Enhancing Production of Oil and Gas by Using Hydraulic Fracturing Process

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I. INTRODUCTION

•The first experimental treatment to "Hydrafrac" a well for stimulation was performed in the Hugoton gas field in Grant County, Kansas, in 1947. by Stanolind Oil.

•In 1948, the Hydrafrac process was introduced more widely to the industry in a paper written by J.B. Clark of Stanolind Oil. A patent was issued in 1949, with an exclusive license granted to the Halliburton Oil Well Cementing Company (Howco) to pump the new Hydrafrac process.

• Howco performed the first two commercial fracturing treatments, in Stephens County, Oklahoma, and the other, in Archer County, Texas, in 1949, using a blend of crude and gasoline. In the first year, 332 wells were treated, with an average production increase of 75%.

•Applications of the fracturing process grew rapidly and increased the supply of oil in the worldwide far beyond anything anticipated. In 2008, more than 50000 frac stages were completed throughout the world.

•Some estimate that hydraulic fracturing has increased USA recoverable reserves of oil by at least 30% and of gas by 90% [1].

II. HYDRAULIC FRACTURING TECHNOLOGY

• Hydraulic fracturing, enhances the recovery of oil and gas from wells by fracturing formation rocks to release the hydrocarbons, allowing them to flow more easily through the rocks to the wellbore. Not wholle oil and gas fields or formations require such treatment to permit extraction of hydrocarbons.

• During this process water containing sand and additives is then pumped at very high pressures, through the casing perforations into the neighboring rock. The excessive pressure apply by the water brake the rock, creating tiny fractures that propagate sometimes tens of meters away from the wellbore (Fig. 1).

• Fracturing activity are normally engineered to restrict the fractures to the desired formation. The sand is added as a "proppant", to support fractures open after the pressure is released. It allows hydrocarbons captured in the rocks to flow to the wellbore [1].

•In Europe, fracturing is carried out in England, Croatia, Hungary, Romania, Poland, Russia. Around 50% of hydrocarbon produced in the USA is obtained from wells after fracturing [2].

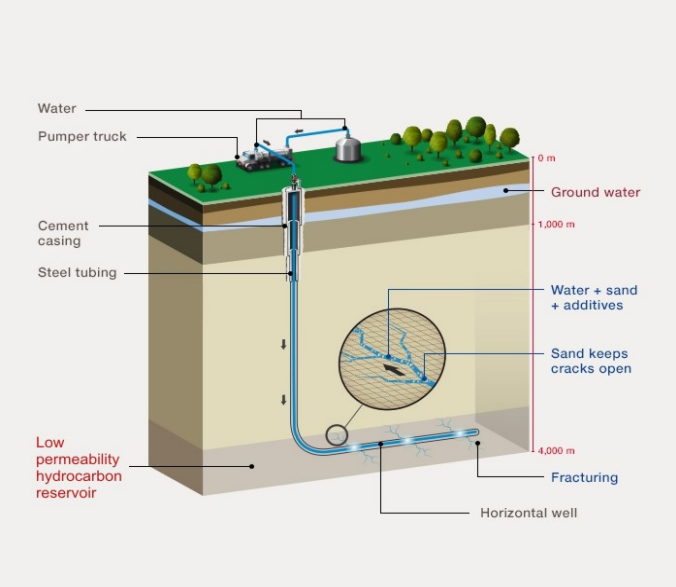

Figure 1. Hydraulical fracturing in a horizontal well [3]

A. Fracturing fluids

• In the first few years of hydraulic fracturing application was a common use of gelled crude and later gelled kerosene. Water started to be used in 1953. as a fracturing fluid.

• In the early 1970s, a major innovation in fracturing fluids was the use of metal-based crosslinking agents to enhance the viscosity of gelled water-based fracturing fluids for higher temperature wells [6].

• In general, a fracturing fluid is the system of three main components: base fluid, additives and proppant. Mostly, water-based fluids are the simplest and most economical solution to fracture a hydrocarbon bearing formation [7].

B. Additives

• The prevailing fluids presently used for fracture operations are waterbased fluids blended with friction-reducing additives to help pumping of the fluids and proppant at lower pressures and a higher rate at than if water alone were used.

• Gelling agents, like as guar gum, aid suspend the proppant in the fluid. The gel-like fluid is more capable to transport the proppant than would a normal low viscous fluid. Supplementary chemicals are added to reduce friction, bacterial-growth, corrosion, and provide other benefits during the stimulation process [7].

C. Proppant types and properties

• There are several group of proppants with different quality which must be appropriate to the type of well and reservoir in order to be hydraulically fractured.

