AquaPac
Integrated water-packing system for openhole completions
Meet the challenges of long, horizontal, openhole completions

The Schlumberger AquaPac® integrated water-packing system for openhole completions meets these challenges by using water packing to achieve full gravel-pack efficiency. The system uses brine as a vehicle for carrying and placing gravel in openhole wells around preinstalled screens. The entire process—design, execution, and evaluation—is supported by software with integrated modules for tool and pumping calculations, simulations, and optimal treatment in both vertical and horizontal wells.

AquaPac technologies are highly effective for the following:
- preventing premature screen-out and enhancing packing efficiency
- avoiding filtercake swabbing before the gravel-pack operation and providing efficient methods for filtercake removal before production
- creating fully packed horizontal sections that effectively prevent sand production and optimize production.

As horizontal wells get longer, completion challenges get bigger. Drilling highly deviated openhole wells provides huge production advantages—and huge challenges: unconsolidated sands, low fracture gradients, reactive shales, premature gravel settling, screen plugging, and proppant rate and concentration fluctuations.
**Integrated approach for openhole sand control**

The AquaPac water-packing system allows you to put a sand management plan into action that ensures gravel-pack efficiency and minimal risk of formation and completion hardware damage.

AquaPac water packing is an integrated approach that

- provides continuous formation stability before and during gravel placement and enables subsequent filtercake cleanup
- ensures complete gravel packing in formations with low fracture gradients
- mitigates the destabilization of shale sections
- uses lightweight proppants to place gravel throughout long, horizontal intervals
- optimizes the removal of reservoir drill-in fluid (RDF) deposits
- uses powerful software to design, execute, and evaluate the entire sand management strategy.

**Antiswab service tool—multiple benefits in a single trip**

When the wellbore features an unconsolidated sandface, stabilization of the open hole is vital to gravel-pack success. Equally as important is the ability to keep downhole tools in a constant position throughout treatment. Finally, efficient removal of the filtercake is critical once the gravel is placed, to allow maximum production.

The Schlumberger antiswab service tool combines an array of modules that address all of these functions. It permits constant hydrostatic pressure in the open hole to eliminate the swabbing effects of hardware movement within the wellbore, ensuring filtercake integrity before gravel placement.

The nonpressure-sensitive module isolates the packer-setting mechanism to prevent presetting caused by circulating pressures. As a result, washdown operations can take place first, the packer can be set, and gravel packing can be performed. After the excess gravel is screened out and reversed, the service tool washdown capabilities can be recovered to allow spotting of filtercake removal treatments. This single tool eliminates the in-and-out trip for a final cleanup run.

*The antiswab service tool incorporates five functional modules and eliminates the in-and-out trip for a final cleanup run.*
Reduced pressure and friction

Openhole completions through formations with low fracture gradients pose unique challenges for high gravel-pack efficiency. In AquaPac water-packing operations, gravel is placed in two waves. During the alpha wave, the gravel dune migrates evenly downward along the lower part of the hole. When the toe is packed, pressure increases as the beta wave carries the dune back toward the heel to fill the top part of the hole. This increased pressure can cause the formation to fracture. The resulting fluid losses can trigger the formation of a gravel bridge that disrupts the beta wave and leaves sections of the screen unpacked. Two key technologies are used to mitigate this type of challenge.

The first is AquaPac pressure attenuator, which mechanically reduces friction pressure by placing pressure-activated diverter valves along the washpipe to reduce the length of washpipe through which the returning gravel-pack carrier fluid must flow. Multiple diverter valves can be used simultaneously in the washpipe.

The second technology is AquaPac friction reducer. The friction reducer is pumped in the carrier fluid, reducing the friction pressure in the screen-washpipe annulus and in the washpipe.

The result in both cases is lower pressure and less friction in the openhole section.

AquaPac pressure attenuator and friction reducer operations are supported by SandCADE* gravel-pack design and evaluation software. The software not only predicts the number and placement of the necessary valves, it also takes those variables into consideration during simulations.
When in contact with water, reactive shales swell rapidly. The same shales remain unaffected when in contact with water treated with AquaPac shale stabilizer. Treated water-base completion fluids also inhibit undesirable reactions of formation shale that can lead to wellbore collapse, early screenout, and decreased production potential caused by polluted, low-permeable gravel packs.

**Shale stabilizer to help ensure well integrity**

Water packing across long open holes is highly effective until shale is encountered. Water-base fluids can cause shale to quickly swell, deteriorate, or both, resulting in wellbore instability and compromising gravel-pack slurry cleanliness. An unstable wellbore can collapse, preventing screen installation. If the screens are already in place, an unstable wellbore can cause incomplete gravel packing and screen exposure.

Another potential problem is water-induced spalling, or breaking up, of the shale. This can result in unwanted enlargement of the wellbore or formation collapse, either of which can also cause premature screenout. With spalling, the shale particles intermix with the transported gravel, impairing pack porosity and permeability and plugging the screen, blocking production, and causing costly completion failure.

