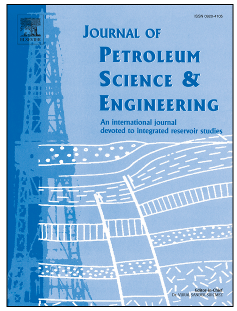

Mineralogy and pore topology analysis during matrix acidizing of tight sandstone and dolomite formations using chelating agents

Mian Umer Shafiq, Hisham Khaled Ben Mahmud, Muhammad Arif

PII: S0920-4105(18)30163-3

DOI: 10.1016/j.petrol.2018.02.057

Reference: PETROL 4727

To appear in: *Journal of Petroleum Science and Engineering*

Received Date: 15 November 2017

Revised Date: 7 February 2018

Accepted Date: 24 February 2018

MINERALOGY AND PORE TOPOLOGY ANALYSIS DURING MATRIX ACIDIZING OF TIGHT SANDSTONE AND DOLOMITE FORMATIONS USING CHELATING AGENTS

Mian Umer Shafiq[1], Hisham Khaled Ben Mahmud[1] & Muhammad Arif[2]

ABSTRACT

Hydrochloric acid (HCl) is commonly used during acidizing but certain problems are associated with its application such as corrosion of pipes, environment hazards, precipitation of fluosilicates or calcium fluorides and incompatibility of HCl with clay minerals. In order to mitigate these problems, few studies have proposed the use of chelating agents (the chemical compound that reacts with metal ions to form stable, water-soluble metal complexes) as an alternative. In this study, three different chelating agents, Ethylenediaminetetraacetic Acid (EDTA), N-(2-Hydroxyethyl) ethylenediamine-N,N',N'-triacetic Acid (HEDTA) and N-Acetyl-L-glutamic Acid (GLDA) were used to stimulate Colton tight sandstone and Guelph dolomite samples. The pH value of these chelates ranged from 1.7 - 3 and was measured before and after the core flooding to observe the physicochemical changes in rock/fluid mixtures. Core flood experiments under 180^{o}F temperature were conducted on core samples at slow injection rate which increased the contact time between the fluid and the rock and increased the amount of dissolved ions.

Porosity, permeability, Inductively Coupled Plasma (ICP), and Tescan Integrated Mineral Analysis (TIMA) were employed to measure the changes in the formation properties. The effluent samples were analyzed for calcium, magnesium, aluminium, sodium, potassium, silicon and iron using the ICP to assess the ability of these chelates on the complexation of these ions.

HEDTA showed a strong ability in chelating calcium, iron, magnesium, sodium and it chelated small amounts of aluminium ions from the sandstone cores. Porosity distribution analysis showed that the HEDTA was more effective in creating fresh pore spaces in sandstone formation while GLDA introduced a large amount of pore spaces in the dolomite. A large number of solid particles were dissolved using HEDTA in sandstone and GLDA in dolomite formations. Panorama of each sample shows that new wormholes had been created by all chelates.

The research introduced the chelates application in sandstone and dolomite formations and they showed good results in terms of matrix acidizing. Moreover, the Tescan Integrated Mineral Analysis (TIMA) has not been applied before to test the change in pore structure and mineralogy during the acidizing.

Keywords: minerals, chelates, permeability, TIMA, matrix acidizing

1. INTRODUCTION

Acidizing is one of the most commonly used technique among all stimulation methods in oil and gas industry (Ituen, 2017). Drilling and production operations can cause formation damage i.e., migration of fines, mud invasion etc. In order to reduce formation damage and maintain reservoir productivity, the acidizing operation is frequently employed (Ghommem et al, 2015). This process improves productivity by introducing high permeability flow paths and by removing the damage. Unlike dolomite acidizing, sandstone acidizing is complex and challenging because of the involvement of several chemical and physical reactions between the injected acid and the formation. Therefore, appropriate selection of acid, its concentration and injection volume is challenging to remove the damage or fines blocking the pore spaces (Thomas et al, 2002).

This complexity of sandstone acidizing is due to the presence of minerals which can only react with a specific acid e.g., siliceous minerals can only react with hydrofluoric acid (HF). The success rate of mud acid has been reduced due to the problems like matrix unconsolidation and incompatibility