

# **SPE Saudi Arabia Section Technical Symposium and Exhibition 2014**

Al-Khobar, Saudi Arabia  
21 - 24 April 2014

ISBN: 978-1-5108-4544-2

**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© (2014) by Society of Petroleum Engineers  
All rights reserved.

Printed by Curran Associates, Inc. (2017)

For permission requests, please contact Society of Petroleum Engineers  
at the address below.

Society of Petroleum Engineers  
P. O. Box 833836  
Richardson, Texas 75083-3836

Phone: (800) 456-6863  
Fax: (972) 952-9435

[books@spe.org](mailto:books@spe.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: 845-758-2633  
Email: [curran@proceedings.com](mailto:curran@proceedings.com)  
Web: [www.proceedings.com](http://www.proceedings.com)

# TABLE OF CONTENTS

<b>Advanced Well Completion Designs to Meet Unique Reservoir and Production Requirements .....</b>	<b>1</b>
<i>Jacob, Suresh; Naimi, Khalid M.</i>	
<b>Anisotropy Effect in Geosteering: Anisotropy and D2B Estimate from Directional Resistivity Tool .....</b>	<b>14</b>
<i>Hagiwara, Teruhiko; Anguiano-Rojas, Pedro</i>	
<b>Application of Best in Class Reservoir Management Practices in the Production Startup of a New Giant Field Development through Integration of Real Time Data: A Case Study .....</b>	<b>23</b>
<i>Al-Ghandi, Faisal A.; Al-Otaibi, Majid H.; Abitrabi Ballan, Abdel N.</i>	
<b>Application of MFO Injections Procedure for MSF Packers Integrity Diagnostic .....</b>	<b>30</b>
<i>Nugraha, Ikhsan; Said, Rifat</i>	
<b>Application of Neural Network to Predict Gas Well Performance During Two-Phase Flow in Gas Condensate Reservoirs .....</b>	<b>40</b>
<i>Al-Dhamen, Mohammed A.</i>	
<b>Assessment of Reservoir Saturation Monitoring in Newly Developed Carbonate Reservoirs .....</b>	<b>49</b>
<i>Alkaba, Fatima H.</i>	
<b>Bottom-Hole Assembly Management System (BHAMS).....</b>	<b>61</b>
<i>Alotaibi, Bader; Contreras Otalvora, William B.; Nefai, Mohammad S.</i>	
<b>Can Sourceless Density LWD Replace Wireline in Exploration Wells? Case Study from Saudi Arabia.....</b>	<b>72</b>
<i>Alakeely, Abdullah; Meridji, Yacine</i>	
<b>Case Study: Application of Azimuthal Resistivity, Azimuthal Density, and Resistivity Inversion to Geosteer in a Clastic Stringer, Saudi Arabia.....</b>	<b>89</b>
<i>Saint, Craig; Martakov, Sergey; Mumtaz, Asim; Al-Dhaferi, Yousef; Al-Khaldi, Nasser; Sinha, Sashi; Al-Sultan, Athbi</i>	
<b>Characterization of Crude Oil of Upper Assam Field for Flow Assurance .....</b>	<b>99</b>
<i>Jha, Nilesh Kumar; Jamal, Mohammad Shahid; Singh, Diwakar; Prasad, Uma Shanker</i>	
<b>Characterization of Heavy Oil Properties in a Complex Shallow Miocene Reservoir in Saudi Arabia using NMR and Other Advanced Log Measurements.....</b>	<b>108</b>
<i>Idris, Umar; Hursan, Gabor; Saldungaray, Pablo; Azam, Hisham</i>	
<b>Characterization of Next-Generation Heavy Oil of Tar Mats in Carbonate Reservoirs and Understanding Its Role in Reserve Estimation and Oil Recovery Economics .....</b>	<b>119</b>
<i>Almansour, Abdullah; Al-Bazzaz, Waleed; Saraswathy, Geetha; Almohsin, Ayman; Bai, Baojun</i>	
<b>CO<sub>2</sub> Minimum Miscible Pressure (MMP) Estimation using Multiple Linear Regression (MLR) Technique .....</b>	<b>137</b>
<i>Alomair, Osamah; Iqbal, Maqsood</i>	
<b>Comprehensive Reservoir Monitoring Program: Challenges, Design, Implementation, and Added Value in a Large Carbonate Reservoir .....</b>	<b>144</b>
<i>Al-Julaih, Ali; Al-Dawood, Naseem</i>	
<b>CT Extended Reach Acid Stimulation in Openhole Wells, Offshore Saudi Arabia: A 23-Well Case Study .....</b>	<b>150</b>
<i>Arukhe, James; Hanbazazah, Shadi; Ahmari, Abdulrahman; Adesegeha, Rotimi; Perez, Joan; Noguera, Jose; Krishnan, Gopi; Nakhwa, Amit</i>	
<b>Data Assimilation of InSAR Measurements for Large Scale Reservoirs .....</b>	<b>158</b>
<i>Katterbauer, Klemens; Hoteit, Ibrahim; Sun, Shuyu</i>	
<b>Density-Driven Flow Simulation in Anisotropic Porous Media: Application to CO<sub>2</sub> Geological Sequestration.....</b>	<b>168</b>
<i>Negara, Ardiansyah; Salama, Amgad; Sun, Shuyu</i>	
<b>Design and Development of Non-aqueous Suspension for Suspending Varied-sized Solid Particulates as a Conventional Diverter.....</b>	<b>184</b>
<i>Agashe, Snehalata; Patil, Prajakta; Raysoni, Neelam; Pandya, Nisha</i>	
<b>Development of Mature Fields Using Reservoir Opportunity Index: A Case Study from a Saudi Field .....</b>	<b>192</b>
<i>Varela-Pineda, Alfonso; Hutheli, Ahmed H.; Mutairi, Saad M.</i>	
<b>Downhole Electrical Disconnect Tool Enables the Parting and Subsequent Re-Connection of the Upper Completion Containing an ESP from the Lower Intelligent Completion.....</b>	<b>203</b>
<i>Izetti, Ronaldo; Pinto, Hardy; Rosas, Fabio; Minassa, Lorenzo; Vayeda, Ravi; Deyo, Benjamin; Bhat, Gireesh; Rodrigues, Desiderio; Bonfim, Antonio</i>	
<b>Dynamic Reservoir Characterization with PTA: Clastic Environments .....</b>	<b>211</b>
<i>Rodolfo, J.; Phillips, G.; BinAkresh, Saud A.</i>	

