Development of An Environmentally and Equipment Friendly Alternative for Matrix Acidizing and Acid-Fracturing Applications

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SUBSURFACE APPLICATION: Mississippian limestone, Lansing Kansas City limestone intervals, Arbuckle, Austin Chalk, Buda limestone, Bakken, Eagle Ford, Niobrara
STATUS: Proposed project
TIMING: Preliminary results available, to be completed in the future if funded.
FUNDING: Seeking funding

Purpose
The overall objective of this project is to evaluate the performance of Ultraseries FF-01 (FF-01) 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 FF01 as a single component product to be injected followed by evaluation of blends of FF01 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 [1]. 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 lead the industry towards a more environmentally and equipment friendly product [2]. FF01 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 the effectiveness and safety [3]. 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 [4, 5]. Acid treatment of oil wells with the purpose of increasing their productivity is a very common practice in the MLP. Considering the millions of barrels of fluids that are being used for acid treatments, 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, both in liquid and vapor forms.

A complete lab study of this 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 FF01 and blends of FF01 with guar and hydrolyzed polyacrylamide (HPAM) products used for hydraulic fracturing of wells.
- Core flooding experiments using different concentrations and blends of FF01 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. Post-treatment data will be analyzed.

**Deliverables**

The deliverables are: 1) an optimized recipe and designed blends using acid alternatives and hydraulic fracturing polymers including a comparison of rheological properties (Figure 1), incremental permeability induced by matrix acidizing and acid fracturing using this new product (Figure 2) compared with HCl, and 2) improvement in the overall productivity due to acid fracturing using HCl alternatives.

![Figure 1. Viscosity versus shear rate for FF-01 and 15% HCl at 25 °C, 40 °C, and 60 °C.](image)

*Kansas Interdisciplinary Carbonates Consortium Prospectus – June 2015*
Figure 2. The upper picture presents a core sample after a matrix acidizing experiment is performed. The bottom picture is a core sample after an acid fracturing experiment was performed.

References


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