LOCATION: NORTH TEXAS

Gel Systems Reduced Influx of Water into Fracture Network in a Shale Play

The Barnett Shale of north central Texas is a sedimentary rock formation of organic-rich shale with components of sand and other sediments. Hydraulic fracturing and horizontal well technologies have made the Barnett shale economical in the thicker sections, but in some cases water production is so high it makes production uneconomical or shortens the life of the well and the ultimate recovery.

When fracturing into a shale, water can be introduced not only to the fracture stimulation, but also from the fracture network around the well in the formation, which occurred on a well in the Barnett shale that was producing only water and no gas. Due to the fracture communication among wells, some offset wells were also experiencing excessive water production. **FracBlock™ gel systems** probide deep penetration into the formation fracture system towards the source of the water, reducing not only the immediate path to the wellbore, but also the water source path to the rest of the fracture network in the immediate vicinity. The well consisted of nine separate intervals that were perforated and hydraulically fractured in the lateral section. The majority of the production was coming from the first three stages below 8,900-ft (2,712-m) measured depth.

The FracBlock gel system was selected for this well for several reasons, including penetration, potential effectiveness, and cost. Its purpose was to penetrate deep into the micro-fractures of the formation to reduce the flow paths from the water source into the fracture network around the wells.

Results

- Increased gas production from 0 to 250 MCFD
- Reduced water production by approximately 72%, from 360 to 100 BWPD
- Increased gas production and reduced water production on two offset wells
- Reduced HSE risks by minimizing equipment needed for the operation
- Placed well back in production three days after treatment

Challenges

- Target well produced only water at 360 BWPD and no hydrocarbons
- Adjacent wells produced excessive water
- Horizontal section extended 2,781 ft
- Reservoir pressure was 800 psi
- Well had nine stages of perforations with six perforated intervals in each stage
- Adjacent wells had similar construction

BHGE solution

- Identified hydraulic fractures producing the majority of water
- Developed customized treatment using the BHGE FracBlock gel system to penetrate into the micro-fracture network
- Accomplished mechanical isolation using a packer

Typical alternative treatment methods, such as cement, might block the larger fractures but not the smaller ones, which are prolific and communicate out in the reservoir. For these reasons, a two-stage gel treatment was chosen with appropriate volumes.

The first stage was designed to allow easier flow of gel back into the microfractures, while the second stage provided a more robust gel and targeted the larger fractures, but still penetrated far into the reservoir. The operation included tubing and a packer set above the bottom three stages targeted for water shutoff.

The operation was performed with a maximum surface pressure of 1,025 psi (70.6 bar). The well reservoir pressure was 800 psi (55 bar), ensuring there was enough pressure differential to move the gel systems into place. During the operation, the pressure, rate, and quality of the material are constantly monitored, allowing us to adapt the treatment to variances in the formation.

Days after the treatment, a cast iron bridge plug was set by the operator above the treated area. When the well was turned on, a gas production rate of 250 MCFD was initiated, and water production was reduced from 360 to 100 BWPD (57 to 16 m^3/d).

Although the targeted well production was not great, two offset wells also increased their gas production, accompanied by a reduction in water production. This reinforces the complexity of the fracture communication around the wells and the importance of penetration into these systems to reduce overall water production closer to the source.

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