DEVELOPMENT OF AN ANALYTICAL MODEL TO PREDICT THE PERFORMANCE OF CHEMICAL EOR METHODS

By

Eng. Mohamed El-Sayed Ahmed Mohamed El-Tayeb

A Thesis Submitted to the
Department of Mining, Petroleum, and Metallurgical Engineering,
Faculty of Engineering at Cairo University
in Partial Fulfillment of the Requirements for the Degree of

Master of Science
in
Petroleum Engineering

Faculty of Engineering, Cairo University
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Under the Supervision of

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Title of Thesis:

Development of an Analytical Model to Predict the Performance of Chemical EOR Methods

Key Words:
Chemical EOR Methods; Predictive Model; Fractional Flow Theory; Areal Sweep Models; Areal Heterogeneity

Summary:
The main objective of this work is to develop an analytical forecasting model for the performance of chemical EOR processes. This predictive model is to be used as a pre-simulation tool for its simplicity and efficiency as it can consider most of the features accompanied by the chemical flooding besides the reservoir heterogenity. The developed model is verified through the application of some field cases and many comparison cases with a well-known commercial chemical simulator.

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Dedication

To my Parents and my beloved sister.

This humble work is a sign of my love to you!

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Nomenclature

Symbol		
A	Area	ft^2
A_i	Adsorption of component i per unit mass of rock	µg/g rock
a	Pattern dimension	ft
C_i	Concentration of component i in fluid per unit pore volume	lbm/ft^3
$\hat{C}_i$	Concentration of component i in stationary phase (rock) per unit pore volume of rock	lbm/PV
D_p	Amount of polymer adsorption expressed in pore volumes	Dimensionless
E_A	Areal sweep efficiency	%
E_{ABT}	Areal sweep efficiency at breakthrough	%
E_D	Displacement efficiency	%
$E_{Vertical}$	Vertical sweep efficiency	%
f	Fractional flow of a given phase	Fraction, Dimensionless
f_w	Water fractional flow	Fraction, Dimensionless
F_{rr}	Residual resistance factor	Dimensionless
G_j	Shape factor of cell i	ft
h	Thickness	ft
K	Permeability	md
K_{ro}	Relative permeability to oil	Fraction, Dimensionless
K_{rw}	Relative permeability to water	Fraction, Dimensionless
K_{rwp}	Relative permeability to water after polymer contact	Fraction, Dimensionless
L	Half distance between the injector and producer	ft
M	Mobility ratio	Dimensionless
m-exponent	Corey exponent for oil	Dimensionless
n-exponent	Corey exponent for water	Dimensionless
N_p	Cumulative oil production	STB
N_s	Original oil in place	STB
OIP	Oil in place	STB
ΔP	Pressure drop between the injector and producer	psi
q	Flow rate	bbl/day
q_{inj}	Injection rate	bbl/day
Qi	Injected pore volume	Dimensionless
r_w	Radius of well	ft
S	Saturation of a given phase	Fraction, Dimensionless
t	Elapsed time	Days