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EXPERIENCE OF APPLICATION OF THE COC-PGD TECHNOLOGY FOR REHABILITATION OF OIL STRIPPERS OF THE ZHETYBAI DEPOSIT

1. INTRODUCTION

The COC-PGD technology (Combustion-Oxidative Compounds Powder Generator) allows formation breakdown by the impulse power excitation of light-end combustion products of solid-rocket and liquid combustion-oxidative compounds (hereinafter COC) [1]. By mechanism of action on the formation and resulting picture of flaw formation this method doesn't have analogues and significantly differs from practically using methods such as breakdown, shock-and-vibration action, electrohydraulic discharge, electromagnetic and acoustic fields etc.

General advantage of the method is that it allows in a wide range changing the dynamics of rock weighting and making stress condition in the formation with the rate 10^1–10^6 MPa/s. The most perfect breakdown systems provide rates of rock weighting not larger than 1 MPa/s. It was found out that for effective initiating of flaw formation in oil and gas mains the value of the mentioned parameter should be not less than 10^2–10^4 MPa/s.

A complex technology is designed for treatment of borehole zone of the formation (BZF) of low-permeable collectors in producing, injection and exploratory wells, which fluid loss properties were deteriorated during the process of boring and exploitation (Fig. 1). The technological process is based on formation of small-size cracks network using compact powder generator PGD-42T and following increase of filtration channels extension by chemical effect of acid compositions and other active liquids. The powder generator PGD-42T is designed for using in bores with the pressure up to 100 MPa and temperature up to 200°C.

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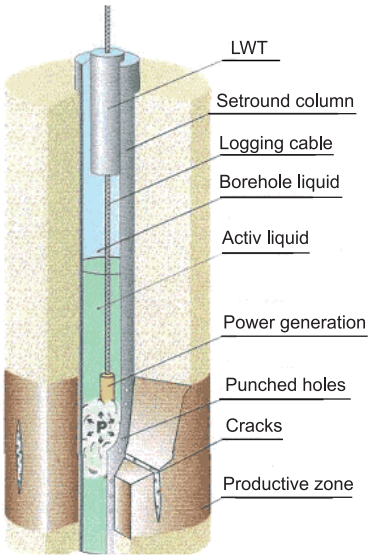

Fig. 1. Combustion-Oxidative Compouds-Powder Generator

Formations with permeability from 0.1 to 0.0001 mcm, rarely to 1 mcm, with porosity 5–14%, rarely to 20% are the objects of treatment.

COC combustion in a borehole, fully or partially filled by a fluid, is accompanied by very rapid formation of a large amount of light-end products that leads to increase of temperature and pressure up to values, sufficient for fracture of rock-collector. Pressure decreases in a borehole in a form of pulsation of depression and repression Mach waves during the time, significantly exceeding the time of COC combustion. As a result, layer is affected by mechanic, thermal and physic-chemical effect.

Mechanical effect creates in a borehole body branched system of residual cracks with the length from 1.5 up to 50 m and more, breaks oil-water barriers, purifies a borehole zone from products of chemical reactions and sandy-argillaceous particles. Forming cracks do not require tightening due to rocks' peculiarities, irreversibly deforming at high-rate dynamic stress.

Thermal and physic-chemical effects on the layer of combustion products, consisted mainly from CO_3, CO, N_2, Hal, become apparent in dissolution of deposits of alkenes and asphalt-tarry matters, decrease of coefficients of viscosity and surface tension of oil at the border of water, fractional failure of carbonates and cements in a borehole zone.

Other known technologies do not have a complex effect of such type.

2. STIMULATION PROCEDURE

Works are carried out with lowered into the well tubes (LWT) with inner diameter 50 mm and more and filled during the interval of processing by acid compositions on the base of orthophosphoric, hydrochloric, etching acids and other active fluids.

In dependence on aggressive peculiarities of active fluid, there are two possible ways of working with generator:

1) Generator trip-in, its combustion in the medium of mild-active fluid, pulling-out of logging cable and driving of active fluid through LWT into the layer by aggregate from the surface.
2) Generator trip-in, its combustion in the medium of active fluid, and following driving of active fluid through LWT into the layer of active fluid by aggregate from the surface.

Compound is prepared directly at the borehole using standard oil field equipment.

