FORECASTING HYDRAULIC FRACTURING OF LOW-PERMEABILITY RESERVOIR BASED ON MATHEMATICAL MODELING AND ANALYSIS OF PRODUCTION DATA IN THE Y FIELD

Newfel Mahdi
Scientific advisor professor Zyatikov P.N.
National Research Tomsk Polytechnic University, Tomsk, Russia

This study focuses on permeability and flow rate enhancement procedures for low permeability formation by creating a conductive path using a fracture model.

Fracpro simulator is used to efficiently simulate the fracturing process. The study focuses also on an effective fracture design procedure and parameters affecting fracture design, as the simulation results show us the effect of the selected hydraulic fracture geometry on oil production..

The purpose of this study is to analyze the role of one of the factors affecting the effectiveness of hydraulic fracturing, namely the size of the fractures, by studying the influence of the size of the fractures on the efficiency of the process using the FracPro program. south of Algeria.

The economical production of hydrocarbons from entrained oil and gas reservoirs requires smart skills and advanced and cost-effective technologies. Fracturing is a technology that has been used in the oil and gas industry for many decades to create highly conductive channels in low permeability formations, and it was discovered that the use of proppant is very important for the recovery of hydrocarbons. This was the first stimulation operation to be directly compared to acidizing. This study explains the mechanical characteristics of rocks, such as the distribution, shape and orientation of fractures [3].

Introduction to FracPro software.

It is a fracture design simulation software, a 3D fracture simulation has been validated by mini-frac and post-frac measurements to provide a scientific basis. These were not only analytical models, but GTI also developed diagnostics and conducted laboratory experiments in the field to determine where the crack goes (spreads), how far it goes and what parameters determine its fate.

Fracture modeling

Table 1

Stages of Achieving Hydraulic Fracturing

reservoir parameters	Fluid and proppant selection
↓	
Treatment schedule	
↓	
Well production	
↓	
Optimizing economic data	

Fracturing data

Table 2

Summary of fracture geometry *

Crack half-length (м)	72	Propped half length (m)
Total crack height (м)	42	Total reference height (m)
Depth to the top of the crack (м)	3443	Depth to top of supported crack (m)
Depth to the bottom of the crack (м)	3485	Depth to the bottom of the supported crack (m)
Equivalent number of multiple fractures	1.0	Maximum. Crack width (inches)
Fracturing fluid efficiency **	0.26	Average Crack width (inches))
		Average Proppant Concentration (lb / ft²)

* All indicated values refer to the fracture system as a whole at a model time of 144.49 minutes (end of shutdown at Stage 12 after flushing out the main hydraulic fracture)

** The value is indicated for the end of the last stage of injection (stage 11, flushing of the main hydraulic fracture)

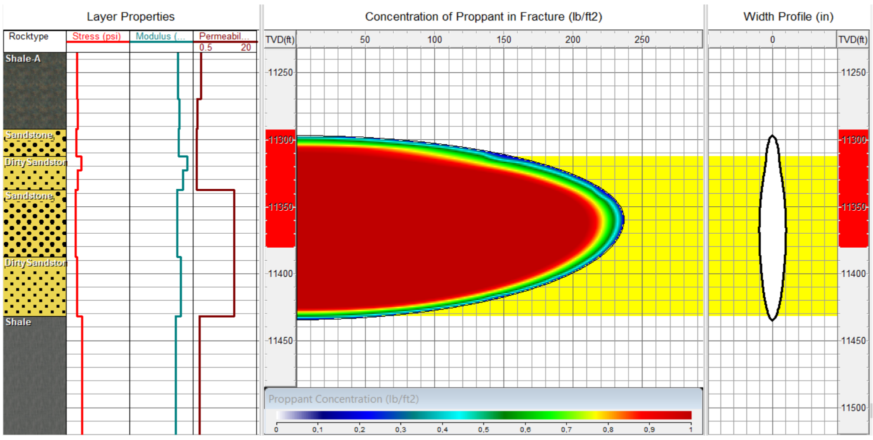

Fig.1 Simulation of fracture sizes by hydraulic fracturing using the FRACPro program

