Innovations

Unconventional Oil&Gas | Innovations

[ww-shortcode-divider style="thin"]The importance of technological development in unconventional resources is evidenced by the rapid development of some of these resources in many areas of the world especially the shale gas in the USA

The development of unconventional resources (eg. tight gas, shale gas and CBM) is more difficult and challenging than that of conventional resources.

This is the reason why new research and development of technologies and industrial processes are required

Technologies and processes should also be economically and environmentally sustainable.

Some of the area of major development are highlighted below.

Advanced Real-Time Cutting Analysis

It allows improvements in unconventional resources characterization (in particular – shale gas reservoir) by means of detailed geochemical and mineralogical analysis on cuttings and cores directly at wellsite.

Advanced Real-Time Cutting Analysis provides a valid support to the wellsite operations which results in time and cost savings.

Moreover, Advanced Real-Time Cutting Analysis allows a quick Formation Evaluation by using the organic matter and mineralogy data to calibrate the wireline logs.

The acquired data were also used to update the geochemical model utilized in the Petroleum System Model performed during the pre-drilling phase for a better understanding of the reservoir during the exploratory campaign.

Advanced Real-Time Cutting Analysis makes use of new improvements and development of technology like:

- X-ray diffractometry for mineralogy, X-ray fluorescence for rock chemical (elemental) composition
- TOC analysis for Total Organic Carbon measurement
- Pyrolysis for source rock characterization
  - Hydrogen Index, free oil content, Petroleum Potential & Maturity Index

Wellsite analyses are validated by laboratories analyses repeated on the same samples, in order to confirm the reliability and accuracy of the rig site measurements.

Multi Stage Fracturing

Hydraulic fracturing has allowed to exploit new oil and gas fields around the world since it was invented and developed decades ago.

Hydraulic fracturing is performed to create greater conductivity of fluids within the formation and improved communication with the reservoir and the wellbore.

The components of hydraulic fracturing include the hydraulic fluids and the proppants used to keep fractures within the rock open.

Multi stage fracturing is a technological breakthrough that is helping to change how fracking is applied in unconventional resources development.

As drilling technology exploits more complex and unconventional reservoirs, completion technology is being designed and developed to effectively fracture and stimulate multiple stages along a horizontal wellbore.

The growth in multi-stage fracturing has increased due to completion technology that can effectively place fractures in specific places in the wellbore

By placing the fracture in specific places in the horizontal wellbore, there is a greater ability to increase the cumulative production in a shorter time frame.

Limiting technologies in the completion of horizontal wells have slowed that growth in some reservoir applications (e.g. reservoirs that require specific fracturing treatments at certain intervals to make them economic to produce).

Open hole Multi Stage Fracturing Method

Before the development of the special designed system, the only options for completing an open-hole horizontal well was barefoot or using slotted or perforated liners

The development of a system to set in open hole, provide mechanical diversion and allow multiple fractures to be performed along the entire horizontal wellbore, with the benefit of cost and time savings

A mechanical open-hole packer system is capable of resisting high differential pressures, with fracturing ports located between the packers

OHMSs use hydraulically set mechanical packers instead of cement to isolate sections of the wellbore.

These packers have elastomer elements that extrude to seal against the wellbore and do not need to be removed or milled out to produce the well, and they provide isolation throughout the life of the well.

Series of packers could be run simultaneously in the well on a liner, and the fractures could be pumped in continuous succession.

When the system reaches total depth, the packers can be set, instead of using wireline and perforating the casing to allow fracturing, these systems have fracturing ports to create openings between the packers.

The major advantage of OHMS is that all the fracture treatments can be performed in a single, continuous pumping operation without the need for CT or wireline, saving time and costs and reducing high-risk health, safety, and environmental operations.

Once the stimulation treatment is complete, the well can be flowed back immediately and production brought on line.

Openhole Multistage-System (OHMS) Fracturing Method in horizontal well

Openhole Multistage-System (OHMS) Fracturing Method in vertical well

Cemented-Liner Multistage-Fracturing Method

This type of completion involves cementing production casing in the horizontal wellbore and plug-and perforation/stimulation.

The mechanical isolation in the liner is achieved by setting bridge plugs using pump down wireline or coiled tubing (CT), followed by perforating and then fracturing the well to provide access to the reservoir.

The cement is able to provide the mechanical diversion in the annulus, while the bridge plug provides the mechanical diversion inside the liner

This process then is repeated for the number of stimulations desired for the horizontal wellbore. After all stages have been completed, CT is used to drill out the composite plugs, thus re-establishing access to the toe of the horizontal wellbore.

Production using this method also can be limiting because cementing the wellbore closes many of the natural fractures and fissures that would otherwise contribute to overall production.***Microseismic Monitoring***

Microseismic monitoring of hydraulic fracturing operations has proven particularly valuable in locating and attempting to characterize the very small-magnitude events generated during the fracturing process in unconventional resources plays, where effective stimulation is critical to well performance.

Microseismic characteristics include:

- depth of target, rock type, and physical size of the slip surface

Using microseismic monitoring, geoscientists try to determine fracture height, width, azimuth, and some estimate of stimulated rock volume.

They also are interested in the local geology of these events, including properties such as source types, implosive (closing) and explosive (opening) events, compensated linear vector dipole, double-coupling, and dip, strike and rake characteristics.

In turn, producers are using these attributes to help determine well spacing and orientation, the number and placement of stages, and forward prediction through discrete fracture network modeling.

Horizontal drilling has had a major impact on microseismic acquisition geometry.

The combination of horizontal drilling and hydraulic fracturing allows additional “contact” with the reservoir, without which many of these plays would be uneconomic.

The three dominant microseismic field acquisition geometries are

- borehole monitoring
- true surface monitoring
- shallow buried grids

Microseismic monitoring – The diagram depicts several multi well pads with several laterals drilled from each.

The expanding circles represent the microseismic signal emanating from a treatment point on one of the wells.

The blue dots represent the station locations.

At each station a multi-element phone is cemented at about 100 m. depth.