AquaPac shale stabilizer is designed to prevent these problems. When added to almost any water-base completion fluid, it inhibits the destructive interactions between the brine and the shale. Testing has shown that the AquaPac shale stabilizer does not damage a formation, reduce gravel-pack permeability, or affect brine properties.

**Lightweight proppants—less settling, higher efficiency**

Premature gravel settling is another challenge in long, horizontal, openhole wells. To meet this challenge, we offer a range of low-density proppants that can be used in place of gravel. They are available in densities up to 60% lower than the density of sand (1.64 to 1.06 sg). Available in multiple mesh sizes and densities, these proppants meet API RP58 specifications for turbidity and crush resistance.

Lightweight proppants have lower settling rates and are more easily transported than sand. As a result, completions can be gravel packed at lower pumping rates, reducing the circulating pressures applied to the formation.
Filtercake removal—better, faster cleanup

Another key component of the AquaPac water-packing system is the MudSOLV NG* filtercake breaker service for openhole completions. This treatment focuses on designing the most effective openhole filtercake cleanup treatment, one that is specifically tailored to the completion environment and is driven by performance metrics and laboratory verification testing.

Schlumberger has developed chemicals and tools specifically for filtercake removal in openhole environments, replacing conventional corrosion-causing acid cleanups with treatments that use nonaggressive elements:

- chelating agent solutions to dissolve carbonate bridging materials
- an enzyme breaker to dissolve starch-based compounds in reservoir drilling fluid (RDF) filtercake
- the antiswab service tool, which allows fluid to be placed through the washpipe after gravel packing is completed
- jetting and cleanup tools that provide optimum hydraulic energy and effective placement of cleanup and breaker fluids.

With the MudSOLV NG service, filtercake is properly removed, uniform inflow velocity is achieved across the formation, and completion hardware is protected—all to extend the effectiveness and life of the completion.

Dedicated pumping equipment and operations

Water-packing jobs require precise pumping and mixing operations. Because brine has poor suspension capabilities, these operations rely on constant fluid circulation and low proppant concentration to ensure that gravel is properly packed around the screens. Rate fluctuations and spikes in proppant concentration can compromise a job.

The AquaPac system relies on Schlumberger pumping and mixing services to help ensure successful operations. Our dedicated sand control pumping equipment is designed for flexibility and for space limitations common in offshore environments. With their small footprint, our modular pumps and mixer skids can be easily rigged up on offshore platforms.

Both skids and vessels are equipped with the SandCAT* sand control computer-aided treatment data monitoring and recording system. This system allows synchronization and remote control of key equipment such as with the POD* programmable optimum density blender and the Hornet surface gravel-pack blender, to ensure that job execution accurately reflects the design. Precise control of proppant concentration is vital during gravel-packing operations. The POD and Hornet blenders precisely control the sand concentration at design values during the entire job, even at low pump rates and low solid-to-liquid ratios.
SandCADE software—design, execute, and evaluate
Sand control takes precision, which is why every AquaPac water-packing treatment begins above ground—with SandCADE® gravel-pack design and evaluation software. This software suite allows Schlumberger to combine all AquaPac system elements and design the ideal gravel-pack strategy before a job begins. Various simulations are run, and numerous critical parameters are manipulated, such as carrier fluid, gravel size, concentration, pump rate, fluid leakoff, surface returns, and hardware configuration. Analysis of these simulations leads to the development of the optimal treatment design.

On the job site, Schlumberger uses this design to execute the treatment program. Tests are run on site, and the resulting data are used to fine-tune the design. SandCADE software collects data throughout the job and uses it to conduct the postjob analysis. The results of this evaluation demonstrate the success of the project, build knowledge and experience, and continuously improve performance.

Comprehensive approach to sand control
Schlumberger tackles openhole environments with an engineering-driven, total-system approach that features the tools, fluid chemistries, technologies, software, services, and people needed to extend the life of long, horizontal intervals and to optimize production.

With the Transcend® family of services and products, we can help you design your sand control treatments with precision, mitigate risks up front, preserve the integrity of your completion, and optimize reservoir recovery.

Identify challenges and evaluate your options with SandCADE software. By simulating different cases, you can optimize your operation and find the solution that best fits your environment.
The Transcend family of sand management services for openhole completions is supported by Schlumberger dedicated experts worldwide who understand the countries, regions, and formations where your projects are located.

With our extensive portfolio of services and products and multidisciplinary industry expertise, we will help you tailor your openhole completions to achieve effective sand control for the life of your well and reservoir and to maximize the performance of your completion.

Contact Schlumberger today.

Transcend
Openhole sand management services

- Screens and ICDs
- AquaPac integrated water-packing system
- OptiPac Alternate Path gravel-packing system
- IntelliPac distributed temperature measurements in real time

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