

## Course: **Comprehensive Course on Hydraulic Fracturing of Horizontal Wells in Unconventional Reservoirs**

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### **Day 1**

#### **Morning**

- Is hydraulic fracturing a new technology? Is it applicable to all types of reservoirs? Brief history of hydraulic fracturing and its impact in Argentina.
- Specific characteristics of Vaca Muerta. Quick comparison with other unconventional reservoirs and analogs.
- What is a fracture? Differences between conventional and unconventional reservoirs. Reservoir engineering aspects that explain why fracturing works — and sometimes why it does not.
- Reservoir-based analysis of the rationale behind multi-fractured wells with transverse hydraulic fractures. Additional advantages.
- Fundamentals of rock mechanics. Discussion of the effects of Young's Modulus, Poisson's Ratio, and Biot's Coefficient on fractures. Laboratory testing. Isotropic vs. anisotropic rocks. Implications. Practical exercise.

#### **Afternoon**

- Applied geomechanics. Fundamentals of stress profile construction, impact on drilling, effects on perforating (where to perforate, oriented perforations). Calibration of the geomechanical model, pre-fracture testing. Initiation, propagation, and growth of hydraulic fractures. What shape do fractures have? Fracture dimensions — we know everything except their length, width, and height! How do we deal with uncertainties? What can we measure and what must we assume? Effect of laminations, fissures, and other geological discontinuities. Practical exercise.
- Review of horizontal well completion methods optimized for hydraulic fracturing. What is Plug & Perf? Fracture plugs. Can optimization continue? New technologies.
- Basic definitions used in horizontal well completion and fracturing. Benchmark of the evolution of well completions in Vaca Muerta (well length, spacing, number of clusters, flow rates, sand and fluid intensities, etc.).

- Well construction cycle.
  - Operations and sequencing of fracturing in multi-well pads (PADs). Implications, challenges, and potential solutions.
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## **Day 2**

### **Morning**

- The key to success: optimizing the contact area. What should be optimized?
- Optimization of stage spacing.
- Cluster divergence. The effect of flow rate. Why do not all perforations take fluid? Strategies to improve cluster efficiency.
- Flow regimes in fractured wells. Fracture cleanup. Fracture length — which one are we referring to? Implications.
- Fundamentals of fracture pumping schedule design. Is the same design applicable for a gas well and an oil well?
- What should be optimized in fracture designs: production, IP, well economics? Introduction to fracture simulators. Practical exercise.

### **Afternoon**

- Fracturing fluids and proppants for unconventional reservoirs. Fluid and proppant selection. Is conductivity necessary? Sand degradation. Industry trends. Usage strategies.
- Variability in production results. Discussion of causes.
- Discussion on the use of sand and fluid intensity concepts. Pros and cons. Production normalization to improve multi-well analysis interpretation.
- Results monitoring. Fiber optics, tracers, pressure- and/or rate-based methods, microseismic, PLT, optical and/or acoustic imaging in cased wells, 4D seismic, etc. Pros and cons of each. What information they provide — and what they do not reveal.
- Group discussion, specific topics, questions, comments. Closing.