The following equipment and tools are required for processing of the COC boreholes:

- steam-productive installation of the SPI type,
- geophysical lift,
- geophysical well-logging system,
- compressor of the CD9-101 type or apparatus for swabbing,
- stalks (by the hole depth),
- high-pressure gate (for shooting and springing operations),
- aerometer for measurements of liquid density.

The method is very mobile, does not require additional equipment, and falls into traditional patterns of stream call and well development. It may be successfully integrated in various types of physic-chemical processing and breakdowns, allowing greatly decrease boundary pressures of pumping of intensification and breakdown agents and enlarge the layer coverage area. Besides this, the COC main components have disbudding characteristics, do not compose slow-breaking emulsions with oil and are additional means of the layer purification.

Successfulness of processing using COC at the average is 80–85%. Increase of output of well, as a rule, is divisible 2–8 times with keeping of duration of the effect from 0.5 to 1.5 years. In dependence on potential abilities of processed deposits, value of additionally produced oil for one processes ranges from 500 up to 1700 tons and more. More than 10 years experience of COC-PGD technologies shows that at efficient management really expended time on one borehole processing ranges from 2 up to 4 days. While gathering geotechnical information at development of concrete deposits and correct choice of objectives efficiency factors may be greatly increased. Terms of spending payback are several months.

3. EXPERIENCE OF APPLICATION

In Kazakhstan the COC-PGD technology firstly has been used at the Zhetybai deposit. Results of 5 wells development using this technology give the grounds to conclude the effectiveness of using complex technology COC-powder generator for stimulation of marginal wells, which producing horizons are represented by low-permeable, mudded reservoirs of the terrigenous type. Test data of 5 boreholes at the Zhetybai deposit are given in

the Table 1. Ratings of 5 boreholes on formation fluids and oil are multiply enlarged while development in comparison with the base rating before development in 2–5 times; and borehole 1133 worked with periodic flowing.

Table 1

Test results of using the COC-PGD technology at the Zhetybai deposit

Borehole number	Horizon	Method	Date of the COC application	Start date after COC	Parameters [ton/day]					
					Before COC application			After COC application		
					Q_{zh} [ton/day]	Q_n [ton/day]	[%]	Q_{zh} [ton/day]	Q_n [ton/day]	[%]
290	8	SHGN	08.10.04	25.11.04	2.1	1.8	14	6	2.6	57
1133	8	SHGN	26.10.04	22.12.04	5.6	4.4	21	15	9	40
2599	9	SHGN	11.10.04	07.11.04	1.6	1.2	25	5.7	2.0	65
2772	10	SHGN	30.10.04	27.11.04	1.2	1.1	8	4	2.1	48
3050	10	SHGN	03.10.04	14.12.04	2.3	1.4	39	4	3	25

In boreholes 1323 and 1356 tests were made on a final stage of the work; and after development positive results were received too, as registered factual regimes of COC combustion were close to determined ones.

According to exploitation data, accumulated ultimate oil production of boreholes after COC-PGD technology application was: 2872 ton, from which additionally 1798 ton were extracted with regard to base recovery rate Successfulness of development without consideration of 2 boreholes was 80%. Effect duration – 10 months; boreholes continue to work with increased rates.

At the same time, it is necessary to note that during the process some disturbances appeared, connecting, in general, with organizational issues. Namely, unequipped apparatus and field equipment were delivered to production works; preparation of borehole was made poor. As a result, 3 of 10 developed boreholes required repeated preparation and pumping of solution that leaded to increase of development time, additional material consumption and, accordingly, rise in the cost of all complex of works. Finally, this affects on the quality of development. So, in the borehole 3050 due to dilution of COC by formation fluid volume of burnt valuable COC with required ballistic characteristics was decreased in 150–180 litre. that affects on planned development regimes. Especially it is important to note unwarrantable great time consumption for well conditioning for development.

4. CONCLUSIONS

In general, results of field tests of technology should be recognized as positive and recommended for industrial application for intensification of oil well streams.

Results of 5 wells development using this technology give the grounds to conclude the effectiveness of using complex technology COC-powder generator for stimulation of marginal wells, which producing horizons are represented by low-permeable, mudded reservoirs of the terrigenous type.

REFERENCES

[1] *Stimulation of oil and gas wells by high-energy impulse methods*. 2004