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Lateef Kareem

Resumé

"blessed is he who studies to solve societal problems"

Education

2011–2013 **MSc**, *King Fahd University of Petroleum and Minerals (KFUPM)*, Dhahran, Saudi Arabia, *3.86*.
Distinction

2002–2007 **B-Eng**, *Federal University of Technology (FUTO)*, Owerri, Nigeria, .

Master's thesis

Title *Improved Numerical Simulation of Wormhole Propagation in Carbonate Acidizing*

Supervisors Dr. Abdullah Sultan, Dr. Abeeb Awotunde and Dr. Rajai Alassar

Description Numerical simulation of wormhole propagation is the solution of systems of equations that describes the wormhole phenomenon as close to the reality as possible. This solution provides access to lots of data that are not available in experimental studies. Knowledge of pressure, concentration, porosity and permeability at every location in the core and time during the simulation provide a better understanding of the stimulation process. In this paper, strongly coupled and stiff system of differential equation describing the phenomenon was solved using Implicit Pressure Explicit Concentration Implicit Mineral Volume Implicit Porosity method (IPECIMVIP). Using 141,647 grid cells $(51 \times 51 \times 81)$ for a 1.5inch diameter, 2.4inch thick carbonate core, we performed numerical simulation of wormhole propagation, discuss the stability criteria for time step selection and present new understandings of the wormhole phenomenon: 1). The use of mean core acid concentration as an indication of the efficiency of the phenomenon, 2). The presence of 2 breakthroughs- Acid and wormhole breakthrough, 3). The shifting effect of local mass transfer coefficient and molecular diffusivity on the acidization curve, 4). The impact of initial permeability of the core on the pore volume injection to breakthrough, 5) The joint impact of Péclet and Damköhler number and 6). Pore volume injection to concentration breakthrough at high injection rates.

Research Experience

Research

2016–Present   **Applied Mathematician/Petroleum Engineer**, *CypherCrescent Ltd (Software Development and Oil Servicing Company).*, PortHarcourt, Nigeria.

Applied Mathematics and Optimization.

Projects Involvement:

- Development of the Mathematics Library.
  Role: I oversaw the development of the mathematics library on which most of our computation is based. The Mathamatics library is a collection of classes such as the Matrix class (for linear algebra calculations- solution of linear system, eigen-system calculations), Solver class (for solution of linear and nonlinear equation, differential equations, numerical inversion of Laplace transforms), Integration class (for all kinds of numerical integration like trapezoidal method simpsons method, gauss-legendre, gauss-jacobi, gauss-laguerre and gauss-hermite), Optimizer class(for linear, nonlinear, constrained and uncnstrained optimization), Complex class (for all complex arithmetic calculations), Valder class (for automatic differentiation) ;
- Development of Water Influx estimation .
  Role: I developed the solution to water influx problem for edge drive, bottom drive for both radial and rectangular geometry,
- Numerical computation of reservoir fluid properties via EOS.
  Role: I performed the solution of the multi-component chemical equilibrium equations used in compositional gradient calculations, phase envolope calculations, and as well developed new criticality condition for multicomponent systems. I also developed a new power correlation for estimation of pure component vapour pressure.

2013–2015   **Research Engineer**, *Center for Petroleum and Minerals, Research Institute, King Fahd University of Petroleum and Minerals*, Dhahran, Suadi Arabia.

Computational Fluid Dynamics Section with Focus on Reactive and Non Reactive Flow in Porous Medium.

Projects Involvement:

- Improved Numerical Simulation of Wormhole propagation in Carbonate Core(Schlumberger Oil Services -project CPM (2298)).
  Role: I processed CT scan images of the core and develop CT scan number porosity relationship and piecewise permeability-porosity equation. I also built a simulator to solve coupled reactive transport differential equations. I performed simulation and carried out report and publication writing.;
- Assessment of Impact of Micro fractures on Well productivity in Shale gas Reservoirs: Numerical Simulation Approach (Baker Hughes sponsored).
  Role: I performed 6 half-cell permeability characterizations, and now I am solving transport differential equation.,
- Inflow Performance Relation of a Fully Penetrating Horizontal Well with Transverse Elliptic Fractures using Spheroidal Coordinate System.
  Role: I solved diffusivity equation in spheroidal, radial and rectangular coordinate systems. I coupled the result to develop the overall pressure drop. Now, I am performing simulation to account for errors due to change from linear to radial and spheroidal flow pattern.

Teaching Experience

Mathematical Methods in Petroleum Engineering and Advanced Reservoir Simulation

Oct. 2016–Present **Visiting Lecturer**, *Institute of Petroleum Studies, University of PortHarcourt and IFP France*, PortHarcourt, Nigeria.
I taught Numerical methods to MSc student 2016/2017 set
Practical Projects:
- Estimation of compressibility facor using Starling Canahans Equation of State (Hall and Yarborough Correlation) using the Newton-Raphsons's method of root finding.
  Role: I walked them through how to compute numerical differentiation of functions, development of newton-raphson agorithm, estimation of initial guess for the Hall and Yarborough equation and the estimation of Zfactor;
- Solution of the diffusivity equation for aquifer flow for the edge-drive dimensionless water influx .
  Role: I walked the student through the derivation of diffusivity equation using the combination of continuity equation and darcy law, solved the equation for pressures and estimate the constants, derive the differentiation of Pressure with space at the inner boundary and evaluate the water flow rate across the boundary and then the water influx by integration of the flow rate over time(all in laplace space), then we performed the numerical inversion to obtain the result in time space;
- Assign a final project on Reserve estimation and aquifer parameter evaluation to the students

