POLITECHNIKA ŚLĄSKA

Wydział Górnictwa, Inżynierii Bezpieczeństwa
i Automatyki Przemysłowej

PRACA DOKTORSKA

MATEUSZ MASŁOWSKI

Wpływ wgniatania ziaren materiału podsadzkowego w skałę złożową na efektywność podsadzenia szczeliny w zabiegach stymulacyjnych wybranych złóż niekonwencjonalnych

Dyscyplina naukowa:

Inżynieria Środowiska, Górnictwo i Energetyka

Promotor: prof. dr hab. inż. Małgorzata Labus

Promotor pomocniczy: dr hab. inż. Piotr Kasza, prof. INiG-PIB

Gliwice, 2022

Abstract

The scientific aim of the work was to investigate the effect of the phenomenon of indenting the proppant grains into the formation rock on the effective propped of the created fracture, after the hydraulic fracturing of the unconventional deposits. Determining the depth of the indentations of the proppant grains into the rock deposit and damage to the fracture wall surface allowed for the assessment of the proppant backing of the fracture, depending on the susceptibility of the rock to the phenomenon of embedment.

The samples of the rocks from two unconventional formations of hydrocarbons were selected for the tests: Rotliegende Permian sandstone representing a reservoir rock of the "tight gas" type, and Silurian clay-bituminous shale from the Baltic Basin, the "gas shale" type. On the basis of the collected geological and deposit data and the determined geomechanical properties of the rocks, appropriate parameters of the fracturing fluid and the proppant material were selected.

Laboratory simulations of the phenomenon of embedment were carried out for two rock types, both dry and saturated with fracturing fluid. The research took into account the deposit conditions similar to the conditions of selected formations (i.e. temperature and compressive stress), as well as different surface concentration of the proppant material.

The damaged faces of the cores were observed using the microscopic method and on this basis, the parameters characterizing the phenomenon of embedment were determined, including an impression of the rock material. The results of the experiments allowed to determine the impact of the unfavorable phenomenon of embedment on the effectiveness of propping the fracture for two selected unconventional deposits of Poland. The most important parameters were the effective width of the fracture and the effective contact surface of the fracture face with the proppant layer. The amount of the impressions of the rock material on the rock surface was also considered as a very important indicator.

Additionally, theoretical calculations of the width of the fracture filled with the proppant were carried out for the four selected surface concentration. A scheme for classifying the effectiveness of the fracture’s filling, on the basis of the rock resistance to the phenomenon of embedment, was also proposed.

The performed analyzes allow for a more detailed understanding of the impact of the unfavorable phenomenon of embedment, taking into account the impression of the rock material, on the initial assessment of the effectiveness of the fracture’s propped, for the proposed stimulation treatment technology.

As a result of the work, the methodology of the analysis and interpretation of the obtained results was developed, and statistical methods were selected to estimate the uncertainty of the measured and calculated values.