

18th European Symposium on Improved Oil Recovery 2015

Overcoming the Barriers

**Dresden, Germany
14 - 16 April 2015**

Volume 1 of 2

ISBN: 978-1-5108-0219-3

Printed from e-media with permission by:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571



Some format issues inherent in the e-media version may also appear in this print version.

Copyright© (2015) by the European Association of Geoscientists & Engineers
All rights reserved.

Printed by Curran Associates, Inc. (2015)

For permission requests, please contact by the European Association of Geoscientists & Engineers
at the address below.

EAGE
PO Box 59
3990 DB Houten
The Netherlands

Phone: +31 88 995 5055
Fax: +31 30 634 3524

eage@eage.org

Additional copies of this publication are available from:

Curran Associates, Inc.
57 Morehouse Lane
Red Hook, NY 12571 USA
Phone: 845-758-0400
Fax: 845-758-2634
Email: curran@proceedings.com
Web: www.proceedings.com

TABLE OF CONTENTS

VOLUME 1

BEST OF TULSA

Tu A01: Ammonia as Alkali for ASP Floods – Comparison to Sodium Carbonate	1
<i>J. Southwick, E. Pol, C. Rijn, D. Batenburg, D. Boersma, Y. Svec, A. Mastan, K. Raney</i>	
Tu A02: An Overview of Conformance Control Efforts for the West Sak Field on the North Slope of Alaska	25
<i>J. Peirce, M. Hutcherson, B. Brice, J. Vasquez, A. Woods</i>	
Tu A03: Diffusion and Matrix-fracture Interactions during Gas Injection in Fractured Reservoirs	49
<i>H. Shojaei, K. Jessen</i>	
Tu A04: CO2 Foam Pilot in Salt Creek Field, Natrona County, WY - Phase I - Laboratory Work, Reservoir Simulation, and Initial Design	70
<i>J. Mukherjee, S. Norris, Q. Nguyen, J. Scherlin, P. Vanderwal, S. Abbas</i>	

PILOT AND FIELD EXPERIENCES I

Tu A06: Novel Approach for Evaluation of Simultaneous Water and Gas Injection Pilot Project in a Western Offshore Field, India	94
<i>R. Saxena, R. Singh, V. Verma, G. Agrawal, A. Kumar, A. Pandey, S. Chaudhary, H. Chadha, A. Agrawal, S. Gupta</i>	
Tu A07: Polymer Suspensions - New Alternatives in Oilfield Chemistry	103
<i>I. Lakatos, J. Lakatos-Szabo, G. Szentes, A. Vago, M. Vadaszi</i>	

PILOT AND FIELD EXPERIENCES II

Tu A09: Reservoir Modeling and Simulation for the Basalt Oil Reservoir Accomplishing Gas Injection IOR	123
<i>K. Yoshioka, T. Okajima, H. Kadono</i>	
Tu A10: Increased Oil Recovery from a Mature Oil Field by Gas Injection	134
<i>B. Matre, J. Rasmussen, K. Hettervik, D. Hongbua</i>	

FROM THE LABORATORY TO THE FIELD

Tu B01: Implementation of CO2 Foam EOR Technology - Taking Chemistry Innovation from the Lab to Oil Fields	143
<i>J. Mukherjee, D. Frattarelli, T. Knight, P. Patil, R. Cruz, P. Vanderwal, P. Rozowski</i>	
Tu B03: Novel Reservoir Conformance Treatments at Gas Fields - from Laboratory to Fields	159
<i>I. Lakatos, J. Lakatos-Szabo, G. Szentes, M. Vadaszi, A. Vago, Z. Karaffa, L. Bartha</i>	

ADVANCED WATERFLOODING I

Tu B05: Effect of Initial Sulfate in Reservoir Chalks on the Spontaneous Imbibition of Sea Water	168
<i>I. Fjelde, S. Asen</i>	
Tu B06: Oil Recovery Improvement from Low Salinity Waterflooding in a Clay-free Silica Core	180
<i>S. Farzaneh, M. Sohrabi, J. Mills, P. Mahzari, K. Ahmed</i>	
Tu B07: Improved Oil Recovery from North Sea Chalk Fields by Injection of Optimized Seawater	201
<i>T. Puntervold, S. Strand, R. Ellouz, T. Austad</i>	
Tu B08: Calcite Dissolution Behaviour During Low Salinity Water Flooding in Carbonate Rock	209
<i>L. Ouden, R. Nasralla, H. Guo, H. Bruining, C. Kruijsdijk</i>	

ADVANCED WATERFLOODING II

Tu B09: Impact of Micro-Dispersion Formation on Effectiveness of Low Salinity Waterflooding	227
<i>P. Mahzari, M. Sohrabi</i>	
Tu B10: Low Salinity Water-surfactant-CO2 Enhanced Oil Recovery: Theory and Experiments	237
<i>T. Teklu, W. Alameri, H. Kazemi, R. Graves, A. AlSumaiti</i>	

