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The Importance of Reservoir Geomechanics in Thermal EOR

Morteza Matinkia
Department of Petroleum Engineering
Omidiyeh Branch, Islamic Azad University
Omidiyeh, Iran
Morteza.matinkia@gmail.com

***Abstract*—The primary oil recovery in heavy oil reservoirs is low due to the high viscosity of the oil. Thermal EOR processes attempt to recover oil beyond the primary production methods. In this regard, the geomechanical response of an oil sands/heavy oil reservoir is complex, reaching both near- and far-field temperatures and pore pressures. In this paper, the latest achievement of thermal geomechanics is investigated. It can be perceived that owning to thermal and pore pressure changes in response to vapor injection methods, isotropic unloading, and shear dilation occur with varying degrees in different geomechanical zones. The extent of these regions is based on drainage conditions within that zone that directly impact the pore pressure evolution. The reservoir has been subdivided into three zones; drained, partially drained, and undrained. Geomechanical processes can lead to significant changes in relative and effective permeability, porosity, compressibility, and reservoir stress/strain behaviors.**

Keywords: Steam injection, EOR, geomechanical characteristics

I. INTRODUCTION

In heavy oil reservoirs, due to the high oil viscosity, oil recovery factor is significantly low. Thermal methods are commonly used for heavy oil reservoirs with high oil viscosities. Heat is usually injected into reservoirs through various methods and causes reduction of oil viscosity, decrease in interfacial tension between the oil and the injection fluid, and consequently moves the oil through the porous medium. Heat is transmitted along the reservoir rock by convective displacement and conduction through the reservoir rocks.

The geomechanical properties of heavy oil sandstone reservoirs are complex and affect the temperature and pore pressure properties in areas near and far from the reservoir [4]. Figure 1 shows the basic interactions between geomechanics and fluid flow in deformable reserves. During steam injection processes the reservoir fluid pressure increases and leads to a reduction in the effective stress that surrounds the reservoir rock. Also, heating the reservoir rocks will lead to thermal expansion of rocks, which increases the enclosing stress. The simultaneous effect of pore pressure and temperature causes a complex interaction between geomechanics and fluid flow [2].

In this paper, first, various thermal methods for oil recovery are described. Then latest findings related to the geomechanical behavior of the reservoir as a result of thermal injection process are investigated.