11th North American Conference on Multiphase Technology 2018

Banff, Canada 6 - 8 June 2018

ISBN: 978-1-5108-7522-7

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© (2018) by BHR Group All rights reserved.

Printed by Curran Associates, Inc. (2018)

For permission requests, please contact BHR Group at the address below.

BHR Group The Fluid Engineering Centre Cranfield, Bedfordshire MK43 0AJ United Kingdom

Phone: +44 1234 750422 Fax: +44 1234 750074

info@bhrgroup.com

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 Web: www.proceedings.com 11th North American Conference on

MULTIPHASE TECHNOLOGY

Banff, Canada: 6 – 8 June, 2018

CONTENTS

FOREWORD

1

KEYNOTE PAPERS

The history of multiphase pipe flows science and technology. Research response to industrial pull. R V A Oliemans, Emeritus professor multiphase flow, TU Delft, The Netherlands	5
Research in multiphase flow developed into new global discipline of flow assurance – an oil industry perspective <i>T J Hill, Independent flow assurance consultant, retired from BP, UK</i>	7
DIVERSE MULTIPHASE	
Experimental investigation of vertical downward two-phase flow in annulus	23
R P Coutinho, P J Waltrich, Louisiana State University, USA	
Investigation of churn/annular and pseudo-slug flow characteristics before and after pipe elbows A Asgharpour, P Zahedi, S A Shirazi, B S McLaury, The University of Tulsa, USA; R Vieira, MSI International Inc., USA; M Parsi, DNV GL North USA, Inc. – North America Oil & Gas, USA	39
Multiphase flow in flexible pipes: simulations and small scale experiments J Vieiro, O J Nydal, Norwegian University of Science and Technology, Norway; Z Wang, Southwest Petroleum University, China	57
EXPERIMENTAL	
Experimental investigation of two-phase flow regime in an inclined pipe C Vieira, M Kallager, M Vassmyr, N La Forgia, Z Yang, Norwegian University of Science and Technology, Norway	73
The effect of a surfactant on slugs in a flowline-riser system	85

E J Pronk, Delft University of Technology, The Netherlands; J H Ellepola, Shell Projects & Technology, The Netherlands; R A W M Henkes, Delft University of Technology and Shell Projects & Technology, The Netherlands

EXPERIMENTS IN MODELLING

Liquid entrainment in gas at high pressure. Part 2: experimental data and model improvement F Viana, Southwest Research Institute [®] , USA; R Mohan, O Shoham, The University of Tulsa, USA	97
FLOW ASSURANCE	
Studies of parameters that influence hydrate plugging tendencies in a gas condensate subsea tieback Y Wang, C A Koh, L E Zerpa, Colorado School of Mines, USA	115
Evaluation of Anti-Agglomerant hydrate inhibitors in gas-dominated system under different flow regimes A Sinquin, M Gainville, C Cassar, IFP Energies nouvelles, France; J Boxall, Chevron Australia Pty Ltd, Australia; D Estanga, Chevron Energy Technology Company, USA	125
Measurements of dispersant additive on hydrate/ice slurry transport A Melchuna, A K Sum, Colorado School of Mines, USA; P Glénat, Total Exploration-Production, France; M Rivero, Total E&P Research and Technology, USA	143
Experimental study of wax deposition under two-phase gas-oil stratified flow Y Chi, N Daraboina, C Sarica, The University of Tulsa, USA; S Zhou, The University of Tulsa, USA and Changzhou University, PR China	153
Wax deposition testing in a large-scale flow loop R Venkatesan, Chevron Energy Technology Company, USA; R Tanti, V Subramani, D Vedapuri, Tridiagonal Solutions Inc., USA; E Akparu, K Johnson, Chevron Africa and Latin America Exploration and Production Company, USA	169
LIQUID LOADING	
Understanding liquid accumulation in inclined pipes during ramp-down G Staff, C Lawrence, Schlumberger Norway Technology Center, Norway; H Holm, Statoil ASA, Norway	185
Existence of slug flow in vertical co-current two-phase flow D Roullier, H Karami, E Pereyra, C Sarica, The University of Tulsa, USA	203
Liquid loading in annuli, the effect of eccentricity J M C van 't Westende, J Kurian, TNO, Heat Transfer and Fluid Dynamics, The Netherlands	219
Investigation of the effect of gas entrainment on slug characteristics in actual fields using the slug capturing technique <i>R I Issa, J Castagna, Multiphase Simulation Ltd, UK</i>	229
A new method of predicting wellborg load up	245

