Advanced PVT & EOS Fluid Characterization

Enhance abilities to analyze & utilize PVT data for improved tuning of EOS and predictive models

29th September 2014 - 3rd October 2014, Kuala Lumpur, Malaysia

Petrosync Distinguished Instructor

Dr. Bahman Tohidi
Managing Director, Hydrafact Ltd.
Professor & Director for Centre for Gas Hydrate Research, Heriot-Watt University

- Over 35 years of experience in Oil & Gas industry
- Specializes in Hydrates, Flow Assurance and PVT; SPE Distinguished Lecturer in 2004-2005
- Managed more than 300 projects with various O&G companies including Total, BP, Shell, Chevron, Petronas, INPEX, Petrobras, Statoil, Dolphim Energy, Saudi Aramco and others

Course Objectives

- Provide professionals with the knowledge on thermodynamic aspects of reservoir fluids
- Learn the importance of PVT tests design and results
- Identify the relevant PVT data for various tasks, best practices and avoiding common mistakes
- Provide insight to various EOR techniques
- Develop effective knowledge of flow assurance and related laboratory tests
- Awareness of various Equations of State, their strengths and weaknesses
- Be cognizant of various techniques for characterizing the heavy end
- Gain knowledge of generating the necessary PVT input data for reservoir simulation using an industry standard software

Specially Designed for

The course is designed for reservoir engineers, production engineers/technologists, petroleum engineers, flow assurance engineers, and managers who would like to learn more on PVT tests/data in various aspects Petroleum Engineering, in particular reserve estimation, reservoir modeling, flow assurance and EOR.

Supported by
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Course Overview

PVT (Pressure-Volume-Temperature) represents the behaviour of the reservoir fluids during life of the field, as well as effect of changes in temperature and pressure during fluid transfer from reservoir to surface/processing facilities.

The trainer will discuss the role of PVT tests/data in various aspects of Petroleum Engineering in particular reserve estimation, reservoir modelling, flow assurance, and EOR. After introducing various laboratory facilities, PVT tests and reports for various hydrocarbon systems will be detailed. This will include quality control, designing tests, identifying the relevant data and maximizing their utilization by applying best practices and avoiding common mistakes.

The course will include flow assurance and EOR, as well as relevant laboratory tests. Fluid characterization and various techniques used for heavy end description will be covered. The most widely used Equations of State are discussed in some details, including their strengths and weaknesses. The course will describe how PVT and other laboratory data are used for tuning of EoS and predictive models, using industry standard software packages. Numerous examples and case studies are included in the course. The participants will have access to 30 days trial of a software for practicing some of the course materials in their own spare time.

Materials to bring:
- Laptop with local admin rights to install software & calculator

Program Schedule

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>08:00 – 09:00</td>
<td>Registration (Day1)</td>
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<tr>
<td>09:00 – 11:00</td>
<td>Session I</td>
</tr>
<tr>
<td>11:00 – 11:15</td>
<td>Refreshment &amp; Networking Session I</td>
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<tr>
<td>11:15 – 13:00</td>
<td>Session II</td>
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<tr>
<td>13:00 – 14:00</td>
<td>Lunch</td>
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<tr>
<td>14:00 – 15:30</td>
<td>Session III</td>
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<tr>
<td>15:30 – 15:45</td>
<td>Refreshment &amp; Networking Session II</td>
</tr>
<tr>
<td>15:45 – 17:00</td>
<td>Session IV</td>
</tr>
<tr>
<td>17:00</td>
<td>End of Day</td>
</tr>
</tbody>
</table>

WHY YOU SHOULD ATTEND PETROSYNC’S EVENTS

- To ensure that all objectives of the course matches yours, all PetroSync programs are developed after intensive and extensive research within the industry
- PetroSync programs focus on your immediate working issues to ensure that you are able to apply and deliver immediate results in real work situations
- Application and implementation of industry knowledge and experience are the drivers for our course design, not theoretical academic lectures
- PetroSync training focuses on practical interactive learning tools and techniques including case studies, group discussions, scenarios, simulations, practical exercises and knowledge assessments during the course. Invest a small amount of your time to prepare before attending the course to ensure maximum learning
- PetroSync follows a rigorous selection process to ensure that all expert trainers have first-hand, up-to-date and practical knowledge and are leaders of their respective industrial discipline
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Course Agenda

Day One - 29th September 2014

Introduction to Petroleum Engineering
- Source Rock
- Fluid Migration
- Hydrocarbon Reservoir Formation

Petroleum Reservoir Fluids
- Paraffins
- Naphthenes
- Aromatics
- Non-Hydrocarbons

Phase behavior of single and multi-component systems
- Bubble/Dew Point Line
- Critical Point
- Phase Change
- Phase Envelope in Multicomponent Systems
- Cricondenbar & Cricondentherm
- Retrograde Condensation
- Changes in phase envelop as a function of composition

