Enhance Multistage Frac Operations

VapR frac plugs helped stimulate the greatest number of stages in a single well in the Beetaloo basin

Background

In plug and perf completions, customers want to maximize their efficiency by deploying dissolvable frac plug technology. The challenge has always been getting the right design and dissolvable technology to provide full zonal isolation throughout the stimulation as well as reliably dissolve in a timely manner. The currently available options are often limited in application due to the fluid/plug interactions downhole, which are highly dependent on variant temperatures and chloride content. Importantly, customers want to eliminate mill-out confirmation runs, this will require confidence in the plug they use.

Solution

A customer operating in the Beetaloo Basin in Australia chose our VapR™ dissolvable frac plug with its unique back up ring packing element, minimalistic design, superior downhole performance during frac treatment, and customized material for a variety of fluid environments.

When it comes to dissolvable frac plug technology, we know that less is more. The minimalistic design of the NOV VapR means much better dissolution.

With thousands of installations in North America, the VapR plug proved to be **reliably fully dissolvable** and provide a dependable method of temporary zonal isolation during frac operations in vertical and horizontal completions. The compact design eliminated milling and post-frac cleanout — leaving no debris to remove from the well.

Rigorous testing protocols were completed during product development phase in different fluid environments including Hydrochloric acid as well as extended duration testing up to 11 hours to ensure frac plug integrity during frac operations.

The customer provided us with the well data and fluid type in order to confirm the compatibility with the VapR dissolvable plug materials. With this information, fresh water compatible VapR frac plugs were selected meeting the customer's required frac hold time and dissolvable time, thereby maximizing efficiency during the hydraulic stimulation for the well. This allowed the operators to perform their plug and perf stimulations without any concern of choked or limited production flowback due to possible wellbore restrictions in this well.

Case study facts

Location: Beetaloo Basin, Australia

Customer: Empire Energy

Well type: Gas well

Products

- 4.5-in. 13-15.1 lb/ft VapR Frac Plug with Ball in Place

General Well Information

- Casing Size: 4.500-in. 13.5 ppf
- Bottom Hole Temperature: 185 °F
- Maximum Pump Down Rate: 12.5 bpm
- Maximum Line Speed: 23,000 ft/hr
- Maximum VapR Plug Setting Depth: 3,003 m

Results

A total of 21 VapR dissolvable frac plugs were deployed in 927 m (3,041 ft) of stimulated horizontal wellbore. Significant efficiencies were achieved through technical learnings during the pump down operations of the first few stages with the optimization of line speed and pump rate. These improved efficiencies were realized through the entirety of the lateral and ultimately resulted in successfully pumping multiple stages per day alongside reduced water consumption through the use of the ball in place design.

Running the ball in place design not only reduced water consumption, but also allowed the operator to achieve a successful casing test immediately after setting the plug to confirm its integrity at setting depth — thereby providing the operator enhanced confidence in our frac plug design and performance.

During the frac operations, all ball seat signatures were identified, no slipping of the frac plug was observed, and the maximum frac rate achieved was 12.5 BPM at 6,900 psi maximum surface pressure during pump down.

To maximize flowback efficiency, a cleanout run was performed two days after the final stage to confirm that all the VapR plugs had fully dissolved. During the cleanout trip, small amounts of rubber were tagged — no other plug components were encountered. While a couple of seal elements for the upper stages were recovered, this is to be expected as dissolvable rubber requires longer duration to dissolve compared to dissolvable magnesium metals at the same temperature.

The operational results of this run met the customer's expectation. Through the simple, unique and minimalist design, we were able to perform frac stimulation and dissolve the plug well within the customer's expected time window. Using the VapR plugs allowed our customer to carry out the initial gas flow rate on their planned date for their first lateral well drilled in the Beetaloo Basin.

The VapR dissolvable frac plug developed by NOV provides reliability and strong performance, adding a modern twist to the industry's plug and perf solutions.