Flow Assurance

ABOUT THE COURSE

Flow assurance is the discipline concerned with the economic and reliable production and transportation of oil, gas, and formation water from the reservoir to the delivery point throughout the entire life of a field, under all operating and environmental conditions.

Operational challenges such as deposition, system blockages, and corrosion-related perforations can disrupt production, resulting in unplanned shutdowns and increased operating costs. These issues may arise from the formation of gas hydrates, paraffin (wax), asphaltenes, inorganic scale, or other flow-impairing mechanisms.

An effective flow assurance strategy must consider both fluid properties and operating conditions. It requires a multidisciplinary approach involving production, maintenance, engineering, laboratory analysis, and health, safety, and environmental (HSE) functions, with a strong focus on prevention as well as remediation.

COURSE OBJECTIVES

Upon successful completion of the course, participants will be able to:

- Develop a comprehensive understanding of flow assurance challenges associated with fluid production, gathering, treatment, and transportation
- Apply fundamental principles of multiphase flow and related phenomena to evaluate and implement flow assurance solutions
- Identify existing and potential threats to uninterrupted fluid flow
- Design cost-effective, efficient, and reliable mitigation strategies that maintain production targets and extend equipment service life while complying with environmental regulations
- Define evaluation criteria and calculate Key Performance Indicators (KPIs) related to corrosion, inorganic and organic scaling, and produced water treatment for disposal or reinjection

COURSE CONTENT

Day 1 - Flow Assurance & Gas Hydrates

- Introduction to Flow Assurance

This session provides an overview of flow assurance, addressing the impact of organic and inorganic deposition, emulsion formation, and corrosion within oil, gas, and formation water systems during production, gathering, treatment, and transportation.

- Gas Hydrates

The session begins with the fundamentals of gas hydrates, including their composition, formation conditions, and prediction methods. Participants will learn prevention strategies, such as: physical methods: water removal, temperature maintenance, pressure control; and chemical methods: thermodynamic inhibitors (e.g., methanol, MEG), with practical exercises for calculating required dosages, as well as kinetic inhibitors and anti-agglomerants. Relevant case studies will be included.

Day 2 – Gas Hydrates & Emulsions

- Gas Hydrates
- Emulsions

This session explores the formation mechanisms, characteristics, and destabilization techniques for emulsions in oil and gas systems. Calculation of emulsion viscosity and inversion points will be presented.

Day 3 - Asphaltene Deposition & Wax (Paraffin) Deposition

- Asphaltene Deposition

Participants will explore the characteristics, molecular structure, and physical-chemical properties of asphaltenes. The session will cover laboratory methods for determining asphaltene content, phase behavior and asphaltenes stability, as well as techniques for predicting their deposition. Emphasis will be placed on key precipitation factors and the design of effective prevention and remediation strategies. Several case studies will be presented. The day concludes with the development of Key Performance Indicators (KPIs) to evaluate the effectiveness of asphaltene mitigation efforts.

- Wax (Paraffin) Deposition

This lecture focuses on the mechanisms and conditions that drive wax precipitation and the operational challenges it causes. Participants will become familiar with diagnostic tests, monitoring strategies, and remediation techniques, along with modeling approaches used to predict deposition. Case studies will highlight real-world examples. The session will close with the formulation of KPIs for evaluating paraffin control strategies.

Day 4 - Wax (Paraffin) Deposition & Inorganic Scale Deposition

- Wax (Paraffin) Deposition
- Inorganic Scale Deposition

The lecture covers the formation conditions, mechanisms, risk assessment, and mitigation of common inorganic scales: calcium carbonate, calcium sulfate, barium sulfate, strontium sulfate, iron carbonate, and iron sulfide. Participants will learn to assess the probability, severity and overall threats of scale formation using appropriate modeling tools. Several case studies will be analyzed. The day concludes with guidance on developing KPIs to monitor and evaluate scale mitigation effectiveness

Day 5 - Corrosion

- Corrosion - Fundamentals and Forms of Corrosion: The day begins with an overview of corrosion drivers and types, followed by analysis of corrosion in multiphase systems—considering the influence of process parameters and fluid properties (oil, gas, and water); Corrosion Prevention, Monitoring & Modeling: The lecture continues with prevention techniques, monitoring methodologies, and corrosion modeling due to CO2, H2S, and their combined presence. Practical examples will be used; Microbiologically Influenced Corrosion (MIC): Discussion extends to corrosion influenced by microorganisms, including mechanisms and predictive models; KPIs for Corrosion Management: Participants will learn how to define and use KPIs to assess corrosion risks and ensure system integrity.