A new method of predicting wellbore load up 245 R Shea, M Guner, G Yuan, Schlumberger, USA

MODELLING IN THE FIELD

Surveillance and optimization of unpiggable lines through real time modeling	257
B L Keinath, S R Hickman, ExxonMobil URC, USA	
A comprehensive engineering simulator for SAGD process optimization and real-time monitoring	267
P Kalghatgi, D Erickson, D Golczynski, Wood Automation & Control, USA	
A comparative study of the performance of multiphase flow pipeline simulators in a hilly terrain pipeline	281
P Dhoorjaty, D Erickson, R Kowta, Wood Automation & Control, USA	
High CO ₂ content effect on the flow of crude oils in production transient operations	297
M J Rempto, M A Pasqualette, E M G Fontalvo, J N E Carneiro, ISDB FlowTech, Brazil; R Fonseca, J R P Ciambelli, Petrobras, Brazil; S T Johansen, B T Løvfall, SINTEF Industry, Norway	
Instantaneous liquid and gas leakage flow during plunger lifting process in vertical wells <i>K Zhao, B Bai, Xi'an Jiaotong University, China</i>	313
Multiphase optimization of gas kick transient characteristics in drilling applications	323
H Karami, University of Oklahoma, USA; B Akbari, Louisiana State University, USA	
MULTIPHASE MODELLING	
(One possible) future of multiphase flow modelling and simulation O K Matar, Imperial College London, UK	341
Thermal behavior in wells T J Danielson, B Gokcal, ConocoPhillips Co., USA	353
Numerical simulation of roll waves in pipelines using the two-fluid model B Sanderse, S Dubinkina, Centrum Wiskunde & Informatica, Amsterdam,	373

B Sanderse, S Dubinkina, Centrum Wiskunde & Informatica, Amsterdam, The Netherlands; S Misra, C W Oosterlee, Centrum Wiskunde & Informatica, Amsterdam, and Delft University of Technology, The Netherlands; R A W M Henkes, Delft University of Technology and Shell Technology Centre Amsterdam, The Netherlands

Onshore gathering systems: multiphase flow modeling accuracy challenges 387 *E C Kempton, G A Hegde, E W Smith, Assured Flow Solutions, USA*

SAND TRANSPORT AND EROSION

Measurements and modelling of spatial particle size distribution in a	405
horizontal slurry pipeline	
M Huard, K F Adane, A Fuhr, InnoTech Alberta, Canada	

CFD simulations and experiments of sand erosion for liquid dominated multiphase flows in an elbow T A Sedrez, Y R Rajkumar, S A Shirazi, The University of Tulsa, USA; K Sambath, H J Subramani, Chevron, USA	419
Threshold particle concentration in single-phase and multiphase flow sand transport in pipelines S Sajeev, B S McLaury, S A Shirazi, The University of Tulsa, USA	431
Effect of particle size on the near wall turbulence characteristics and the critical velocity required for the particle removal from the sand bed deposited in horizontal pipelines <i>S K Arnipally, M M Hirpa, M Bizhani, E Kuru, University of Alberta, Canada</i>	443
VISCOSITY EFFECTS	
Pseudo slug flow in viscous oil systems – experiments and modelling with	461

Pseudo slug flow in viscous oil systems – experiments and modelling with LedaFlow J Kjølaas, I E Smith, C Brekken, SINTEF, Norway
Experimental and modelling study of the wall shear stress profile in horizontal pipes for highly viscous two-phase slug flow <i>T Kim, E Pereyra, C Sarica, The University of Tulsa, USA</i>

AUTHOR INDEX