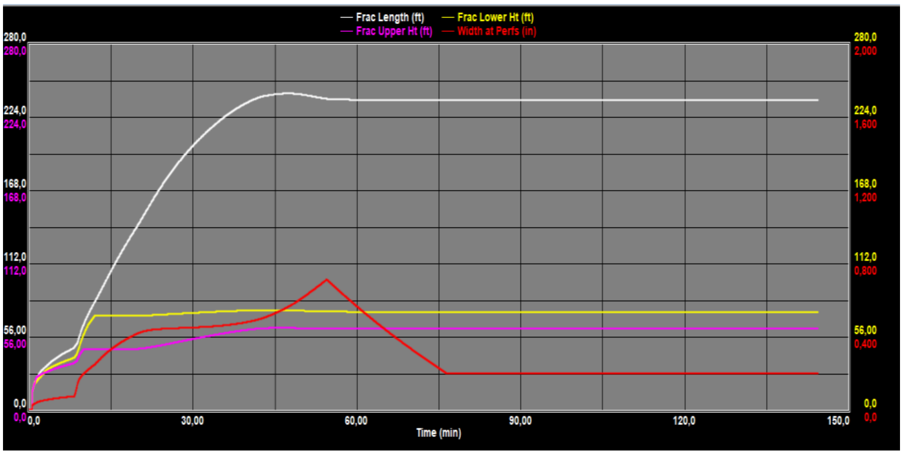

Fig.2 Changes in fracture size due to hydraulic fracturing over time

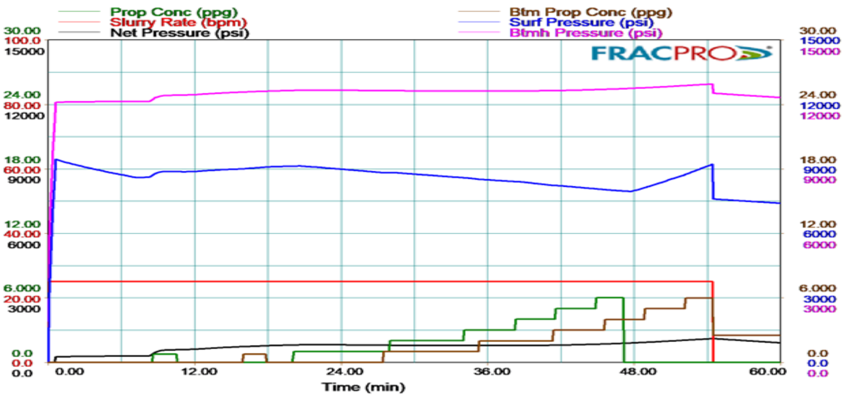

Fig.3 Curve showing the results of the hydraulic fracturing process (simulated using the FRACPro program)

Results analysis

- In the process of hydraulic fracturing, both the pressure at the bottom of the well and the pressure at the surface increased.
- The bottomhole pressure increased at the end of the process to 12,000 psi as shown in the graph in Figure 3.
- In the formation, permeability before using the hydraulic fracturing process was very tight at about 0.5 md. After using hydraulic fracturing, the permeability increased to 25 md. The conductivity of the formation has changed from 123.52 md-ft to 1642.3 md-ft, as shown in the graph in Figure 1.

The influence of fracture size on the fracturing process is associated with many factors, the most important of which is the nature of the geographic layers and the fluids used, since for the efficiency of the process it is associated with natural fractures, in the case of natural fractures, as the effect of increasing the length or height of the fracture as a result of hydraulic the fracture is better when it intersects more with natural fractures, which creates more permeable inner surfaces, so a good study of the nature of the geological plates as well as natural fractures is necessary to determine the ideal dimensions.

References

1. Lecampion, A. Peirce, E. Detournay, X. Zhang, Z. Chen, A. Bunger, C. Detournay, J. Napier, S. Abbas, D. Garagash, The impact of the near-tip logic on the accuracy and convergence rate of hydraulic fracture simulators compared to reference solutions, in: Effective and sustainable hydraulic fracturing, InTech, doi:10.5772/56212, 2013.
2. Lecampion, H. Zia, Slickwater hydraulic fracture propagation:neartip and radial geometry solutions, Journal of Fluid Mechanics .
3. Zia H., Lecampion B., Zhang W. Impact of the anisotropy of fracture toughness on the propagation of planar 3D hydraulic fracture, International Journal of Fracture 211 (1-2) (2018) 103–123, doi:10.1007/s10704- 018-0278-7.
4. Moukhtari F., Lecampion B., Zia H., Propapagation of a planar hydraulic fracture perpendicular to the isotropy plane of a transversely isotropic material, in: 53rd US Rock Mechanics/ Geomechanics Symposium, 2019
5. Crouch S.L., Starfield A. M., Rizzo F. Boundary element methods in solid mechanics, Journal of Applied Mechanics 50 (1983) 704.
6. Hills A., Kelly P., Dai D., Korsunsky A. Solution of crack problems: the distributed dislocation technique, vol. 44, Springer Science & Business Media, 1996.
7. Batchelor G., An Introduction to Fluid Dynamics, Cambridge University Press, Cambridge, UK, 1967.
8. Economides M. (1992). Practical assistant for reservoir stimulation. Amsterdam: Elsevier Technical Map for Well OMM-202, Hassi Messaoud, Algeria, courtesy of Halliburton, 2020
9. Badzhestani B.M. and Osuli A. (2015). The effect of interaction between hydraulic fracturing and natural fractures. When cracks propagate. International Society of Rock Mechanics and Rock Engineers.

