SandWedge® ABC Aqueous-Based Conductivity Enhancement Service

Technology Advancement Provides HSE and Operational Benefits for Both Primary and Remedial Treatments

Halliburton's continuing research focused on achieving highly conductive fractures has resulted in a new aqueous-based version of SandWedge® enhancer service. The new version delivers all the benefits of Halliburton's proprietary conductivity enhancement technology and adds the benefits of providing improved health, safety and environmental (HSE) performance while being operationally more efficient, versatile and reliable. The aqueous-based system also enables important applications in remedial treatments.

Applicable for Treating Both New and Existing Proppant Packs

Since SandWedge ABC enhancer is an aqueous-based system it can be added directly to water-based treating fluids. This means it is now possible to better maintain initial productivity with pre-treatment or with remedial treatment to help control further damage caused by fines invasion and migration in existing propped fractures and to minimize subsequent fines damage.

The aqueous-based carrier system also enables SandWedge ABC enhancer to be used as part of the fracturing fluid system.

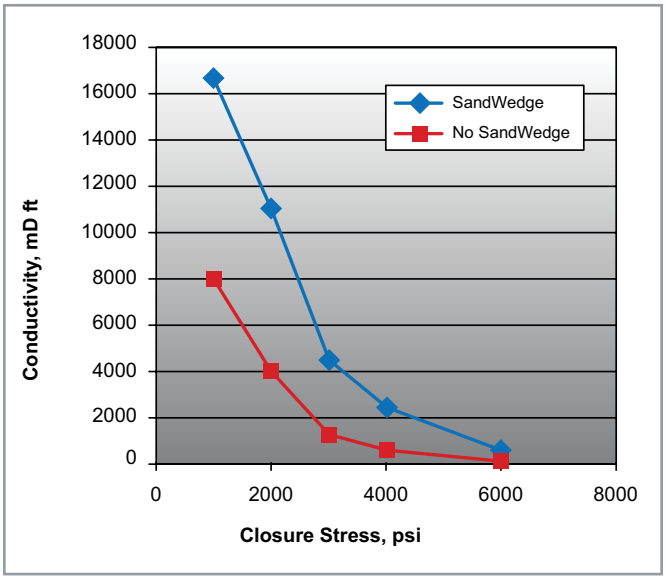

Figure 1 – Coating proppant with SandWedge enhancer typically results in conductivity enhancement of 20 to 30% when measured with base brines. When conductivity is determined utilizing actual complete fracturing fluid, the enhancement is typically a 100 to 200% improvement. Improved conductivity contributes to better frac fluid cleanup and increased long-term production.

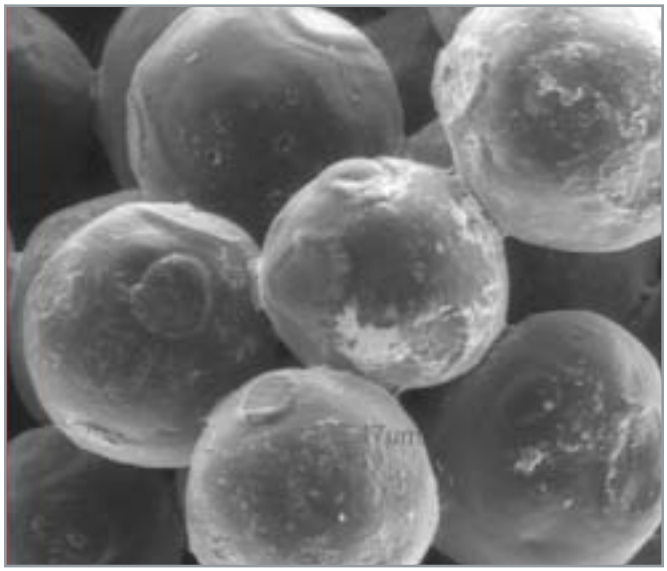

Figure 2—SandWedge ABC enhancer coats the proppant causing it to become permanently tacky to help control intrusion of formation material (fines) into the proppant pack, reduce proppant settling and help maintain proppant strength—all leading to improved long-term conductivity.

SandWedge ABC Enhancer Delivers Well-Proven Benefits Plus New Capabilities

- Helps maintain a high production rate for a longer period of time.
- Provides improved HSE performance and reliability.
- Enhances frac fluid clean-up (Figure 1).
- Highly effective in both hard rock and unconsolidated formations for primary or remedial applications (Figure 2).
- When SandWedge ABC enhancer is included in the pad fluid, proppant grains adhere to the formation face, minimizing premature proppant settling (Figure 3).
- Enables treatment of existing proppant packs to help prevent further damage caused by fines invasion (Figures 4 and 5).
- Inhibits adverse geochemical precipitates to reduce the effects of diagenesis (Figure 6).
- Inhibits scale formation in treated proppant pack (Figures 7 and 8).

Improves HSE Performance and Reliability

With SandWedge ABC enhancer, the onset of tackiness is delayed which means the mixing equipment does not become coated with sticky material. This eliminates the need for special solvents on location, reducing environmental exposure. In addition, the coating process is improved resulting in more uniformly coated proppant.

SandWedge ABC enhancer can be used to treat most wells from low temperature to more than 450ºF to provide improved and sustained fracture conductivity.