• Proppants materials can be classify into three main categories: silica sand, resin coated sands, sintered and/or fused synthetic ceramic materials (Fig. 2). The proppants' main particle sizes are between 0,589 mm (30 mesh) and 0,297 mm (50 mesh), and typical density is between 2,65 and 3,56 g/cm^3 [8].

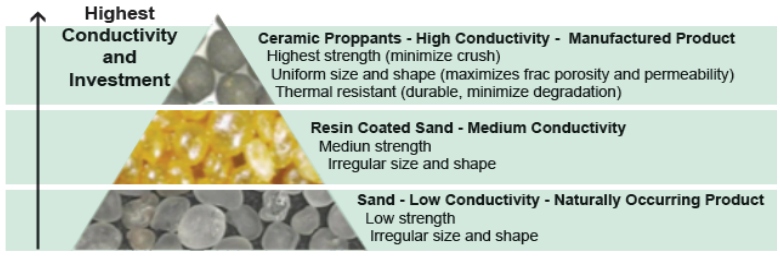

Figure 2. Scheme of proppant type [8]

III. NEW DEVELOPMENTS IN H.F. TECHNOLOGY

• Service companies create a new approach to fracturing that maximizes productivity, minimizes down time, and optimizes the operator's return on their service investment. Strategies for improving fracture production by optimizing conductivity have traditionally included: enhancing proppant roundness and strength, lowering proppant crush and gel loadings, improving gel breakers.

• The HiWAY™ technique fundamentally changes the way proppant fractures generate conductivity. It decouples fracture productivity from proppant permeability and creates flow channels. So instead of flowing through the proppant in the pack, hydrocarbons flow through channels, increasing conductivity by orders of magnitude (Fig. 3). Conductivity extends all the way to the tip of the fracture, allowing for longer effective fracture half-length, higher effective contact area, better fluid and polymer recovery, and less fracture face damage.

• The average HiWAY™ flow-channel fracturing technique job increase production by more than 20%, on average, helps operators use 40% less proppant per job and compared to slickwater treatmens uses 25% less water [9].

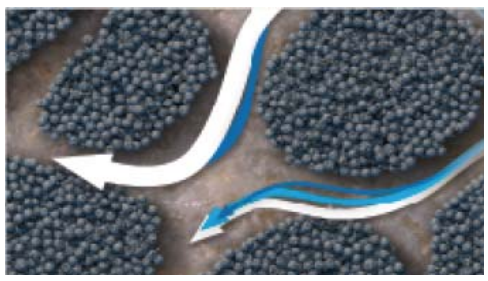

Figure 3. The HiWAY technique create stable, infinite-conductivity flow channels within fractures [9]

IV. HYDRAULIC FRACTURING IN SERBIA

• Method of hydraulic fracturing has been used in Serbia since 1976, when it was applied for the first time on the Banatsko Karđorđevo field. During the eighties, the method was used also on the oilfield Kikinda East.

• Modernization of the very process of hydraulic fracturing, but also possession of necessary assets for its application, have enabled more intensive use of this method since 2010. In addition to method of standard hydraulic fracturing, new technology is performed on NIS-Gazpromneft's fields using methods of BroadBand Shield™ and HiWAY™.

• The HiWAY™ method was proven successful on oil fields of Itebej, Elemir and Mokrin (Fig. 4). During 2016, hydraulic fracturing was done on 39 wellbores out of which more than half operations deployed HiWAY method, whereby additional production of 17,000 tons of oil was achieved. Fracturing is used these days in Serbia on five local fields [2].

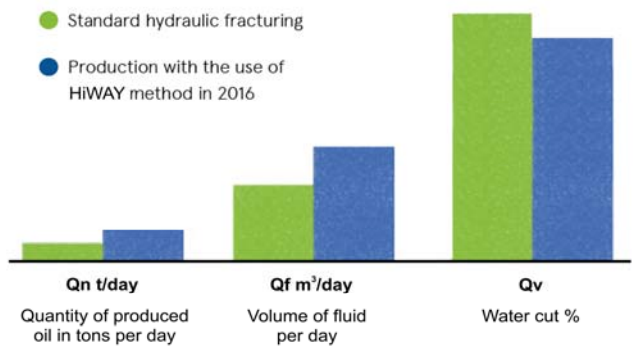

Figure 4. Diagram of production realized in the field "Itebej" in Vojvodina by different methods of fracturing [2]

V. CONCLUSION

• Hydraulic fracturing has been used by the petroleum companies seven decades as a way to improve hydrocarbon production.

• The recent improvements in technology have allowed companies to extract oil and gas resources from formations that previously inaccessible.

• The newest generation of Schlumberger HiWAY™ technology optimized operation performance which enables creation of fractures with complex structure of their stable channels. This technology was proven successful on oil fields of Itebej, Elemir and Mokrin in Serbia.

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