Classification of reservoir fluids
- Dry Gas
- Wet Gas
- Gas Condensate
- Volatile Oil
- Black Oil

Fluid Sampling
- Downhole Sampling
- Surface Sampling
- Well Preparation

Day Two- 30th September 2014

Introduction to PVT test/reports
- General Structure of PVT report (examples of PVT reports)

Effect of sample contamination
- How to find out if the sample is contaminated
- De-contamination options (examples)

Quality checks
- Opening pressure
- QC tests

PVT test facilities
- Basic requirements
- PVT cells for oil/gas condensate
- Other relevant test facilities

PVT tests for dry gas, wet gas, black oil, gas condensate & volatile oil including:
- Constant Composition Expansion (CCE)
- Differential Liberation (DL)
- Constant Volume Depletion (CVD)
- Separator Tests

Identify relevant data in PVT reports, conducting various calculations, including:
- Oil Formation Volume Factor (Bo)
- Gas Formation Volume Factor (Bg)
- Gas Oil Ratio (GOR)
- Condensate Gas Ratio (CGR)
- API gravity
- Z-factor
- Total Formation Volume Factor
- Isothermal Compressibility for Oil and Gas

Case studies: PVT reports for various fluid systems including black oil, volatile oil and gas condensate

IN-HOUSE SOLUTIONS

SAVE COST • IMPROVE PERFORMANCE • REDUCE RISK

PetroSync understands that in current economic climate, getting an excellent return on your training investment is critical for all our clients. This excellent training can be conducted exclusively for your organization. The training can be tailored to meet your specific needs at your preferred location and time. We will meet you anywhere around the globe.

If you like to know more about this excellent program, please contact us on +65 6415 4502 or email general@petrosync.com
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Day Three - 1st October 2014

Introduction to Flow Assurance
- Definition
- Importance

Laboratory equipments and tests for:
- Wax
- Asphaltene
- Hydrates
- Scale
- Emulsion
- Foam
- Corrosion

Predictive techniques
- Integration of lab data and predictive techniques
- Other laboratory tests (IFT, viscosity, swelling tests)

Day Four - 2nd October 2014

Introduction to EOR
- Gas Injection
- Water alternating gas injection

PVT tests for heavy oil and EOR

Fluid Characterization
- Gas Injection
  - Ternary Diagram
  - Minimum Miscibility Pressure/Enrichment
  - Rising Bubble, vanishing IFT, etc

Day Five - 3rd October 2014

Ideal Gas Law
- Real Gas
- Z-factor

Equation of State (EoS)
- Initial development
- Strengths and Weaknesses
- Data requirements for modeling
- Need for tuning and laboratory data

Most popular EoS
- Peng Robinson (PR)
- Soave-Redlich-Kwong (SRK)

EoS Modelling
- Data requirements
- Shift parameters
- Mixing rules
- Binary interaction parameter

EoS tuning using the data generated in PVT tests
- Identifying relevant data
- Best practices
- Avoiding common mistakes

Generating PVT files required for reservoir simulation

Case studies: EOS tuning for a black oil and a gas condensate

Reservoir Engineering Training Courses (JANUARY - DECEMBER 2014)

<table>
<thead>
<tr>
<th>DATE</th>
<th>COURSE TITLE</th>
<th>INSTRUCTOR</th>
</tr>
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<tbody>
<tr>
<td>10th – 14th Mar</td>
<td>Mastering Gas Condensate &amp; Volatile Well Test Analysis</td>
<td>Alain Gringarten</td>
</tr>
<tr>
<td>23rd – 27th June</td>
<td>Waterflood Optimization</td>
<td>Deepankar Biswas</td>
</tr>
<tr>
<td>18th – 22nd Aug</td>
<td>Practical Aspects of CO2-EOR Project Development</td>
<td>Ashok Singhal</td>
</tr>
<tr>
<td>29th Sep – 03rd Oct</td>
<td>Advanced PVT &amp; EOS Fluid Characterization</td>
<td>Bahman Tohidi</td>
</tr>
<tr>
<td>13th – 17th Oct</td>
<td>Integrated Reservoir Characterization and Modelling</td>
<td>Hai Zui Meng</td>
</tr>
<tr>
<td>17th – 21st Nov</td>
<td>Naturally Fractured Reservoir Characterization</td>
<td>Djebarri Tiab</td>
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After graduation (BSc in Chemical Engineering from Abadan Institute of Technology, Iran), he joined National Iranian Oil Company (NIOC) in 1984 where he worked as Production Engineer as well as University Lecturer for seven years. Bahman Tohidi joined Heriot-Watt University in 1991 and graduated with a PhD in Petroleum Engineering in 1995 with his doctoral work on the phase behaviour of water-hydrocarbon systems and gas hydrates. He started his employment at Heriot-Watt University in January 1994 working in both Hydrate and Reservoir Fluids research projects.

