Artificial Lift Design and Optimization - Intermediate Level

Course Description

This course is designed to develop a solid foundation of the main artificial lift methods. This course provides detailed discussions and hands-on training for designing Artificial Lift Systems (ALS) to maximize oil production. This training covers the artificial lift selection process, pros and cons analysis of each artificial lift method, and workflows for designing ALS. Gas lift (GL) and ESP are the artificial lift systems designed for handling high fluid production rates. Participants will learn how to design Gas Lift and ESP under different reservoir and operating conditions.

Participants will also gain the knowledge and skills related to integrated production modeling for production optimization.

ALS course material includes hands-on exercises, presentations, case studies, best practices and lessons learned based on published books and SPE papers. The course will be supplemented by practical class project example problems, group exercises and interactive group discussion designed to consolidate and reinforce learning associated with ALS of oil fields.

Who Should Attend?

This course is designed for production and field operations engineers, petroleum engineers and field technicians, production managers, reservoir engineers, reservoir managers, facility engineers as well as geoscientists who wish have a better understanding of ALS.

What You Will Gain:

- Learning the artificial lift selection process
- Understanding the general workflow for Artificial Lift Systems design.
- Learning how to model reservoir deliverability and wellbore completion capacity (IPR/VLP).
- Understanding the advantages and disadvantages of each artificial lift system

- Understanding how to connect subsurface and surface models to perform production optimization
- Recognize how to identify opportunities for production optimization
- Analyzing case studies to identify and offer solutions to specific problems associated with ALS.

Training Methodology

The training course will combine lectures (30%) with workshop/work presentations (30%), interactive practical exercises and case studies (20%), supported by video material, software and general discussions (20%)

Course Content

Introduction to Nodal Analysis

- Introduction to nodal analysis
  - System Variables
  - Pressure continuity and system pressure drop
- Reservoir inflow performance modeling (IPR)
  - Reservoir deliverability
  - Flow regimes: steady state, transient flow, pseudo-steady state
  - Reservoir models: Darcy, Vogel, Forchheimer, others
  - Types of well architecture, effective well radius concept
  - Completion options
  - Inflow Performance Relationship (IPR)
  - Horizontal wells, well productivity enhancement
  - IPR class exercises

Modeling fluid flow in pipes

- Modeling fluid flow in pipes
  - Single and multiphase flow
  - Liquid holdup and pressure drop in vertical, slant, and horizontal systems
  - Liquid hold-up, flow regimes, multiphase flow correlations main applications and limitations
  - Pressure losses per tubing unit length as a result of gravity, friction and acceleration
  - Wellbore enthalpy model, wellbore heat transfer coefficient, fluid heat capacities
- Heat flow modeling
  - Heat transfer applied to wellbores
  - Estimating reservoir temperature & geothermal gradient

- History matching of production test
    - Workflows
    - Sensitivity analysis
    - Exercises using commercial software

Artificial Lift selection. Gas lift design

- Overview of Artificial lift systems
- Artificial lift selection process
- Gas Lift System
    - Basic components of a gas lift system
    - Surface equipment: gas supply (compressor plant, moto-compressor), gas separation and dehydration equipment, gas-lift network components
    - Wellbore equipment: unloading gas-lift mandrels process, orifice valves
    - Operating parameters: gas-lift allocation rates, injection pressure, valve operating pressures
    - Closed rotative gas lift system
- Gas Lift Design
    - Introduction
    - Continuous gas lift
    - Properties of injection gas
    - Volumetric gas throughput of an orifice
    - Gas lift equipment
    - Gas lift design using a commercial software. Input Parameters, valves type, valve settings, injection point, pipe correlations, chart analysis and interpretation.

ESP design. Introduction to integrated production system

- Basic components of the ESP
- Electrical Submersible pump design
- Introduction to integrated production system
- Exercise: Gas field Network Modeling with GAP

Gas lift/ESP optimization

- Hands on project to implement ALS lesson learned
    - IPR calculations and sensitivity analysis
    - VLP calculations
    - Continuous Gas Lift System Design (or ESP design), performance curve analysis, valves selection, valve sensitivities, gas rate sensitivities
    - Team discussion