Waterless fracturing for shale gas/oil production using plasma blasting

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When extremely high voltage electricity is applied to metal electrodes, electrical energy in an arc discharge is then dissipated through the medium around the electrodes in nanoseconds or microseconds. The sudden temperature in the zone immediately adjoining the electrode increase produces a gas/plasma bubble, which causes an explosive volume increase, which in turn generates a very strong shock and pressure wave to transport energy to wall– this is the phenomenon known as plasma blasting.

We have developed a plasma blasting fracking method that uses a liquid hydrocarbon (LHC) instead of water as the medium for transporting energy and registered into an US patent. The pressure of this shockwave reaches up to 3,500 bar with the 60% energy of hydraulic fracturing, and propagates through the medium of the wellbore and makes a crack in the shale layer. As a result, it is possible to collect shale gas using less than 10% of the LHC used by the existing LHC fracturing method.

We believe that its method is able to save drilling cost because of lower viscosity and density of LHC compared to water, which results in the longer effective fracture length than that of hydraulic fracturing. This technology can minimize energy usage and substantially reduce the amount of potentially dangerous fluids being used; these results in advantages such as reducing costs, more effective production, minimizing the environmental impact, and preventing the depletion of water resources.

We have obtained below results in a laboratory and will show them.

1. A wall of wellbore was kept while plasma blasting
2. Cracks by the plasma blasting showed the similar shape and direction with ones by the hydraulic fracturing
3. When the discharge plasma energy is increased, both main cracks and sub cracks with differences in extensity were observed
4. Multiple blasting experiments showed the extension of cracks, namely possible to have the desired effective fracturing lengths
5. Verified that proppants can be transported into cracks
6. Computer simulation to perform the parametric study for a plasma blasting