PMG **Petro Management Group Ltd.**

Review of Well Injection Tests

Course Objectives:

The purpose of this one-day course is to offer a complete coverage the various injection tests conducted in the industry; their applications and how to analyse test data. Injection tests are conducted for: 1. water disposal and injection wells. 2. Steam injection wells. 3. Subsurface injection/disposal/storage of CO_2. 4. Frac design using Mini frac tests or Diagnostic Fracture Injection Test (DFIT). **Learning outcome:**

1. Understand the theory/fundamentals of well test interpretations, including flow geometry and boundary conditions.
2. Understand the benefits injectivity/fall-off tests to maximize water injection and select candidate wells for wellbore stimulation
3. Select perforating intervals for unconventional reservoirs using N2 injectivity/fall-off tests
4. Why conduct step-rate tests and packer leak-off tests
5. Learn the benefits of the Hall plot for water disposal/injection wells
6. Learn the aapplications of Diagnostic Fracture injection Test (DFIT) or Mini Frac and their requirements by the AER
7. Understand the analysis techniques of DFIT including:
    a. Pre-Frac Closure
    b. After Closure Analysis (ACA)
    c. Numerous case studies from the Duvernay and Haynesville shale gas
8. Learn how to extract geo-mechanical parameters from DFIT; such as, closure pressure, ISIP, and types of leak-off, which are essential to the frac design.
9. Illustrate how injection tests are analyzed using commercial software

A detailed course hand-out, which is an excellent reference, will be provided. Hand calculators are required for this class.

Who Should Attend?

This course is aimed at all the technical staff such as reservoir, petroleum and exploitation engineers/technologists, geophysicists, and geologists who are involved in well production/injection optimization and hydraulic frac design.

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Course Instructor:

Mr. Saad Ibrahim, P. Eng, president of Petro Management Group Ltd. He has over 35 years of diversified experience in the oil and gas Industry as a worldwide highly recognized engineering consultant and a distinguished instructor. He also completed a post-graduate program with the University of Calgary in Chemical and Petroleum Engineering. The focus of Mr. Ibrahim's experience lies in the area of Reservoir management, and well test planning/analysis. Mr. Ibrahim is a member of APEGA and SPE.

Course Agenda:

- **Introduction to injection tests and stages of well testing**

- **Technical background on well test analysis, including:**
  - Flow geometry and boundary conditions
  - The use of the Horner and pressure derivation plots for pressure transient analysis (PTA)
  - The use primary pressure derivative to identified wellbore dynamic effects

- **Injectivity/off-test**
  - How to analyze for injection/disposal wells and coal-bed-methane (CBM)
  - Case study
  - The application of N_2 injection/fall-off tests for unconventional reservoirs.

- **Step-Rate Test**
  - Benefits and analysis method
  - Packer leak-off test (case example)
  - Use of step-down test to estimate the pressure drop in the perforations and near wellbore due to tortousity

- **Hall Plot**
  - Theory and applications
  - Interpretations of the Hall Plot
  - Class problem

- **Single Well Chemical Tracer Tests (SWCTT)**
  - SWCTT is widely used to estimate the remaining oil saturation after:
    - waterflooding (S_{orw}), and
    - Enhanced oil recovery schemes

- **Diagnostic Fracture injection Test (DFIT) or mini Frac.**
  - Applications/benefits
  - Analysis techniques, including:
    - Pre-closure analysis
    - After Closure Analysis (ACA)
  - **Use of DFIT results for practical applications, including**
    - Well flow-back design
    - Stress calibration and identification of natural fractures
    - Use of Net Fracture Pressure to monitor frac progress
  - **Several case studies including tests from Duvernay, Haynesville**

- **Closing comments and a question period**

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