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Calculation of the Economic Effect of the Introduction of Fishbone Technologies at Bukhara Stage in Bukhara-Khiva Region

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Abstract: this article describes the fishbone technology and analyzes the efficiency, as well as the level of profitability when implementing this technology in the extraction of oil from fields at the last stage of development.

Keywords: oil and gas economics, fishbone technology, oil recovery efficiency, well profitability.

Fishbone-based drilling operations are developed for drilling wells in tough mining and geological conditions, including hostile settings. This method removes the need for many horizontal wells.

When compared to a traditional horizontal well, the design of multilateral wells of this sort boosts well productivity by 40% and allows each branch to be directed to independent oil-bearing zones without opening gas or water intervals.

Comparison base and calculation method

The calculation was made on the example of “Jizzakh Petroleum” using the group working project data and estimates for the construction of production wells *Toshkuduk No.12G, South Kemachi No.169G, Gazli No.27, Dzhangul No.4 and Kalandar No.23.*

As a comparison, the design indicators of well drilling with a horizontal profile when drilling under the production string were used.

The calculation was done on the basis of cost components and the utilization of new technologies. The difference in operational costs for digging a well is used to determine the economic impact of using Fishbone technology (interval).

Table-1 Initial data and calculation using “Fishbone” and “Horizontal drilling” technology, 2022

The name of indicators	Basic option (Horizontal drilling)	«Fishbone»
1	*2*	*3*
Initial data		
Purpose of drilling	Operation, development	
Type of drilling	Horizontal	

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Drilling rig	ZJ-90DBS	
Well depth, m	*3500*	
Drilling interval, m		*1050 - 3500*
Drilling per bit, m		
Mechanical drilling speed, m/h	*5-10 m/h*	*5-10 m/h*
Expenditure figures		
Drilling in the interval, m	*2450*	*2450 + 250*10*
Mechanical drilling time, h	*490*	*990*
Time saving, h	*500*	-
The cost of 1 hour of renting a drilling rig, $	*2200-3400$*	
Cost of side branches of the well, $	-	*10 * 300 000*
Total	*1,078-1,666 mln $*	*5.718 - 6,366 mln $*
Calculation of operating costs		
Mechanical drilling time	*2,113 mln $*	*5,844 mln $*
Technical resources and chemicals	*1,230mln $*	*3.943 mln $*
Total	*3,343 mln $*	*9.787 mln $*
Calculation of economic efficiency		
Cost price of a well drilling meter, $	*2271.02*	*6593.06*
Well cost price, $	*5,100 mln*	*16,153 mln*
Savings in operating costs, $	*10.498 mln*	-

Source: Compiled by the author

Comparison of potential production rates at the last stage of development in these wells

$$Q_г = \frac{2\pi kh * \Delta P}{\mu_н * B \ \ln\frac{R_K}{r_c}} * \frac{\Delta P}{\ln\frac{4R_K}{L} + \frac{h}{L} * \ln\frac{h}{2\pi r_c}} \quad (1)$$

$$Q_г = \frac{2\pi kh * \Delta P}{\mu_н * B \ \ln\frac{R_K}{r_c}} * \frac{\Delta P}{\ln\frac{4R_K}{L} + \frac{h}{L} * \ln\frac{h}{2\pi r_c}} * 1,4 \quad (2)$$

here

$Q_в$ – oil production rate of a vertical well, m^3/day;

$Q_г$ – oil rate of a horizontal well, m^3/day;

k – reservoir permeability, m^2;

h – oil-saturated thickness, m;

ΔP – drawdown, Pa;

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Parameter	Value
Average net pay thickness, m	1,6
Reservoir oil saturation factor, unit fraction	0,43
Permeability, 10-3•µm2	5,1
Initial reservoir pressure, MPa	40
Viscosity of oil in reservoir conditions, mPa•s	0,73
Volumetric coefficient of oil, unit fraction.	1,233

µ – oil viscosity in reservoir conditions, mPa•s;

B – volumetric coefficient of oil, unit fraction;

L – length of the horizontal part of the wellbore, m;

Rk – well feed loop radius, m;

rc – well radius, m;

Consider the following example of a horizontal well calculation with parameters (the calculation basis is based on calculations of a horizontal well with the identical well parameters):

L = 2450 m;

Rk = 200 m;

rc = 0,1 m;

ΔP = 5 mPa.

The flow rate of a horizontal well according to the Borisov formula:

$$Q_{в} = \frac{2\pi kh * \Delta P}{\mu_{H} * B \ \ln\frac{R_K}{r_c}} * \frac{\Delta P}{\ln\frac{4R_K}{L} + \frac{h}{L} * \ln\frac{h}{2\pi r_c}} = \frac{2*3.14*5.1*10^{-9}*1.6}{0.73*10^{-3}*1.233} * \frac{5*10^{6}*86400}{\ln\frac{4*200}{2450} + \frac{1.6}{2450} * \ln\frac{1.6}{2*3.14*0.1}} = 21{,}957 m^3/day$$

The production rate of the horizontal well Fishbone will be calculated in the same way using the Dupuis formula (1), however, the potential production rates will be 40-45% higher.

The results of well flow rate calculations using Borisov's formulas for the length of the horizontal section L=2450 m are presented below

Well flow rates, m^3/day

With a horizontal well length of 2450m, the flow rate is 21,957m^3/day

When using the Fishbone technology with a length of 2450 m and 10 branches of 250 m each, the flow rate is 21,957*1.4 = 30,734 m^3/day

Calculation of the economic effect

As of 2020, the price of Brent crude oil was 32US dollars per barrel. It was during this period of time that oil was produced at the South Kemachi field. It is not difficult to calculate the cost per day of drilling a horizontal well and Fishbone.

For horizontal 5 100 000$: 57 = 89 474 $ a day

For Fishbone 16 157 000$: 92 = 175 619 $ a day

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Let's calculate the output flow conditionally for one year for a horizontal well and Fishbone:

First, let's convert US barrels to m^3:

1 US barrel = 159 l;

1 m^3 = 1000 l.

It is not difficult to calculate that 1 m^3 = 6,29 US barrels.

So for a horizontal well, the cost of crude oil volume per day is 21,957*6,29*32 = 4 419,5 $;

For Fishbone 30,734*6,29*32 = 6 187,3 $ a day

Conclusions:

In this age of technology and huge prospects in the oil and gas industry, specialists and analysts are working on projects to improve the efficiency of a certain operation while lowering expenses, which they frequently try to connect.

Because it has the potential to convert the idea into practice, fishbone technology may be reliably credited to this portion of the success of specialists in the correlation of costs and savings.

The “Fishbone” technology was the subject of this article's review and analysis.

The adoption of “Fishbone” technology in the South Kemachi field is effective, but not effective, because the well cost does not pay off quickly enough, which will have a significant impact on profitability. The cost of processing raw materials and delivering them to end users is likewise high. Price changes on the stock exchange will, in the end, have an impact.

Fishbone is a complicated and expensive technology, but it can significantly boost well productivity and comes with a long list of labor-intensive benefits.

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