DESIGNED FOR

This course is particularly tailored for petroleum production engineers, laboratory personnel, field operators, system designers, and anyone seeking practical experience in this field, including researchers or managers who want to understand technical issues that support effective decision-making.

CIURSE DELIVERY METHOD

The course will consist of lectures supported by worked examples, and case studies. In addition, participants are encouraged to bring their own examples for in-class discussion and analysis.

INSTRUCTOR

Snežana Šević holds a B.Sc., M.Sc. and Ph.D. from the Faculty of Technology, University of Novi Sad, and has 40 years of experience in the oil and gas industry. Her areas of expertise include diagnosing issues arising from produced fluid properties; conducting risk analyses and recommending flow assurance management programs during fluid production, gathering, treatment, and transportation; modeling of flow assurance issues, simulation, and optimization of process systems.
She has worked with PM Lucas d.o.o., NIS-Gazprom Neft, and Qimica Apollo – Mexico. She has been involved in over 50 projects across Serbia, Mexico, Kazakhstan, and Russia. Dr. Šević has authored over 30 scientific and technical papers, a book titled *The Impact of Formation Water on Oil and Gas Production and Transportation*, and has supervised several undergraduate, master's, and doctoral theses. In 2018–2019, she was selected as a Distinguished Lecturer by SPE and was part of the SPE E-Mentoring Program for five years.

CONTENT- FLOW ASSURANCE COURSE

Detail Day wise breakup of training program with topics to be covered.

Flow Assurance

- What is Flow Assurance
- What Happens during Hydrocarbons Production - Common Production Problems
- Flow Assurance Problems and Their Typical Location in the Production System
- Properties of Reservoir Fluids
- Phase Behavior of Reservoir Fluids and Phase Envelopes
- Typical Tools Used for Flow Assurance Assessment

Gas Hydrates

- What are Gas Hydrates – General Information
- Hydrates Formation
- Prediction of Hydrates Formation

Gas Hydrates

- Preventing the Formation of Gas Hydrates
- Physical methods
    - Water Removal
    - Maintaining high process temperature
    - System Pressure Decreasing
- Chemical methods
    - Thermodynamic inhibitors
    - Kinetic Inhibitors
    - Anti-agglomerants
    - Comparison between LDHIs and Thermodynamic Inhibitors
- Case Studies

Emulsion

- Definition
- Characteristics and Physical Properties
- Destabilizing Emulsions
- Methods of Emulsion Breaking or Demulsification
- Field Emulsion-Treatment Program

Asphaltenes Deposition

- Introduction to Asphaltenes
- Molecular Structure
- Typical Asphaltene Molecular Properties
- Other Properties of Asphaltenes
- Laboratory Determination of Asphaltenes Content
- Asphaltenes Stability and Phase Behavior
- Asphaltenes Deposition
- Prediction of Asphaltenes Deposition
- Field Experience
- Techniques for Treatment of Asphaltene Deposition
- Key Performance Indicators
- Case Studies

Wax Deposition

- Crude Oil Wax – Nature, Chemical Composition
- Wax Deposition
    - Wax Deposit Envelope
    - Location of Wax Deposition
    - Factors Leading to Wax Deposition

- Mechanism of Wax Deposition
- Wax Deposition in Multiphase Flow

- Wax Detection and Estimation Techniques
- How to Fight Wax
- Advantages and Disadvantages of Each Wax Preventive or Removal Method inside Wells
- Key Performance Indicators
- Case Studies

Inorganic Scales

- Scale – Definition, common types at the field, locations, problems
- Scale Protection – An Easy Task?
- How to Develop the Management System
- Risk Assessment
- Management Strategy
- Monitoring, Validation & Optimization
- Key Performance Indicators
- Case Studies

Corrosion

- Introduction
- Parameters Affecting Corrosion
- Forms of Corrosion
- Strategies for Preventing Metal Corrosion
- CO_2 Corrosion Rate calculation
- H_2S Corrosion Rate calculation
- CO_2/H_2S Corrosion Rate calculation
- Review of Models for Assessing Microbiologically Influenced Corrosion
- Key Performance Indicators
- Risk-Based Inspection (RBI)