Oct. 2016–Present **Visiting Lecturer**, *Petroleum and Gas Engineering Department, University of PortHarcourt*, PortHarcourt, Nigeria.
I taught Application of Laplace transform to MSc student 2016/2017 set in Petroleum and Gas department

Sep. 2012– Jan. 2013 **Teaching Assistant**, *Petroleum Engineering Department, King Fahd University of Petroleum and Minerals*, Dhahran, Estern Provinces, Saudi Arabia.
I taught Application of Laplace transform to MSc student 2012/2013 set in Petroleum Engineering department, I also assisted the lecturer (Dr Abeeb Awotunde) in advanced reservoir simulation

Publication

- **Kareem, LA**, Iwalewa, TM and Omeke, JE. (2014). 'Isobaric specific heat capacity of natural gas as a function of specific gravity, pressure and temperature.' *Journal of Natural Gas Science and Engineering.* 19, pp. 74–83.
- **Kareem, LA**, Sultan, AS and Iwalewa, TM. (2015) 'Simplified Semi-analytical Productivity Index for an Eccentric Horizontal Well in a Box Model Reservoir.' *Journal of Energy Exploitation and Exploration.* 33, pp. 785-808.
- **Kareem, LA**, Iwalewa, TM and Al-Marhoun, M. (2015). 'New explicit correlation for the compressibility factor of natural gas: Linearized z-factor isotherms.' *Journal of Petroleum Exploration and Production Technology.*, p. 1-12
- **Kareem, LA**, Sultan, AS. 'New Understanding in Numerical Simulation of Wormhole Propagation in Carbonate Core Acidizing.' *Journal of Transport in Porous Media.*, Decision: revise and resubmit (2015).

Conference Presentation

- **Kareem, LA**, 'Z factor: Implicit correlation, convergence problem and pseudo-reduced compressibility' (2014). *36th Nigerian Annual International Conference and Exhibition*, Abuja, Nigeria, August, 2014.

- **Kareem, LA**, Explicit Half Range Cosine Fourier Series Expansion For Z Factor (2013). *35th Nigerian Annual International Conference and Exhibition*, Lagos, Nigeria, August, 2013.

- **Kareem, LA**, Characteristic Equation and Determinant of a Null Matrix. *Southeastern Meeting American Mathematical Society*, Tulane University, New Orleans, Louisiana, United States, October 13-14, 2012.

- **Kareem, LA**, Omeke, JE, Furui's IPR Model Correction and its Application in Horizontal Well Cresting Control & Inflow Control Device Installation (2012). *34th Nigerian Annual International Conference and Exhibition*, Lagos, Nigeria, August, 2012.

- **Kareem, LA**, Omeke, JE, Specific Heat Capacity of Natural Gas; Expressed as a Function of Its Specific gravity and Temperature (2011). *33th Nigerian Annual International Conference and Exhibition*, Abuja, Nigeria, August, 2011.

- **Kareem, LA**, Omeke, JE, Achumba, GA, A New Approach for Recovery Factor Estimation; Using the Mechanics of Fluid Flow through Reservoir and Production Tubing and Expansion of formation and Reservoir Fluids (2010). *32th Nigerian Annual International Conference and Exhibition*, Calabar, Cross Rivers, Nigeria, August, 2010.

Membership of Professional Bodies

Oct. 2002–Present Society of Petroleum Engineers, Nigeria, Board of Technical Review Committee since 2014

Feb. 2011–Present Society of Petroleum Engineers, Saudi Arabia

Nov. 2015–Present Society of Petroleum Engineers, London

Board of Reviewers for Journal

May, 2014–Present Journal of Natural Gas Science and Engineering

June, 2016–Present Journal of Petroleum Science and Engineering

Research Profile Pages

- Google Scholar, Academia, Researchgate, and Matlab file Exchange

Computer skills

Computational Matlab, Fortran, Mathematica, Julia, C++ and C#

Visualization Matlab and Paraview

High Performance Computing	IBM HPC Platform Version 4
Word Processor	MSWord and Latex
Presentation	MSPowerPoint and Latex
Operating System	Windows and Linux

Interests

Research	Numerical Simulation of Reactive and Non-reactive Flow in Porous Medium, Modeling, Numerical Solution of Partial Differential Equation and Optimization of Physical Systems
Teaching	Mathematics, Physics, Thermodynamics, Mechanics (Statics and Dynamics), Fluid Mechanics, Analysis of Statically Determinate Structures

Languages

Yoruba	**Native User**	
English	**Expert User**	*IELTS Score 7.5/9.0*

Volunteering

- Matlab File Exchange Contributor. I have contributed 8 file getting over 170 downloads per month

References

Muhammad Al-Marhoun	Professor, Department of Petroleum Engineering, King Fahd University of Petroleum and Minerals and CEO at Restec Tel: +966 50 481 4439 Email: marhoun@restec.com
Abeeb A. Awotunde	Assistant Professor, Department of Petroleum Engineering, King Fahd University of Petroleum and Minerals Tel: +966 3 860 7560 Email: awotunde@kfupm.edu.sa
Rajai S. Alaassar	Professor, Department of Mathematics, King Fahd University of Petroleum and Minerals Tel: +966 3 860 2787 Email: alassar@kfupm.edu.sa