields in the same zones. The interval from 3886 to 3923 Meter contains several zones with significant anisotropy.

The difference between the minimum and maximum cross-component shear energy, shown in the depth track, is an indicator of anisotropy. The tool orientation (blue), track 2, is used to determine the absolute fast-shear azimuthal direction (red), with its uncertainty (gray shading), track 3.

The interval between 3886 and 3923 m contains several Kashkadarya zones. The average of the fast component of the shear-wave direction, shown in the azimuthal projection (inset, right), is between 20° and 30°. Acoustic time anisotropy (black with shaded gray) is shown in track 4. This measurement is more sensitive to acoustic properties deep within the formation than surface effects such as drilling-induced fractures. Both fast (blue dashed) and slow (red) components of the shear slowness are computed by STC processing and are shown in track 4. For visual quality control, the fast (red) and slow (blue) waveforms from the largest spacing receiver are shown in track 5. The light yellow band shows the shear-wave processing window, which should include the first few cycles of the shear arrival. Both move out and energy differences between the fast and slow shear waves are easily visualized and can be verified on the display. Both waves would be identical in an isotropic formation 303rd well of Zeverda field. (Figure-3)

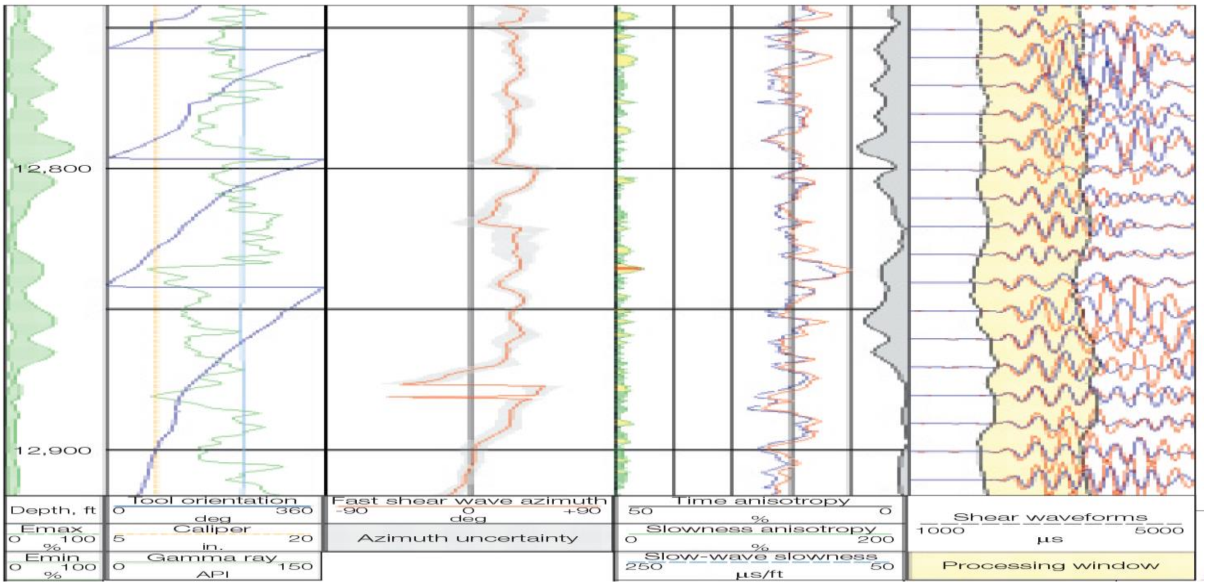

Figure-3 303rd well of Zevarda field.

Drilling of the strong formation (Cf = 18,000 psi) results in a hole with the same diameter as the drill bit. By contrast, drilling of the weak (Cf = 2,000 psi) formation resulted in an enlarged due to analyses of 303rd well. I suggest that The penetration achieved by the thru-tubing gun (21.84 cm) is similar to the cement depth of the drilling wash-out (13.46 cm). In the strong formation the perforation will only penetrate less than 2 in beyond the cement. The tubing conveyed perforator is recommended since this is the only gun which will penetrate to the weaker, washed out (probably more permeable) formations

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