

Case study: Sakhalin Island, Russia

Stimforce vessel pumps Diamond PAQ HT fluid in alternate path screens

An operator working offshore Sakhalin Island, Russia, required a carrier fluid for its first extended reach (>6000-m) dual-zone, openhole gravel pack. Due to formation sensitivities, alternate path screens were utilized and the fluid had to meet the operator's strict performance criteria in the brine selected and be as non-damaging as possible.

Engineers from the Pressure Pumping and Completions and Well Intervention product lines at Baker Hughes proposed using its new polymer-free **Diamond PAQ™ HT fluid system** pumped from the Stimforce III modular stimulation vessel to meet these challenges.

The Diamond PAQ HT system is a low-molecular weight viscoelastic surfactant-based fracturing fluid

system with performance properties similar to crosslinked polymer fluid systems but with superior formation and proppant pack cleanup. This system, typically used for openhole gravel pack applications, met the customer's requirements for suspending sand.

Once the fluid was chosen, the design work began using **PowerPack™ sand control modeling software**. PowerPack software provides application engineers valuable qualitative and quantitative information about the effects of casing, wellbore geometry, screen, wash pipe size, screen centralization, fluid properties, and flow rate on the design objectives of the gravel packing process.

Challenges

- Extended reach (>6000-m) dual zone well
- Sensitive formation required very particular brine
- Stringent performance criteria
- Operational concerns due to fluid nature
- Short timeframe to complete job due to onset of extreme winter weather

Results

- Diamond PAQ HT fluid delivered operator's desired performance criteria in the areas of sand suspension, friction reduction, and minimal formation damage



Left, the Stimforce III vessel ready to sail; right, results of Diamond PAQ HT sand settling tests performed at 176° F (80° C) for 60 minutes

All of the lab testing for fluid performance was conducted by the Pressure Pumping team in Tomball, Texas, while all of the openhole gravel pack modeling was performed by the Completions and Well Intervention team in Houston. Baker Hughes had almost-daily interaction with the customer in both its Houston and Sakhalin offices to discuss changes to either fluid performance or design parameters in order to provide the best chance for the most efficient fluid. The end result was a fluid that Baker Hughes felt confident would perform to expectations, and that, operationally, Baker Hughes could deliver at the designed rates.

In order to properly perform the job, several modifications were needed on the Stimforce III vessel, which could provide rapid deployment of fracturing and stimulation pumping equipment. Because the Diamond PAQ HT fluid has a low flash point, a higher scrutiny was placed on it. This led to a redesign of the equipment layout in order to deliver the base surfactant most effectively.

Addressing all HSE issues, Baker Hughes reassured the customer that the fluid could be pumped safely by expanding the hazard zone on the vessel, as well as moving the liquid additive pump and flow meter into the hazard zone to allow for a combination of batch mix

and on-the-fly addition. The modular nature of the Stimforce III vessel made these modifications much quicker and easier to perform.

Baker Hughes pumped 8% Diamond PAQ HT fluid in a combination of 4% batch mix and 4% on-the-fly.

The job was completed with “textbook” execution by the Baker Hughes offshore pumping team. The Diamond PAQ HT fluid provided the customer with the desired fluid performance—namely sand suspension, friction reduction, and minimal formation damage.