

Hydraulic Fracturing's Progress Reviewed in Workshop

Approximately 110 professionals converged on Cartagena, Colombia from 11 to 13 August for SPE's Applied Technology Workshop (ATW) titled "Hydraulic Fracturing in the Americas." The international audience, representing the US, Canada, Mexico, Argentina, Venezuela, Brazil, Colombia, Romania, and Indonesia, shared the latest information on how hydraulic fracturing has been applied to improve hydrocarbon recovery during various stages of field life.

Two full days of discussion included 21 high-level fracturing topics divided into six subtopics, including high-permeability and low-permeability fracturing, unconventional reservoirs and horizontal well fracturing, fracture design and diagnostics, and advances in fluids and proppants.

The ATW's first session on high-permeability fracturing featured discussions by representatives of Schlumberger, Halliburton, and Ecopetrol-ICP. Highlights of the session included an explanation of how the microannulus between cement and rock favor fracture initiation and propagation, and that a wide propped width is required to provide high fracture conductivity and offset embedment. The leakoff areas above and below a perforated interval help contain fracture height growth and facilitate tip screen out and it is important to consider the cool down temperature profile for proper design of fracturing fluids. Packerless multistage CT fracturing in Argentina using hydrate technology is performing well in high-permeability formations and in tight gas sands. Frac design in Colombia includes a procedure for selecting candidates considering reservoir and geomechanical data. Also, organic preflushes have shown excellent results when performed prior to main frac treatment.

The second session on low-permeability fracturing considered experiences in the East Kalimantan in Indonesia and the Burgos Basin of Mexico. At East Kalimantan, poroelastic hysteresis is severe, and special considerations need to be taken in fracturing these poroelastic sensitive formations. The main considerations are to follow a rigorous planning schedule and demand high-quality services for fracturing operations. Also, an analysis of the history of fracturing in the area is a must before designing new fracturing jobs.

Use of microemulsion technologies has showed good results in the Burgos Basin. Another parameter for success includes getting proper values for rock permeability, closure pressure, and rock mechanical properties from minifrac tests. Flowback tests using chemical tracers showed that the recovery of fracturing fluids after a treatment is in the range of 5–20% of the total injected fluids.

In a session discussing the fracturing of unconventional reservoirs, experiences from the Barnett Shale were present-

ed. The speakers recommended accounting for the shale's network of natural fractures, and considering a switch to clean fluids when encountering high pressure due to the large increase of sand concentration near the mouth of the fracture. A return of more than 30% of water is a bad sign for the fracturing job.

The fourth session covered horizontal well fracturing, where a recommendation was made to complete these wells assuming they will need hydraulic fracturing unless the reservoir is known to have high permeability. Presenters advised operators to consider fracturing the well at the beginning rather than when the production is poor. Microseismic monitoring has opened the door for many real-time decisions such as fracture height, length, and faults, and allows greater understanding of when physical results are desirable or when needs of the next job will change. Experiences in the North Sea showed that the use of cemented and perforated completions continue in many applications. The selection of acid versus propped fracture depends on the operator, and multizone diversion is critical.

In the fracture design and diagnostics session, speakers focused on several diagnostic methods, most of which complement each other and help the stimulation design engineer evaluate his subject well, group of wells, or specific frac design among multiple scenarios. The diagnostic processes include geomechanical modeling and integration with reservoir data and microseismic monitoring of frac treatments, which identifies fracture geometry. Dynamic fracture injection tests were recommended to quantify stress, permeability, and reservoir pressure values which are then used to gauge forward well performance and uncertainty and risk data analysis. This type of analysis can be used to identify which factors directly or indirectly affect well performance and improve the decision on the best treatment option.

The ATW's final session highlighted proppants and fluids and showed the need for performing laboratory tests to properly design the stages of a fracturing job. The session also demonstrated how field analysis must be implemented to establish material and equipment quality conformance. The use of a relative permeability modifier combined with low polymer fluids will also help achieve better production results.

Water availability is a growing issue for hydraulic-fracturing operations in environmentally sensitive areas. Different fluid alternatives may exist, but careful design and evaluation are musts to prevent further problems. Because water disposal costs are increasing, presenters recommended reusing water for fracturing when possible.

Joint Workshop Highlights Increasing Production in Complex Offshore Reservoirs

A Joint Technology Workshop between SPE and the Instituto Brasileiro de Petróleo, Gás E Biocombustíveis (IBP) titled “Well Technologies for Enhancing the Productivity of Complex Offshore Reservoirs” was held in Vitória, Brazil earlier this year. With a focus on discussing challenges in well construction for proper production in heavy oil sands, tight gas sands, and heterogeneous reservoirs, the workshop drew ninety-five participants from several countries.

