# Hydraulic Fracturing From Low Permeability to Tight Reservoirs

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## ABSTRACT

Conventional reservoir simulation collapses when trying to simulate fluid flow through tight reservoirs. Conventional reservoirs have been fracture stimulated using acid fracturing and proppant fracturing. Acid fracturing is performed to improve well productivity in acid-soluble formations such as limestone, dolomite, and chalk. Hydrochloric acid is generally used to create an etched fracture, which is the main mechanism for maintaining the fracture open during the life of a well. Proppant fracturing is an alternative option that has been applied in carbonaceous and siliceous formations.

The transport phenomena controlling fluid flow through tight formation is no longer sufficient to be modeled by Darcy's flow. Diffusion and imbibition are important transport mechanisms. The concept of osmosis and flow through semi-permeable membrane component are critical. Additionally, diffusion and a special case of molecular flow due to Knudson effect should be considered when designing hydraulic fracturing.

Fracturing low permeability reservoirs is totally different than fracturing tight formations. The fracture geometry required in low permeability reservoirs need to be planar, conductive and penetrating deep in the reservoir. Fracture complexity in these reservoirs is to be avoided for optimum stimulation treatment. However in fracturing tight formation, a complex fracture network is desirable for better recovery. Creating multiple fractures in horizontal openholes wells without the use of mechanical intervention, is becoming essential especially in tight gas reservoirs. We have learned how to initiate hydraulic fractures into a specific direction and place as many fractures as desired in horizontal wells but with casing and perforation. Economical production from tight reservoirs, including shale gas and shale oil formations, requires horizontal well drilling and massive proppant hydraulic fracturing stimulation. The stimulation involves generating sufficient fractures network or stimulated reservoir volume (SRV), which is achieved by placing optimized stimulation treatments along the horizontal section of wellbores ideally drilled from multi-well pads to increase the production rate and ultimate recovery. Hydraulic fracturing in naturally fractured formations is characterized by generating a fractures' network that should be designed for in extremely low permeability of unconventional reservoirs. Fractures should extensively reach tight matrix to achieve commercial production. Therefore, production rate and ultimate recovery depend on the size of the created SRV.

This presentation will cover critical concepts related to rock mechanics and fluid transport phenomena as related to producing from tight reservoirs. Laboratory experiments and numerical simulation studies will be presented to support those critical parameters. Numerical studies on a hydraulically fractured well to simulate the dynamic processes during fracturing injection, following well shut-in (soaking), and production will be discussed.