<b>Effective Geosteering Using High-Resolution Electrical Images and Deep Azimuthal Resistivity .....</b>	<b>216</b>
<i>Kumar, Rohit; Otaibi, Saud Faihan; Mumtaz, Asim; Saint, Craig; Hameed, Mahmoud</i>	
<b>Efficient Open-Hole Logging of the Horizontal Wells Using Openhole Tractoring. Field Experiences From TATWEER Petroleum Company-Bahrain .....</b>	<b>227</b>
<i>Ofield, Bill; Down, Michael; Al-Hashimi, Lana; Hermes, Amir; Murphy, Nicolas; Hamdy, Mohamed; Eissa, Moustafa; Annovi, Enrico</i>	
<b>Environmentally Acceptable Swell Packer Fluid for Unconventional Reservoirs with High-Temperature Applications .....</b>	<b>239</b>
<i>Pandya, Nisha; Kalgaonkar, Rajendra; Allison, Dave</i>	
<b>Evaluate Fracturing Fluid Performance for Hydraulic Stimulation in Pre-Khuff Sandstone Reservoirs of Ghawar Gas Field.....</b>	<b>251</b>
<i>Das, Prasanta; Rahim, Zillur</i>	
<b>Evaluation and Investigation of Miscible Flood in Kuwait - Case Study .....</b>	<b>263</b>
<i>Alajmi, Abdullah; Algharaib, Meshal; Gharbi, Ridha; Alenezi, Huda; AlMatar, Bader; Al-Enezi, Khalaf</i>	
<b>Evaluation of Diagenetic Scaling on Flowback Proppants .....</b>	<b>271</b>
<i>Nanda, Jajati; Pal, Omprakash; Patil, Anil</i>	
<b>Exploration Drilling Performance Optimization in Red Sea Shallow Water: Shifting West with Offshore Exploration Drilling Best Practices .....</b>	<b>279</b>
<i>Khalifa, Saleh; Azzouni, Suliman; Tiwari, Shrikant; Adewuyi, Opeyemi</i>	
<b>Extending the Applicability of Chemical EOR in High Salinity, High Temperature &amp; Fractured Carbonate Reservoir Through Viscoelastic Surfactants .....</b>	<b>295</b>
<i>Azad, M.S.; Sultan, A.S.</i>	
<b>FAWAG Using CO<sub>2</sub> Philic Surfactants for CO<sub>2</sub> Mobility Control for Enhanced Oil Recovery Applications.....</b>	<b>311</b>
<i>Sagir, Muhammad; Tan, Isa M.; Mushtaq, Muhammad; Talebian, Seyedeh Hosna</i>	
<b>Field Deployment of a Novel Inlet Device for Multiphase Separators - Steps from R&amp;D to Industrial Application .....</b>	<b>319</b>
<i>Jutaily, Sulaiman A.; Charry Prada, Iran D.; Haider, Syed Z.; Oshinowo, Lanre; Vilagines, Regis D.</i>	
<b>The First Successful Multistage Acid Frac of an Oil Producer in Saudi Arabia .....</b>	<b>333</b>
<i>Rafie, Majid; Said, Rafiq; Al-Hajri, Muhammad; AlMubarak, Tariq; Al-Thiyabi, Adel; Nugraha, Ikhsan; Soriano, Eduardo; Lucado, Jared</i>	
