Thermal Recovery Methods for Heavy Oil Fields

Course Price

£3050

Course Description

This course is designed to cover all the traditional and modern Thermal Recovery Methods used in the oil industry for Heavy Oil recovery. Perhaps no other single subject dominates the oil industry like thermal recovery. For many of oil fields, particularly where low-to-medium gravity oils are found or where the oil viscosity is unfavourable for conventional EOR methods application, Thermal Recovery Methods are the best techniques for ultimate recovery. Vast deposits of heavy oil exist in Canada, Venezuela and USA that are amenable to recovery by Thermal Recovery. Thermal Recovery is usually applied to heavy to medium oils, however these methods can be applied to any field being considered and be competitive with alternative methods. The course consider the following methods: Cycle Steam Injection, Double Injection Nitrogen-Steam, CO2-Steam Injection, Flue Gas-Steam Injection-This methods have given excellent results in China and Louisiana (USA), Steam Drive Process, Hot Water Injection Processes, In Situ Combustion Processes, Cold Heavy Oil Production with Sand (CHOPS), Vapor Extraction Method (VAPEX) and Steam-Assisted Drainage (SAGD).

Course Objectives

Who Should Attend

This course is designed for Production and Reservoir Engineers and their supervisors; Chemical Engineers Associated with crude oil production in areas of high viscosity. Technical field personnel and services companies representatives to obtain or increase the understanding of the overall concepts and principles of improving the efficiency of production, treatment and the handling of heavy crude oils.

Course Content

Topic 1: Reservoir Characteristics Analysis and Screening Procedures

Objective: To analyse fundamental parameters related to Thermal Recovery

Porosity; Oil Saturation; Permeability; Reservoir Depth; Reservoir Geology; Viscosity; Temperature; Reservoir Production Mechanics and crude oil composition, Formation Thickness;
Oil Gravity and Mobility

Topic 2: Thermal Properties of Rocks and Fluids
Objective: To study in depth water and rocks thermal properties

A. Thermodynamics Properties of Water (Steam)
   • Water: solid, liquid, and vapor
   • Enthalpy
   • Superheated steam behaviour
   • Tables and charts for enthalpy and specific volume for saturated steam and superheated steam
   • Steam Quality – measurement and methods of calculation and field approximation
   • Thermodynamic Correlations to determine steam properties
   • Problems and solutions/ Exercises

B. Thermal Conductivity: Liquid and Gases – Correlations
   - Reservoir Volumetric Heat Capacity Calculation

C. Specific Heat of Liquid and Gases – Correlations

D. Latent Heat of Vaporization

E. Rock Thermal Conductivity and its Variation with Density, Temperature, and Fluid Saturation.

F. Effect of Temperature on Relative Permeability

G. Steam Generators for Thermal Recovery (General Specs. and Practices)
   • Steam Generator Efficiency calculations and Efficiency determination.
   • Water Characteristics for Steam Generation/ Ionic Exchanger Units / Procedures
   • Scale Control in Steam Operations

Topic 3: STEAM INJECTION PROCESSES

Objective: To study casing and tubing behaviour under thermal stresses and design cycle and drive steam injection projects.

A. Thermal Well Completion – Design/Practices and Procedures
   • Insulation – solids and liquids
   • Thermal packers
   • Pre-stretching method

B. Performance Prediction and Formation Heating Process
   • Marx and Langenheim’s Mathematical Model
   • Myhill-Stegemeir Technique
   • Other mathematical Models
C. Cycle Steam Injection

- Heat loss and Heat Transmission calculation
- Oil recovery and its evaluation
- Steaming period
- Number of cycles
- Spacing of wells
- Quality of steam injected
- Process factors in steam injection
- Heat loss Calculations
  - generator
  - surface
  - well-bore
  - adjacent formation

D. Steam Flooding

- Theoretical front diagrams
- Heat loss calculation
- Oil recovery calculation – radial flow
- Field cases

Topic 4: HOT WATER INJECTION PROCESS

Objective: To study the effect of hot water injection as a EOR method.

A. Evaluation of the Process
B. Field Case Histories

Topic 5: PATTERN AND WELL SPACING

Objective: To learn different well patterns and theirs effect on Thermal Recovery Methods

A. Well Pattern for Pilot Test
B. Well pattern for Field Development

Topic 6: IN SITU COMBUSTION PROCESSES, ANALYSIS, FRONT DIAGRAMS AND PREDICTIONS

Objective: To conduct a technical study on In Situ Combustion Processes, design and review of project case histories

A. Dry Forward in Situ Combustion
B. Dry Reverse In Situ Combustion
C. Cafcow Process
D. Partial Quenched Combustion

Topic 7: DOUBLE INJECTION NITROGEN/STEAM/CO2 Cycle Injection

- Introduction
- Physical characteristics of Nitrogen
- A comparison of CO2, Nitrogen and Flue Gas Characteristics
- Field Experience with Double Injection
- Analysis of the Mechanism of mixture of N2 and Steam reactivating mature wells
- Cycle Injection of CO2 in Heavy Oil in Comparison with Steam Injection
- Results C02 Cycle Injection in Louisiana State, USA.
- Summary
- References

Topic 8: NEW METHODS IN THERMAL RECOVERY

Objective: To study the new technology in thermal recovery applied in Heavy and extra-heavy Oils

1. Cold Heavy Oil Production Technology (CHOPS)
2. Description of the Process
3. Field Application, limitations and results
4. Vapor Extraction Method (VAPEX)
5. Description of the Method
6. Field Application, limitation and results
7. Steam Assisted Gravity Drainage (SAGD)
8. Description of the technology
9. Field Applications, limitations and Results

Topic 9: REVIEW OF SEVERAL THERMAL MODELS AVAILABLE IN USA

Objective: Present several Mathematical software to assist engineers to predict the performance of thermal methods

The models will be presented and explained how to setup in your computer and how to use the models in general; but no specific case will be presented. Only the general presentation and capability and description and examples available in the CD.

Topic 10: GENERAL DISCUSSION ON THERMAL RECOVERY METHODS

Objective: To review and clarify concepts, and discuss participants field Cases.

CPD Unit

Continuing Professional Development