The audience, which was slightly larger than is typical for this kind of event, represented operating companies (62.1%), service companies (27.4%), and academia (9.5%). The technical professions represented included exploration geology, drilling and drilling fluid engineering, underbalanced drilling, rock fluid interface dynamics, well stimulation, intelligent completions, equipment, formation evaluation, and reservoir engineering/geology.

The sessions included 28 technical presentations in the following topics:

- Searching for the best facies. This session focused on the latest logging-while-drilling/ navigation technologies available to ensure well construction in the best reservoir facies. A major concern was the geological uncertainties in carbonate reservoirs and the need for efficient information interchange among operators.

- Minimizing formation damage. This session addressed problems, challenges, and existing solutions for minimizing formation damage in tight gas sands and carbonate reservoirs as well as hole enlargement issues in heavy oil sands. Relevant discussion points included imbibition and phase trapping in tight gas sands, difficulties and risks of underbalanced/overbalanced fluctuations while drilling and completing sensitive reservoirs, the necessity of massive stimulations in tight gas sands and carbonates, and the proper comprehension of damage mechanisms to specific reservoir scenarios and their impact on drilling and completion fluid selection.

- Complex reservoir evaluation. This session focused on emerging evaluation technologies such as testing-while-drilling, NMR logging, and reservoir properties estimation based on invasion logging data. Carbonate reservoir evaluation again received focus as a topic for improvement.

- Sand control. This session highlighted the advantages and disadvantages of various sand control strategies adopted by different operators. Openhole gravel packs and stand-alone-screen successes and failures were discussed, and it was agreed that risk analysis and local experience are fundamental topics to be considered when designing sand control for new developments. Synthetic-based gravel pack carrier fluids (both considering alpha/beta wave placement and alternate path) field experiences were also discussed.

- Intelligent completions. In this session, two major service companies presented the present state and future challenges for intelligent completion sensors, equipment, and tools for specific reservoir scenarios. The major conclusion was that a significant gain in well completions will only be observed when real-time data analysis and interpretation capability reach the level and speed of data generation.

- Flow equalization in horizontal wells. This session focused on operator experience with different inflow control devices in several areas. There was agreement that flow equalization is a field development strategy which may bring impressive gain in different reservoir scenarios. Attendees also agreed that while different concept tools are available, there is still some controversy on the feasibility of gravel packing.

A poster session was also held which displayed seven different posters from local universities. Attendees expressed the opinion that this poster session enabled an interesting moment for advanced technical discussion and highlighted the fundamental role that academia plays in technological development.

Argentina Holds Technology Workshop on Artificial Lift Systems

More than 130 participants from 13 countries attended SPE's Applied Technology Workshop on artificial lift systems earlier this year. Over the course of three days and nine technical sessions, attendees representing a nearly equal split between operating and service companies were exposed to all aspects of artificial lift systems and saw the full interactive circle of technologies and competencies.

The Keynote Speaker was Mary Corsaro, Manager of the Processes and Projects Engineering Group for Pan American Energy. Corsaro discussed how Pan American's Well and Field Facilities Automation Project has evolved at the Cerro Dragón field, Argentina, with particular emphasis on project challenges and benefits, how to identify the internal clients, how to sell the project to management, and how to implement it within the organization.

Throughout the workshop several noticeable trends were discussed both during the presentations and the session breaks. One of these was the increase in innovative artificial lift methods, borne out by the increase in crude oil prices over the past several years. Several creative innovations were discussed, including the Vann System, which

utilizes standard reciprocating downhole pumps and cables to convey the reciprocating motion. Other innovations discussed were the Recoil System that utilizes a long hose into which the produced fluid is lifted, the swab system, and concentric Jet Pump completions. What were considered uneconomical methods in the past have recently become extremely economical.

In addition to novel and innovative artificial lifting methods, the need to optimize and automate wells was paramount in the minds of many operators. It is no longer sufficient to just measure basic parameters such as stroke length and strokes per minute, pump revolutions per minute, amperage, and fluid levels. The trend is moving towards multipoint pressure-temperature measurements downhole as well as multipoint monitoring at many surface locations including in flowlines, manifolds, and tanks.

Additional presentations covered topics such as new rod connections, electrical submersible pumps in heavy oil production areas such as Brazil and Colombia, polypropylene-lined tubing to reduce wear, and tubingless production utilizing hollow rod technology.

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