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Novel Method to Initiate and Propagate Fractures in Very Soft Unconsolidated Formations

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ABSTRACT

Unlocking oil reserves that are deposited in very soft unconsolidated formations is an emerging challenge. Current hydraulic fracturing techniques are incapable of addressing such geological issues because of the physics involved. Hydro-jet applications can result in premature screenout because of the plasticity effect or ballooning. Downhole acoustic generation shows some improvements in near-wellbore fracture initiation. Combining acoustic waves with pressurized fluids yields good results; however, the fracture width and length are limited.

A key parameter in such treatments is the injection rate. Unlike hard-rock hydraulic fracturing, in very soft rocks, if the injection rate ramps up, it can promptly result in premature screenout caused by losing the fracture tip. This is mainly a result of the tip process. Tip propagation is primarily caused by the initial shear dilation and later tensile failure. Injection at high rates causes the system to fail under shear only.

Very soft and unconsolidated formations are mostly observed in Canadian oil sand deposits, as well as heavy-oil deposits in California. The unique method proposed in this paper combines a mechanical and hydraulic fracturing approach. In this approach, the fracture initiation (the so-called breakdown in hydraulic fracturing) is mechanical; however, its propagation is hydraulic. This scheme has been tested successfully in pure unconsolidated sandy formations.

This paper describes the physics of such an approach and various possible applications. It is believed that coupling this technique with acoustic waves will result in much better system performance.