His research interests include gas hydrates, flow assurance, PVT, phase behaviour and properties of reservoir fluids and CO2-rich systems. Currently, he leads Hydrate, Flow Assurance and Phase Equilibria Research Group at Institute of Petroleum Engineering, Heriot-Watt University. He is the Director of Centre for Gas Hydrate Research and the Centre for Flow Assurance Research (C-FAR) at Institute of Petroleum Engineering, Heriot-Watt University with several projects on various aspects of gas hydrates and flow assurance, and phase behaviour and properties of reservoir fluids and CO2-rich systems. His is a consultant to major oil and service companies. Bahman is Managing Director of “HYDRAFACT LIMITED” a Heriot-Watt spin-out Company formed in 2006 with Flow Assurance and PVT as its main area of activity.

His teaching activities included Petroleum Engineering and Production Technology, as well as offering several short courses to the industry (including; Flow Assurance and Gas Hydrates, PVT and Phase Behaviour of Reservoir Fluids, and Petroleum Engineering for other Disciplines). He has published more than 200 papers and holds 10 patents mainly in gas hydrates and PVT. He was SPE Distinguished Lecturer in 2004-2005 with his talk entitled, “Gas Hydrates: Friend or Foes?”. Bahman is a Professor at the Institute of Petroleum Engineering, Heriot-Watt University and a visiting Professor at Qatar University. Bahman is a member of the Society of Petroleum Engineers and a member of the EPSRC (the UK Engineering and Physical Science Research Council) Peer Review College for 2006-2009 and 2010-2013 and former member of editorial board of Journal of Chemical Engineering Research and Design (2009-12). He is currently Deputy Head of Institute of Petroleum Engineering.
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INVESTMENT PACKAGES

<table>
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<tr>
<th>Investment Package</th>
<th>Deadline</th>
<th>Course Fee</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Price</td>
<td>26th Sep 2014</td>
<td>SGD $5,995</td>
</tr>
<tr>
<td>Early Bird Offer</td>
<td>29th Aug 2014</td>
<td>SGD $5,795</td>
</tr>
<tr>
<td>Group Discount (3 or more Delegates)</td>
<td>26th Sep 2014</td>
<td>10% discount for groups of 3 registering from the same organization at the same time</td>
</tr>
</tbody>
</table>

Group Discount is based on Standard Price

- To enjoy the promotion & discount offer, payment must be made before deadline
- For 7 or more delegates, please inquire for more attractive package.
- Prices include lunches, refreshments and materials. Promotion & discount cannot be combined with other promotional offers.
- Important: Please note that registration without payment will incur a SGD 200 administration fee.

DELEGATES DETAILS

1st Delegate Name _______________________________ Mr ☐ Mrs ☐ Ms ☐ Dr ☐ Others ☐
Direct Line Number: ___________________________ Email: ___________________________
Job Title: ___________________________ Department: ___________________________
Head of Department: ___________________________ 

2nd Delegate Name _______________________________ Mr ☐ Mrs ☐ Ms ☐ Dr ☐ Others ☐
Direct Line Number: ___________________________ Email: ___________________________
Job Title: ___________________________ Department: ___________________________
Head of Department: ___________________________ 

3rd Delegate Name _______________________________ Mr ☐ Mrs ☐ Ms ☐ Dr ☐ Others ☐
Direct Line Number: ___________________________ Email: ___________________________
Job Title: ___________________________ Department: ___________________________
Head of Department: ___________________________ 

INVOICE DETAILS

Attention Invoice to: ___________________________ Fax: ___________________________
Company: __________________ Industry: __________________
Address: __________________ Postcode: __________________
Country: __________________ Email: __________________
Please note:
- Indicate if you have already registered by Phone ☐ Fax ☐ Email ☐ Web ☐
- If you have not received an acknowledgement before the training, please call us to confirm your booking.

PAYMENT METHODS

☐ By Credit Card :
   Please debit my credit card: Visa ☐ MasterCard ☐ AMEX ☐ Security Code: ___________
   Card Number: ___________ Expiry Date: ___________
   Name printed on card: ___________________________

☐ By Direct Transfer: Please quote invoice number(s) on remittance advice
   PetroSync LLP Bank details:
   Account Name: PetroSync LLP
   Bank Number: 7144 • Branch Code: 013 • Account No: 13-1-005531-6
   Name of Correspondent Bank: Standard Chartered Bank, 6 Battery Road,
                              Singapore 049909
   SWIFT Code of Correspondent Bank: SCBLSGSGXXX
   All bank charges to be borne by payer. Please ensure that PetroSync LLP receives the full invoiced amount.

Authorized Signature: ___________________________

Payment terms: Payment is due in full at the time of registration. Full payment is mandatory for event attendance.

Course Confirmation

I agree to PetroSync's terms & conditions, payment terms and cancellation policy.