POSTER SESSION

Tu P02: Novel Insights into IOR/EOR by Seawater and Supercritical CO2 Miscible Flooding Using Dual Carbonate Cores at Reservoir Conditions	257
<i>X. Zhou</i>	
Tu P03: Novel Method of Water Management by Interpreting Downhole Monitoring Data for Horizontal Wells	273
<i>M. Chen, M. Wang, G. Liu, C. Li, L. Chen</i>	
Tu P04: Rheological Behavior of Nanofluids and their Application in Emulsion Inversion	284
<i>D. Slavova, S. Pollak, M. Petermann</i>	
Tu P05: Estimation of Critical Temperatures Based on New Viscosity Model for HPAM Polymer Flooding in High-Temperature Reservoir	293
<i>B. Choi, M. Jeong, J. Choi, K. Lee</i>	
Tu P06: A Study of Rock Wettability Effect on Prediction of Polymer Retention Using Pore Network Modeling	312
<i>S. Nafchi, B. Rostami, S. Seyyedi</i>	
Tu P07: Application of Artificial Neural Network in Prediction of Fluid Properties of CO2-Decane System	321
<i>J. Foroozesh, M. Seyyedi</i>	
Tu P08: Implementation Time of Chemical Flood and its Impact on Ultimate Recovery	332
<i>A. Alshehri, A. Khatib</i>	
Tu P09: An Analytical Model for Imbibition Experiments with Porous Plate	346
<i>P. Andersen, S. Evje, R. Ahsan, A. Hiorth</i>	
Tu P10: Lessons Learned from IOR Steamflooding in a Bitumen-Light Oil Heterogeneous Reservoir	357
<i>W. Al-Mudhafar, S. Nasab</i>	
Tu P11: Effect of Salinity and Pressure on the Rate of Mass Transfer in Aquifer Storage of CO2	371
<i>R. Khosrokhavar, A. Eftekhari, R. Farajzadeh, K. Wolf, H. Bruining</i>	
Tu P12: Systematic Phase Behaviour Study and Foam Stability Analysis for Optimal Alkaline/Surfactant/Foam Enhanced Oil Recovery	383
<i>S. Nasab, P. Zitha</i>	
Tu P13: Applying the Hydrophilic – Lipophilic Deviation (HLD) Concept to Chemical EOR Formulations	404
<i>G. Trahan, T. Nguyen, B. Jakobs-Sauter</i>	

FIELD EVALUATION FOR IOR

We A01: Chemical EOR Strategy Optimization in the Presence of Economic and Technical Uncertainty	413
<i>A. Alkhatib</i>	
We A02: Use of a New Class of Partitioning Tracers to Assess EOR and IOR Potential in the Bockstedt Field	433
<i>S. Hartvig, O. Huseby, V. Yasin, O. Ogezi, B. Ernst, S. Reimann, B. Leonhardt</i>	
We A03: Fall-Off Test Analysis and Transient Pressure Behavior in Foam Flooding	445
<i>N. Gargar, H. Mahani, J. Rehling, S. Vincent-Bonnieu, N. Kechut, R. Farajzadeh</i>	
We A04: Discerning In Situ Performance of an EOR Agent in the Midst of Geological Uncertainty	468
<i>S. Fatemi, J. Jansen, W. Rossen</i>	

FOAMS I

We A05: Nanoparticle Stabilized Foam in Carbonate and Sandstone Reservoirs	476
<i>J. Roebroeks, A. Eftekhari, R. Farajzadeh, S. Vincent-Bonnieu</i>	

We A06: Simulation based Planning, Implementing and Interpretation of Results of Foam Treatment to Reduce GOR	487
<i>A. Mosesyan, Y. Simakov</i>	
We A07: Improved Mobility Reduction of Non Dense Gas Foam in Presence of High Residual Oil Saturation	499
<i>M. Chabert, L. Nabzar, A. Cuenca, V. Beunat, E. Chevallier</i>	
We A08: Effect of Permeability on Foam-model parameters - An Integrated Approach from Coreflood Experiments through to Foam Diversion Calculations	508
<i>L. Kapetas, S. Vincent-Bonnieu, R. Farajzadeh, A. Eftekhari, S. Mohd-Shafian, R. Bahrim, W. Rossen</i>	

