

## **Experimental Study of Chemically Assisted Steam Flooding in Fractured Rocks for Enhanced Oil Recovery**

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### **Abstract**

The increase in worldwide energy consumption and the decrease or decline in conventional oil resources point to a more aggressive exploitation of heavy oil. Heavy oil is a major source of energy in the Sultanate of Oman. However, economically speaking heavy oil production costs much more than that of conventional oil. Oman is one of the countries that has started to focus on heavy oil production and the enhanced oil recovery (EaR) of heavy oil. Qam Alam Field and Mukhaizna Field are examples of heavy oil fields in Oman. In Oman, more than 90% of the initial oil-in-place (IOIP) is contained within the matrix porosity. The geometry and the extent of the fracture network, the matrix permeability, the wettability and the nature of the fluid system are some of the most important factors to be considered in an EaR scheme in Oman. The research conducted in this study uses Mukhaizna crude in fractured and non-fractured Berea core. The Mukhaizna Oil Field is a Gharif carbonate reservoir and is not fractured. It is a matrix reservoir and the fluid density is 16 API. Steam injection is considered to be the most promising recovery method for this field. Nevertheless, because of the presence of fractures, the optimization of the EaR scheme presents a formidable challenge. This research is aimed at optimizing such a scheme. It also endeavors to study the impact of various additives that might increase the efficiency of the EaR scheme. However, using chemical additives has been found to be environmentally damaging and often prohibitively expensive. Hence, this research will develop an array of natural additives that are economically attractive and environmentally friendly. The overall process would be optimized through laboratory and numerical investigations. A series of laboratory experiments were conducted in a Berea core using

Mukhaizna oil with 16 API. An autoclave was used as a steam generator. Experimental set-ups were prepared as follows:

l= Fractured core

1. 1- Pure steam test

1.2- Steam with synthetic sodium solution

1.3- Steam with wood ash solution

Each test was repeated at different temperatures (100 °C , 120oc, and 13 S°C) and at different time set-ups. The results of this work helped to understand the mechanisms and show that wood ash solution allows for as close a recovery as a synthetic solution. Wood ash extracted alkaline substances are environmentally friendly and naturally abundant, whereas injection synthetic alkaline solutions are costly and environmentally toxic and harmful. The surface tension associated with a water-oil system induces a capillary pressure, which, in turn, provides the driving force for spontaneous imbibitions into the matrix blocks. So using wood ash as a dilute is to reduce the surface tension of the water-oil system in order to release the residual oil saturation of the system.