
Mathematical modeling and inverse mapping to find the saturation of carbonate-water in the fingering phenomenon

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The fingering phenomenon occurs during the secondary oil recovery process when the water is injected at a relative speed through the porous media. Water injection (water flooding) is a cheap and very effective method that depends on the oil-water viscosity ratio. Carbon Dioxide is a miscible gas with both oil and water, and it can reduce the viscosity of oil in a process called swelling. That led scientists to study water injection together with CO₂ gas in the oil recovery process to recover important portion of oil. For the first time, in this study we build up a mathematical model to find the saturation of carbonate-water of the fingering phenomenon and, also discussed the effect of the inclination angle of the oil layer. To determine the parameters of this model we used the Method of Directly Defining the inverse Mapping (MDDiM) which is a novel technique to solve nonlinear differential equations. This study proves the saturation of carbonated water is high compared to the previous studies for saturation of water. If the saturation of injected fluid is increasing then it leads to increase oil recovery. Therefore this study reflects the fact that the important portion of oil recovery when the carbonated water injection than the water injection. We obtained second and third-order solutions for carbonate-water saturation for different inclination angles and they are accurate enough with the squared residual errors that were found using Maple 16. We can conclude that carbonate-water saturation increases with the inclination angle and further it is founded that third-order solutions are more accurate compared to the squared residual errors.

Keywords: Carbonate-water saturation, Fingering phenomenon, Incline angle, Method of directly defining the inverse mapping

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