FOAMS II

We A09: Foam as Mobility Control for Integrated CO₂-EOR in Fractured Carbonates	524
<i>M. Steinsbo, B. Brattekas, G. Ersland, K. Bo, I. Opdal, R. Tunli, A. Graue, M. Ferno</i>	
We A10: Small Core Flood Experiments for Foam EOR - Screening Surfactant Applications	539
<i>S. Jones, V. Bent, R. Farajzadeh, W. Rossen, S. Vincent-Bonnieu</i>	
We A11: Experimental Investigation of CO₂, CO₂SWAG and CO₂-Foam Injection Scenarios for Enhanced Heavy Oil Recovery	550
<i>S. Farzaneh, M. Sohrabi, A. Emadi</i>	

FUNDAMENTAL SCIENCE (ADVANCED WATERFLOODING)

We B01: Ion-induced Wetting Transition during Low Salinity Waterflooding	562
<i>B. Bera, I. Siretanu, A. Maestro, M. Duits, M. Cohen-Stuart, H. Ende, F. Mugele, I. Collins</i>	

VOLUME 2

We B02: Investigation of Rock Wettability Alteration by Carbonated Water - Contact Angle Measurement	572
<i>M. Seyyedi, M. Sohrabi, A. Farzaneh</i>	
We B03: Osmosis as Mechanism for Low Salinity EOR	588
<i>K. Sandengen, K. Melhuus, L. Josang</i>	
We B04: Spontaneous Imbibition Revisited - A New Method to Determine Kr and Pc by Inclusion of the Capillary Backpressure	602
<i>M. Ferno, A. Haugen, B. Brattekas, N. Morrow, G. Mason</i>	

FUNDAMENTAL SCIENCE (PORE SURFACES)

We B05: Adsorption/desorption of Ca²⁺ and Mg²⁺ to/from Kaolinite Clay in Relation to the Low Salinity EOR Effect	620
<i>Z. Aghaeifar, S. Strand, T. Puntervold, T. Austad, S. Aarnes, C. Aarnes</i>	
We B06: Zeta Potential in Carbonates at Reservoir Conditions - Application to IOR	629
<i>A. Alroudhan, J. Vinogradov, M. Jackson</i>	

FUNDAMENTAL SCIENCE (CHEMICALS)

We B07: Towards a Nanoscopic Understanding of Oil-sandstone Wettability - Implications for Enhanced Oil Recovery	639
<i>R. Kareem</i>	
We B09: Effect of Permeability on Foam-model Parameters and the Limiting Capillary Pressure	657
<i>R. Farajzadeh, M. Lotfollahi, A. Eftekhari, W. Rossen, G. Hirasaki</i>	
We B10: Associative Copolymers for Polymer Flooding - Structure-Performance Relationships in Porous Media	676
<i>R. Reichenbach-Klinke, A. Stavland, T. Zimmermann, C. Bittner, G. Brodt</i>	
We B11: In situ Viscosity Measurements of Microemulsions in Cores with Different Permeabilities	691
<i>E. Unsal, S. Oedai, M. Buijse, K. Humphry, M. Lee</i>	

IOR IN CHALLENGING ENVIRONMENTS

Th A01: Evaluation of Asphalt Particle for Impeding Channeling and Enhance Oil Recovery in Naturally Fractured Reservoir	706
<i>G. Liu, H. Jiang, M. Wang, F. Chen, S. Ding</i>	
Th A02: Numerical Simulation of Foam EOR Processes in Heterogeneous Fractured Carbonate Reservoirs	717
<i>S. Agada, K. Soni, S. Geiger</i>	
Th A03: Rheological and Physico- Chemical Characterization of EOR Chemicals at High Temperature	728
<i>M. Nowak, P. Schuler, L. Siggel</i>	
Th A04: A Geostatistic Approach to Upscale Naturally Fractured Reservoirs for EOR studies in the Gulf of Mexico	737
<i>J. Molano, G. Roa, L. Merino, N. Hernandez, S. Reyes, A. Trejo, J. Flores</i>	

MODELLING IOR

Th A06: The Impact of Reservoir Conditions on Capillarity, Multiphase Flow and Hysteresis for CO₂-brine Systems	755
<i>S. Krevor, B. Niu, C. Reynolds, A. Al-Menhali</i>	
Th A07: Development and Testing of Advanced Methods for the Screening of Enhanced-Oil-Recovery Techniques	766
<i>M. Siena, A. Guadagnini, E. Rossa, A. Lamberti, F. Masserano, M. Rotondi</i>	
Th A08: The Decomposition of Volumetric Sweep Efficiency and Its Utility in EOR Simulations	775
<i>A. Alsofi, M. Blunt</i>	

MODELLING IOR (ADVANCED WATERFLOODING)

