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Energized fracturing fluids as an alternative for effective stimulation of shales gas formation

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Hydraulic fracturing is nowadays the most popular method of stimulation of oil and gas deposits in shale formations. This was the very efficient technique, that made the extraction of hydrocarbons from unconventional deposits feasible. Hydraulic fracturing consists of the controlled creation of fractures in the reservoir and parent rocks of hydrocarbons, by injecting under high pressure, significant volumes of a suitable fluid, into the formation through a well. The resulting fractures are kept open by introducing proppant into them, e.g. sand, allowing the return of injected fluid (and then recycling of the so-called flow back) and the increased inflow of gas or oil into the well. Fracturing is necessary to enable the production of hydrocarbons from formations with low (sandstones) and very low permeability (shales, tight sandstones) in which gas is accumulated.

Hydraulic fracturing is performed with the assistance of technological fluids prepared on the base of the water. Stimulation of gas shale formations requires the use of large volumes of fracturing fluids. From a technological point of view these fluids are very simple systems consisting of water and chemical additives that constitute no more than 0.5% of total amount of fluid. Although, it is often an effective technological solution, it can sometimes result in negative impact. These impacts include mainly interactions of large amount of injected water with clay minerals (eg. smectite group) and the need for long term clean up treatment of the deposit after fracturing.

One possible solution to minimize these unfavorable phenomena is the use energized fracturing fluids. In these fluids, water is partially replaced by gas (N₂ or CO₂) to form quasi-stable two-phase system. The introduction of large amounts of gas into the fracturing fluid results in less water consumption. A smaller amount of water will affect of the limited interaction with the clay minerals. Thereby less water has to be removed from the deposit, and in addition the pressurized gas provides additional energy to enhance the removal of residual water.

On the basis of these assumptions, an attempt was made to develop new fluids for fracturing shale formations based on energized fluids. The presented results of laboratory tests, performed in order to confirm the usefulness of such fluids in industrial applications are very promising. The research was carried out in stages, firstly preparing the base fluids. For this purpose, based on the research, necessary chemical additives were selected. A series tests of rheological properties of designed fluids were

performed. They allowed for characterization and assessment of parameters typical for two-phase energized fluids.

