Acidizing Technology of Carbonate Reservoir Used for Enhanced Oil Recovery in the Oilfield of Iraq

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ABSTRACT
An acidizing technology was applied to a carbonate reservoir oil field in Iraq. The oilfield is located in the Southeast of Iraq, whose main production reservoirs have two intervals. Interval A mainly consists of dolomite, limestone and a little of sandstone whereas interval M mainly consists of limestone. Both A and M belong to the middle-high porosity and low-middle permeability carbonate reservoir. The oilfield has rich resource and low oil production rate and low productivity. The matrix stimulation is a technology which can effectively improve the production of the oil wells of carbonate formation. The acidizing system, operation and spent acid flowing-back technology are selected to apply for the carbonate reservoir in the oilfield according to the reservoir characteristic and acidizing technology requirement including retarding property on the condition of high temperature, dissolving the matrix, passing by the plug, low damage to the reservoir and deeper perforation distance. 15 wells have been treated from June to December 2012 and the acidizing result is very obvious with the increasing production per day by 5897 m³ in the early after treatment.

KEY WORDS: Carbonate; Matrix Acidizing; Coiled Tubing; Nitrogen Gas.

INTRODUCTION
The Ma oilfield is located in the Southeast of Iraq, whose main production reservoirs are interval A of tertiary and interval M of cretaceous. The initial geological reserves are 12.4×10⁸ m³ and the cumulative productivity is 5.8%. The lithology of reservoir with the depth of 2800-4400 m mainly consists of limestone and dolomite. The initial pressure of formation is 32.6-44.8 MPa and the current pressure of formation is 28-40 MPa. The temperature of formation is 100-140 °C. The permeability is 1-1000 mD and the porosity is 10-19%. The property of oil is middle-heavy oil with the saturation pressure of 16.8-18.3 MPa and the initial oil-gas ratio of 86.3-124.6. The degree of mineralization of formation water is 22% and the water type is sodium bicarbonate. The pore is the main reservoir space of oil and gas and the natural fracture is the main seepage channel of oil and gas. The wells have no production after perforation and being induced flow, so we need to take the measure of matrix acidizing to put into production.

As for the carbonate reservoir in Ma oilfield, whether the acidizing system can dissolve matrix effectively, pass by the plug, penetrate the damage zone and connect the fracture and hole of formation or not play a decisive role in the matrix acidizing successfully. The technical difficulties are as follows:

1. The temperature of formation is high and the acid-rock reaction rate is fast. How to reduce the acid-rock reaction rate is a key factor which will have an effect on acidizing.

2. The formation is deep, whose temperature is high. The pump rate of matrix acidizing is low and it will take a long time for acid to contact with the production string. So the properties of high temperature corrosion inhibitor will directly affect the safety of operation and the life of the production string.

3. After acidizing, a lot of calcium chloride will be dissolved in the spent acid, which will make the density of the spent acid increase. If the formation energy is not high enough to flow back the spent acid quickly, the spent acid can cause a second time pollution and have an effect on acidizing (Yin Bencai and Zhang Gaoqun, 2011; Lv Hong and Yan Jinchuan, 2010).

The lithologic characteristic of Ma oil field
The lithology mainly consists of carbonate rock in Ma oilfield and the carbonate rock has some differences between interval A of tertiary and interval M of cretaceous. The interval M is very thick. The lithology of interval M mainly consists of limestone whose distribution is relatively stable. However, the sedimentary environment of interval A is relatively unstable.

The thin section analysis of core of interval A: the core contains sandy microcrystalline limestone with microcrystalline structure and micro cracks. The basic ingredient of core is microcrystalline calcite which has the phenomenon of slight recrystallization. The terrigenous clastic distributes in the core. The cementation type of debris and interstitial material is basal cementation. The photographs of the thin section analysis of core of interval A are shown in Fig.1.