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## Energy Colloquium

# Mathematical Modelling of Hydraulic Fracturing and Related Problems


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**ABSTRACT:**

Hydraulic fracturing is an important part of modern technologies for intensification of hydrocarbon production. Propagation of the hydraulic fracture is stipulated by a high-pressure pumping of viscous fluid, which creates pressure on fracture's walls high enough to overcome the rock closure stresses and cause the rock failure. Process of the hydraulic fracture growth is governed by several factors: flow of viscous fluid with additives in a narrow fracture's gap, elastic reaction of the fracture's walls; filtration of fluid from the fracture to the reservoir, rock failure and advance of the fracture. Description of the hydraulic fracture dynamics is a complicated problem that is rarely solved in its most general formulation. Another important component of hydraulic fracturing procedure is the control of the fracture consisting in the determination of its basic geometrical parameters: size and position. The control is usually performed during the fracture production and based on the microseismic monitoring. However, this method is not exact and gives only an estimation of the fracture positioning. Thus, any complimentary studies for the control of hydraulic fracture are highly relevant. In the talk we give an overview of mathematical models of physical processes taking place during the hydraulic fracturing; models for transport of non-Newtonian fluids in the fracture and in the wellbore; models for estimation of the productivity of a horizontal multiple fractured well, and some new approaches for the fracture control, developed in Lavrentyev Institute of Hydrodynamics. Presented models extend the existing approaches by a proper account of fluid exchange between the fracture and the reservoir; demonstrate the influence of inhomogeneity of physical properties of the reservoir and presence of proppant to the fracture propagation. For a multiple fractured horizontal well we analyze the dependence of fractures positioning and geometry to the long-term production of the well. As for the methods for fracture control, we propose two approaches, based on the non-stationary fluid pumping into the fracture, and on the estimation of the streaming potential in a deformed porous medium.


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