<b>Fluid Production Studies Using NMR and High-Frequency Dielectric Permittivity .....</b>	<b>348</b>
<i>Taherian, R.; Valori, A.; AlZoukani, A.; Ali, F.</i>	
<b>Foamability and Foam Stability of Several Surfactants Solutions: The Role of Screening and Flooding.....</b>	<b>357</b>
<i>Belhaj, Azmi; AlQuraishi, Abdulrahman; Al-Mahdy, Osama</i>	
<b>A Graphical Method to Evaluate Multi-Reservoir Commingling .....</b>	<b>367</b>
<i>Barri, Assad; Alnuaim, Sami</i>	
<b>High-Performance EOR System in Carbonate Reservoirs .....</b>	<b>375</b>
<i>Abdelgawad, K.Z.; Mahmoud, M.A.</i>	
<b>How Malfunctioning Completion Accessories Affect Well Performance in Offshore Saudi Arabia .....</b>	<b>388</b>
<i>Al-Khanferi, Mohammed; Bubshait, Ahmed; El-Fattah, Mahmoud Abd; Al-Shabibi, Hussain; Bawazir, Mustafa</i>	
<b>Impact of Brine Composition on Carbonate Wettability: A Sensitivity Study .....</b>	<b>401</b>
<i>AlShaikh, Murttha; Mahadevan, Jagannathan</i>	
<b>Innovative Hot Oiling Operation in a Low BHP Well Minimizing Formation Damage: A Case Study.....</b>	<b>415</b>
<i>Haindade, Zishaan M.W.; Mamen, A.M.</i>	
<b>Integrated Formation Evaluation of Tight Gas Delineation Wells: Best Practices and Lessons Learned .....</b>	<b>423</b>
<i>Hammou, Nasreddine; Balawi, Ali; Eid, Mahmoud; Quirein, John</i>	
<b>Integrated Model for Sustainable Development (IMSD): Impact of Technology Integration.....</b>	<b>434</b>
<i>Hasan, Ahmed</i>	
<b>Integrated Modeling for Better Reservoir Management: a Case Study from a Large Carbonate Middle East Reservoir .....</b>	<b>448</b>
<i>Shammari, B.A.; Putra, S.A.; Nooruddin, H.A.; Bellaci, I.J.; Shammari, A.T.</i>	
<b>Integrating Intelligent Field Data into Simulation Model History Matching Process .....</b>	<b>459</b>
<i>Yuen, Bevan; Olukoko, Olugbenga; Ansah, Joseph</i>	
<b>Intelligent Distributed Acoustic Sensing for In-well Monitoring.....</b>	<b>468</b>
<i>Xiao, J.J.; Farhadiroushan, M.; Clarke, A.; Abdalmohsen, R.A.; Alyan, E.; Parker, T.R.; Shawash, J.; Milne, H.C.</i>	
<b>Intelligent Field Infrastructure Embedded Cyber Security Protection .....</b>	<b>480</b>
<i>Al-Sharif, Noor; Almadi, Solomon</i>	
<b>Investigating Formation Water Salinity Using a Unique Water Extraction Technique in a Hydraulically Active Area.....</b>	<b>486</b>
<i>Forsyth, D.; Witjaksono, M.; Palmer, R.; Silva, A.; Najrani, Hussain; Zeghlache, Mohamed L.; Mitchell, P.</i>	