SPATIAL VARIABILITY OF ORGANIC MATTER IN SURFACE SEDIMENTS OF THE LAPTEV SEA SHELF (EASTERN PART)

Oberemok I.A.

Scientific advisor associate professor Gershelis E.V.

National Research Tomsk Polytechnic University, Tomsk, Russia

Increasing global warming in the Arctic leads to a significant rate of terrestrial and submarine permafrost degradation [6, 9]. A vast amount of remobilized organic matter (OM) is involved in the modern biogeochemical cycle. It was shown that an increased supply of remobilized (“old”) OC may lead to severe acidification of the Arctic waters and significantly contributes to the greenhouse effect as a result of the OC to CO_2 transformation. Understanding of the fate of terrestrial OM moving from the land to the Arctic shelf is essential for predicting the potential feedback of Arctic ecosystems. Reliable identification of both OM sources and the mechanisms of its trans-formation within the “land – shelf” system is an important step towards a comprehensive understanding of the modern Arctic carbon cycle.

The East Siberian Arctic Shelf (ESAS), represented by the Laptev Sea, the East Siberian Sea, and the Russian part of the Chukchi Sea, is unique because it occupies a huge area (>$2*10^6$ km^2) and has a shallow average depth (~50 m). Moreover, the ESAS contains more than 80% of the world's subsea permafrost which is believed to store permafrost-related and continental slope methane hydrates [8, 9].

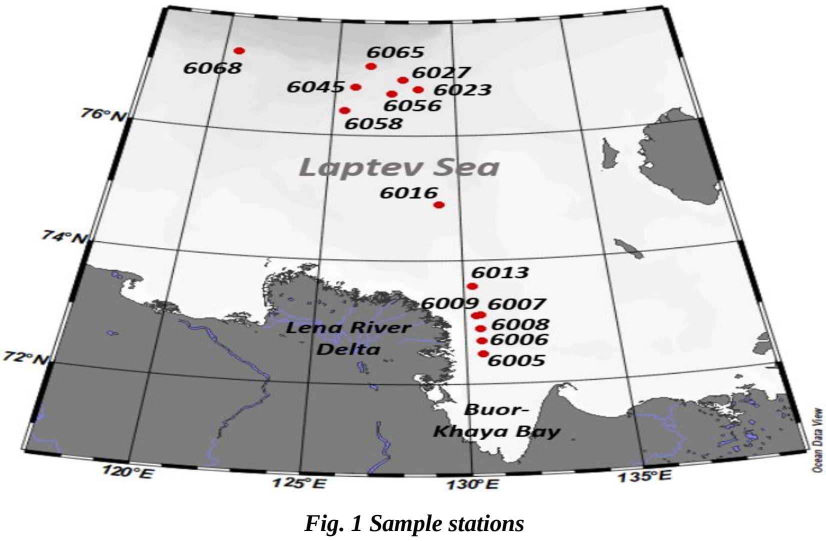

Fig. 1 Sample stations

The Laptev Sea is an Arctic sea dominated by terrestrial OM that receives a substantial contribution from both coastal erosion and Lena river runoff [7]. It was previously shown that accelerating coastal erosion acts as the main contributor to the terrestrial OM pool exported to the Laptev Sea [10]. About 25% of the Laptev Sea coastline is composed of ice-rich permafrost deposits known as the Yedoma Ice Complex which is highly susceptible to erosion. The retreat rate of the permafrost-dominated coast has been steadily increasing due to the combined action of thermal and mechanical forces [4]. The total input of the