Development of An Environmentally and Equipment-Friendly Alternative for Matrix Acidizing and Acid-Fracturing of the Mississippian Limestone Formation

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STATUS: Project Proposed
TIMING: Preliminary results. To be completed in the future if funded
FUNDING: Seeking funding
STAFFING: Faculty member Reza Barati and part-time undergraduate students, Tyler Betz and Fred Markey

Purpose
The overall objective of this project is to evaluate the performance of UltraFrack™ as an environmentally- and equipment-friendly alternative for HCl that can be used for matrix acidizing and acid fracturing of wells producing from limestone formations. Specifically, this project will focus on developing this new product for the Mississippian Limestone Play (MLP) reservoirs in Kansas by evaluating the performance of UltraFrack™ as a single component product to be injected followed by evaluation of blends of UltraFrack™ and different polymers used in hydraulic fracturing of limestone formations.

Project Description
Well acidizing is one of the most common practices in the oil industry. Hydrochloric acid (HCl) has been used as the main acid for limestone stimulation purposes (Buijse et al. 2004). However, serious concerns regarding the health and safety of the field crew, corrosive nature of the acids for the tubular and equipment, environmental effects of the produced HCl, and rapid spending rate of HCl that prevents deep penetration into the formation has led the industry towards a more environmentally and equipment-friendly product (Adngua et al. 2013). UltraFrack™ is an environmentally- and equipment-friendly product of 101st Earthborn Environmental Technologies LP, which is a conversion to an organic carrier to maintain very low pH as a vehicle for aggressiveness, along with the creation of buffers and surface tension relievers for effectiveness and safety (Earthborn Clean Products). Low pH, linear reaction with limestone, small amount of residue after reaction, longevity and higher viscosity than water, with shear thinning behavior, are the properties of this product.

The Mississippian Limestone Play (MLP) has become an important source of income for both Kansas and Oklahoma with hundreds of horizontal wells drilled and completed and millions of dollars of extra income (Holt, 2012; Everly, 2012). Acid treatment of oil wells with the purpose of increasing productivity is a very common practice in the MLP. Considering the millions of barrels of fluids that are being used for acid treatment, use of a more environmentally- and equipment- friendly product will both save the companies money on their equipment and prevent the exposure of the acidizing crew and surface environment to HCl.
A complete lab study of this novel product including rheological, core-flooding and fracture conductivity tests at reservoir and ambient conditions will be followed by a matrix acidizing field test in a MLP production well. During the research and development phase of this project:

- Rheological measurements will be conducted for UltraFrack™ and blends of UltraFrack™ with guar and hydrolyzed polyacrylamide (HPAM) products used for hydraulic fracturing of wells.
- Core-flooding experiments using different concentrations and blends of UltraFrack™ with each fracturing polymer as viscosifying agents and fracturing fluids will be conducted at reservoir conditions.
- Fracture conductivity measurements for fractures generated using the selected fluids will be conducted at reservoir conditions. Base cases will also be conducted using HCl for both ambient and reservoir conditions.

The final products most suitable for matrix acidizing and acid fracturing will be selected and the conditions of different wells owned by the producer will be studied to select a MLP well with the most appropriate conditions for matrix acidizing. The field test will be designed and conducted and the post-treatment data will be analyzed.

**Deliverables**

The deliverables are: 1) an optimized recipe for UltraFrack™ and designed blends using hydraulic fracturing polymers including a comparison of rheological properties (Figure 6), incremental permeability induced by matrix acidizing and acid fracturing using this new product compared with HCl, and 2) improvement in the near-wellbore permeability for a MLP well after matrix acidizing using the new product.
Figure 6 Viscosity versus shear rate for UltraFrack\textsuperscript{TM} at 25 °C, 40 °C and 60 °C and 3000 psi pressure.

References
EVERLY, S., 2012, Kansas could see oil boom from Mississippi Lime formation, The Kansas City Star, Kansas City.