<b>Isothermal Oil Compressibility Curve Crossing</b> .....	496
<i>Al-Marhoun, Muhammad Ali</i>	
<b>Lessons from the First Successful Oil Producer Multistage Acid Fracturing in Saudi Arabia: The QA/QC Process from the Laboratory to the Field</b> .....	502
<i>Almubarak, Tariq; Bataweel, Mohammed; Rafie, Majid; Said, Rifat; Al-Ibrahim, Hussain; Osode, Peter; Aljaiji, Mohammed; Alenizi, Sultan; Aldajani, Omar; Karadkar, Prasad</i>	
<b>Monitoring Residual Surfactant in the Flowback and Produced Water: A Way Forward to Improve Well Productivity</b> .....	523
<i>Rane, Jayant P.; Xu, Liang</i>	
<b>Multiphase Flow Measurement Modeling of an Oil-Water Flow Through an Orifice Plate</b> .....	531
<i>Noui-Mehidi, Mohamed N.; Black, Michael J.</i>	
<b>Nanotechnology Applications To Minimize Geo-Mechanical Related Challenges While Drilling Intercalated Sediments, Western Desert, Egypt</b> .....	538
<i>El Sherbeny, Wael; Al-Baddaly, Hesham; Rahal, Ayman; Said, Mohamed; Hardman, Douglas; Henry, Todd</i>	
<b>Narrowing Formation Fracture Gradient Uncertainty by Integrating Geomechanics and Microfracturing Test Results: A Case Study from Saudi Arabia</b> .....	550
<i>Alrayyes, Zaid; Alquaimi, Bander; Ansa, Joseph; Alsuwadi, Saleem; Almutairi, Bader; Perumalla, Satya; Burgdorff, Katharine; Imtiaz, Saad; Zaitsev, Andrey</i>	
<b>A New Chemical EOR for Sandstone and Carbonate Reservoirs</b> .....	558
<i>Mahmoud, M.A.; Abdelgawad, K.Z.</i>	
<b>New Hybrid Drill Bit with Innovative Technology Improves Drilling Efficiency in Challenging Jordanian Drilling Project</b> .....	574
<i>Ismail, Ahmed; Moustafa, Waleed</i>	
<b>A Novel Method to Boost Production From Low Production Gas Wells to Increase Overall Recovery and Avoid Well Intervention</b> .....	581
<i>Al-Malki, Bandar H.; Baqawi, Ahmed M.; Peeran, Syed M.; Beg, N.</i>	
<b>A Novel Non-damaging Approach to Isolate Open hole Lateral that Allowed Performing Mechanical Descaling in the Non-Monobore Cased Completion: A Case Study in Saudi Arabian Carbonate Reservoir</b> .....	587
<i>Mukhliss, A.E.; Ogundare, T.M.; Dashash, A.A.; Malik, A.R.; Rivadeneira, E.V.; Molero, N.</i>	
<b>On The Joint Optimization of Well Placement and Control</b> .....	596
<i>Awotunde, Abeeb A.</i>	
<b>Optimization and Post-Job Analysis of the First Successful Oil Field Multistage Acid Fracture Treatment in Saudi Arabia</b> .....	620
<i>Almubarak, Tariq; Bataweel, Mohammed; Rafie, Majid; Said, Rifat; Al-Ibrahim, Hussain; Al-Hajri, Mohammad; Osode, Peter; Al-Rustum, Abdullah; Aldajani, Omar</i>	
<b>Optimizing Acid Stimulation Treatment Design in South Ghawar Power Water Injectors Wells</b> .....	641
<i>Tammar, Hasan; Alkadem, Mortada; Jandal, Ahmed; Atayev, Nurymyrat</i>	
<b>Optimizing Saudi Aramco Reentry Drilling Operations with the First Worldwide Combined High Dogleg RSS and Underreaming Drilling System</b> .....	650
<i>Saleh, Rami; Ali, Noor Chozin; Abuaahmad, Yousif; Otaibi, Naser; Osman, Ahmed; Farid, Mazhar; Ali, Anis; El-Fouly, Islam</i>	
<b>Optimizing Spacing of Horizontal Multistage Fractured Wells in Gas Reservoirs</b> .....	663
<i>Alghannam, Maryam; Rahim, Zillur</i>	
<b>Performance Evaluation and Challenges Using Open Hole Multistage Fracturing Completion to Develop Tight Gas Reservoirs in Saudi Arabia</b> .....	674
<i>Al-Dawood, Mahdi; Aziz, Azly Abdul; Al-Omair, Ahmed; Rahim, Zillur</i>	
<b>A Productive Technique To Do Drilling Analysis and Risk Assessment</b> .....	683
<i>Sidaoui, Ziad; Siddiqui, Mohammed Abdul Qadeer; Aldawood, Jihad</i>	
<b>Real Time Kick Detection Applying an Ultrasonic Caliper Featuring a Downhole Sonic Speed Measurement for Calibration Purposes</b> .....	693
<i>Elahifar, Behzad; Fasch, Franz; Thonhauser, Gerhard; Tollschein, Christian</i>	
<b>A Saudi Arabia Giant Field Development: Lessons from Integrating Technologies</b> .....	698
<i>Arukhe, James; Harthi, Mabkhout; Namlah, Sultan; Ahmari, Abdulrahman</i>	
<b>Shale Gas Characterization and Property Determination by Digital Rock Physics</b> .....	708
<i>Almarzooq, Anas; AlGhamdi, Tariq; Koronfol, Safouh; Dernaika, Moustafa; Walls, Joel</i>	
<b>Shale Gas Field: Exploration, Exploitation and Development Strategies Globally</b> .....	724
<i>Saleem, Waleed Anwar; Baber, Shahzaib; Jafri, Muhammad Osama</i>	
<b>Simulation of Single Well Tracer Tests for Surfactant-Polymer Flooding</b> .....	740
<i>Bu, Peter X.; AlSofi, Abdulkareem M.; Liu, Jim; Benedek, Lajos; Han, Ming</i>	
<b>Smart Completion Design for Managing Steam Injection in CSS Process</b> .....	754
<i>Suranto, AM; Bae, W.; Permadi, AK; Dang, Son T.</i>	

