
3D pore scale imaging as a tool to understand multiphase flow in porous media

Souhail Youssef*^{†1}

¹IFP Energies Nouvelles (IFPEN) – IFP Energies Nouvelles – France

Abstract

Multiphase flow in porous media is central in a wide range of phenomena and applications in geosciences, including hydrocarbon formation, migration and production, water resources management, soil remediation as well as CO₂ sequestration. Understanding and predicting fluid displacement mechanisms are one of the big challenge in reservoir engineering. Since pioneer works of Vinegar and Wellington (1984), who modified a medical CT scanner for core analysis, until recent developments in synchrotron based X-ray tomography that allows sub-second temporal resolution with a spatial resolution ranging from 0.5 to 11 μm ; X-Ray 3D imaging has emerged as a key technology to study multiphase flow in porous media with a continuous quest for space and time resolution. We present a workflow combining high speed CT-scan, laboratory based micro-CT and synchrotron x-ray ultra-fast tomography to investigate chemical enhance oil recovery process from the pore scale to core scale. We show how the combination of these multi-scale imaging technics allows to better understand how oil is recovered by surfactant injection and to better access the impact of rock structure on oil trapping and mobilization. Then we propose an adimensional analyses that will help to link pore scale proprieties to macroscopic properties such as the capillary desaturation curve and the relative permeabilities. Finally we discuss how lab scale parameters can be used in a reservoir simulation to predicting the efficiency of an EOR process.

*Speaker

[†]Corresponding author: souhail.youssef@ifpen.fr