Th A09: Design and Performance Prediction of an MEOR Field Pilot by Numerical Methods	785
<i>H. Alkan, I. Gutierrez, H. Bultemeier, E. Mahler</i>	
Th A11: Modelling of Hybrid Waterflood EOR Processes	802
<i>A. Skauge</i>	
Th A12: Low Salinity Waterflooding for Enhanced Oil Recovery - Stochastic Model Calibration and Uncertainty Quantification	811
<i>M. Spagnuolo, C. Callegaro, A. Guadagnini, R. Sabatino</i>	

MODELLING IOR (CHEMICAL FLOODING)

Th A13: Modelling of ASP Flooding Using X-ray CT Core Flooding Experiments	826
<i>T. Matsuura, W. Stoll, D. Batenburg, J. Wunnik, P. Boerrigter</i>	
Th A14: Relative Permeability Functions for Tertiary Polymer Flooding	841
<i>A. Skauge, I. Salmo</i>	
Th A15: Upscaling Polymer Flooding to Model Sub-gridblock Geological Heterogeneity and Compensate for Numerical Dispersion	858
<i>A. Aldhuwaihi, P. King, A. Muggeridge</i>	
Th A16: Multi-objectives Assisted Inversion of Surfactant-polymer Flooding Experiments on Sandstone Cores	870
<i>S. Leray, F. Douarche, F. Roggero, R. Tabary, P. Moreau</i>	

POLYMERS

Th B01: Polymer Stability Following Successive Mechanical Degradation Events	885
<i>S. Jouenne, H. Chakibi, D. Levitt</i>	
Th B02: Quantifying Viscous Cross-flow and its Impact on Tertiary Polymer Flooding in Heterogeneous Reservoirs	901
<i>Y. Zhou, A. Muggeridge, C. Berg, P. King</i>	

Th B03: Polymer Flooding for EOR in the Schiehallion Field - Porous Flow Rheological Studies of High Molecular Weight Polymers	914
<i>E. Chapman, D. Mercer, G. Jerauld, R. Shields, K. Sorbie, D. Mogford, A. Cable</i>	
Th B04: Influence of Polymer Structural Conformation and Phase Behaviour on In-situ Viscosity	938
<i>T. Skauge, O. Kvilhaug, A. Skauge</i>	

ALKALI AND SURFACTANT FLOODING

Th B05: Review of ASP Flooding	958
<i>H. Guo, Y. Li, F. Wang, Z. Yu, Z. Chen, Y. Wang, X. Gao</i>	
Th B06: Chromatographic Separation of Surfactants in Chemical EOR	981
<i>M. Lee, E. Pol</i>	
Th B07: Alkali and Surfactant Consumption in Sandstone Outcrop Rocks	997
<i>E. Pol, C. Rijn, J. Southwick</i>	
Th B08: Low-salinity Water-alternate-surfactant in Low-permeability Carbonate Reservoirs	1008
<i>W. Alameri, T. Teklu, R. Graves, H. Kazemi, A. AlSumaiti</i>	

CHEMICAL FLOODING

Th B09: Adsorption of EOR Chemicals under Laboratory and Reservoir Conditions, Part 1 - Iron Abundance and Oxidation State	1024
<i>D. Levitt, R. Weatherl, H. Harris, R. McNeil, M. Didier, M. Loriau, E. Gaucher, M. Bourrel</i>	
Th B10: Enhancing Oil Recovery with Nanoemulsion Flooding	1038
<i>E. Braccalenti, L. Gaudio, P. Albonico, A. Belloni, M. Bartosek</i>	
Th B11: Mobilization of Trapped Oil by Surfactant Injection - An Experimental Study Using Multi-scale Imaging	1050
<i>S. Youssef, R. Oughanem, Y. Peysson, D. Bauer, O. Vizika</i>	
Th B12: Visualization of ASP Coreflood Experiments Using X-ray CT Imaging	1062
<i>S. Berg, S. Oedai, D. Batenburg, K. Elewaut, D. Boersma</i>	

HEAVY OIL

Th B13: Sensitivity Analysis of the Performance of In-Situ Upgrading for the Recovery of Heavy Oil Using Dimensionless Analysis	1077
<i>J. Maes, A. Muggeridge, M. Jackson, M. Quintard, A. Lapene</i>	
Th B14: Heavy Oil Waterflooding Enabled by Optimal Waterflood Voidage Management	1090
<i>E. Vittoratos, G. Boccardo</i>	
Th B15: Experimental Investigation of Solvent Addition to Vertical Steam Drive (VSD) as an Improved Method for Thermal Recovery of Extra-heavy Oil/bitumen	1109
<i>V. Lastovka, T. Hooijkaas, J. Dorp, M. Verlaan</i>	
Th B16: Asphaltene Precipitation from a Heavy Crude Oil with CO₂ and Solubility of Crude Oil/CO₂ Mixtures	1136
<i>C. Seifried, R. Hu, T. Headen, J. Crawshaw, E. Boek</i>	
Author Index	