<b>State-of-the-Art of In-Depth Fluid Diversion Technology: Enhancing Reservoir Oil Recovery by Gel Treatments</b> .....	763
<i>Han, Ming; Alshehri, Amar J.; Krinis, Dimitrios; Lyngra, Stig</i>	
<b>Statistical Approach to Forecasting Fluid Loss Solutions</b> .....	773
<i>Alexeyenko, A.V.</i>	
<b>A Streamlined Process to Track Field Operations through Management Operations Dashboard</b> .....	781
<i>Al-Buraik, M.; Al-Naim, H.; Alakeely, A.</i>	
<b>Successful Field Application of Aqueous-Based Formation Consolidation Treatment Implemented in Nile Delta, Egypt</b> .....	789
<i>Songire, Sumit; Hassan, Amro; Amer, Mohamed, Halliburton Farid, Saber; Luijckx, Jean-Marie; AbdelKhaleq, Mohamed</i>	
<b>Successful Inorganic Scaling Prediction in Early Conceptual Design Phase: Gas Field Development Experience</b> .....	796
<i>Nengkoda, Ardian; Birkle, Peter; Harbi, Bader; Mufleh, Jamal; Awwami, Mofeed; Duailej, Yasser, Saudi Aramco Khaldi, Mohammed; Cai, Xiaolong; Haas, Michael; Alharith, Ibrahim</i>	
<b>Sweet Spot Identification and Optimum Well Planning: an Integrated Workflow to Improve the Sweep in a Sector of Giant Carbonate Mature Oil Reservoir</b> .....	807
<i>Al-Sada, Abdullah I.; Bouaouaja, Mohammed T.; Al-Hhuthali, Ahmed H.; Al-Safi, Abullah A.</i>	
<b>Tar Area Development in a Giant Carbonate Field in Saudi Arabia</b> .....	817
<i>Benedek, Lajos; Ali, Razally; AlGhamdi, Humam; Alhuthali, Ahmed H.</i>	
<b>Transport of Temperature Nanosensors Through Fractured Tight Rock: An Experimental Study</b> .....	833
<i>Alaskar, Mohammed; Li, Kewen; Horne, Roland</i>	
<b>Unconventional Flare Gas Recovery Systems (FGRS)</b> .....	848
<i>Salu, Samusideen A.; Soliman, Mohamed; Ansari, Nisar Ahmad K.</i>	
<b>Use of Emulsified Acid System with Corrosion Protection up to 350°F</b> .....	852
<i>Wadekar, Sushant; Pandya, Nisha</i>	
<b>Using a New Spectroscopy Tool to Quantify Elemental Concentrations and TOC in an Unconventional Shale Gas Reservoir: Case Studies from Saudi Arabia</b> .....	858
<i>Al-Salim, Ahmed; Meridji, Yacine; Musharfi, Nedhal; Al-Waheed, Hilal; Saldungaray, Pablo; Herron, Susan; Polyakov, Marina</i>	
<b>Water - Chemical Treatment, Management and Cost</b> .....	872
<i>Wiggett, Adrian J.</i>	
<b>Well Placement Optimization Under Constraints Using Modified Cuckoo Search</b> .....	880
<i>Alghareeb, Zeid M.; Walton, Sean P.; Williams, John R.</i>	
<b>Author Index</b>	