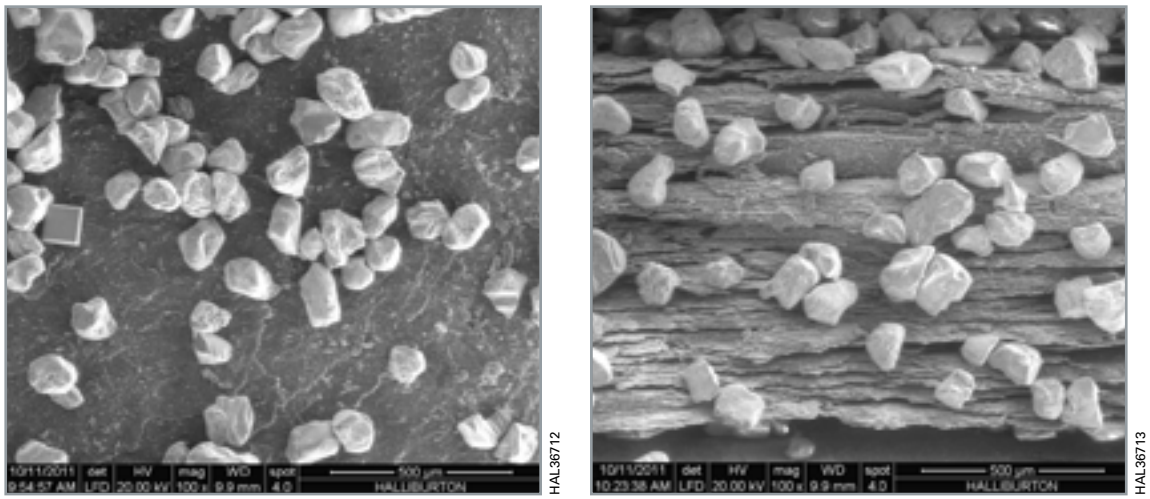

Figure 3—Adding SandWedge ABC agent to the fracturing pad fluid results in the fracture faces becoming adhesive and attracting proppant particles, anchoring the particles in place. This action minimizes premature proppant settling. Experiments were performed to demonstrate the effectiveness of treating fracture faces of shale cores with diluted SandWedge ABC solution prior to exposing to fracturing fluid containing 70/170-mesh Oklahoma No. 1 sand. The proppant particulates readily adhered to the treated fracture faces. In the photo on the left, the core was fractured parallel to the bedding planes and on the right the core was fractured perpendicular to the bedding planes.

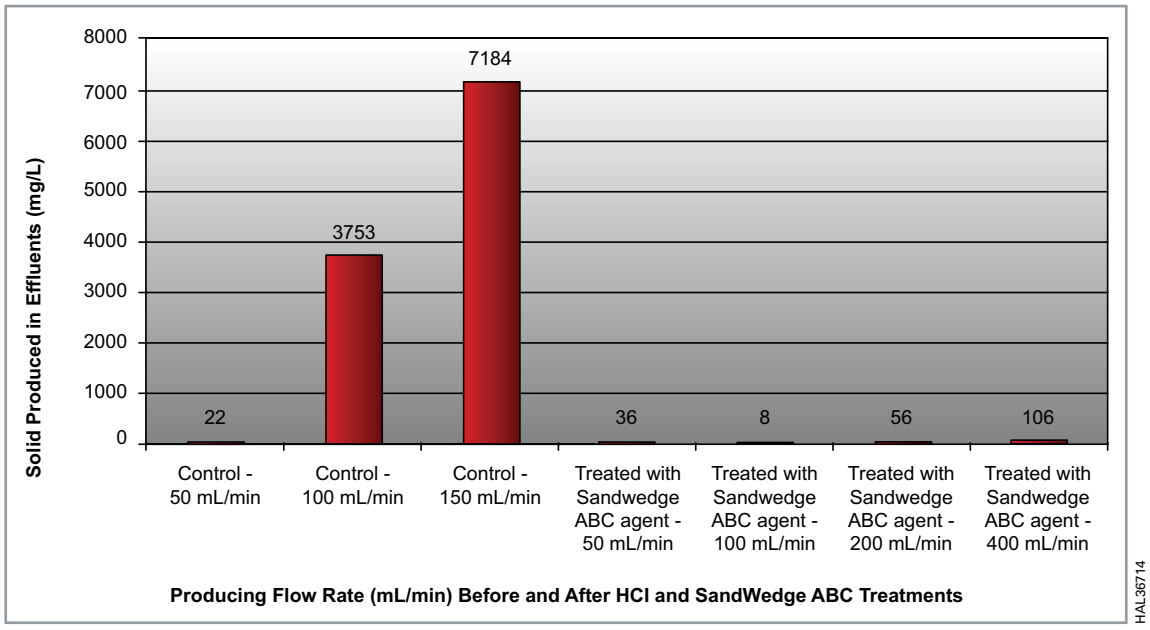

Figure 4—This graph shows total suspended solids in effluents collected at increasing flow rates, before and after treatments of 15% HCl acid and diluted SandWedge ABC solution. An acid treatment was introduced to the sand pack that was damaged by invaded formation fines, sand, or scale buildup to remove these materials. After the acid treatment, a diluted SandWedge ABC solution was used to treat the sand pack to lock the formation sand and fines in place. Notice that at over twice the flow rate, solids production was virtually negligible after the sand pack was treated with SandWedge ABC agent.

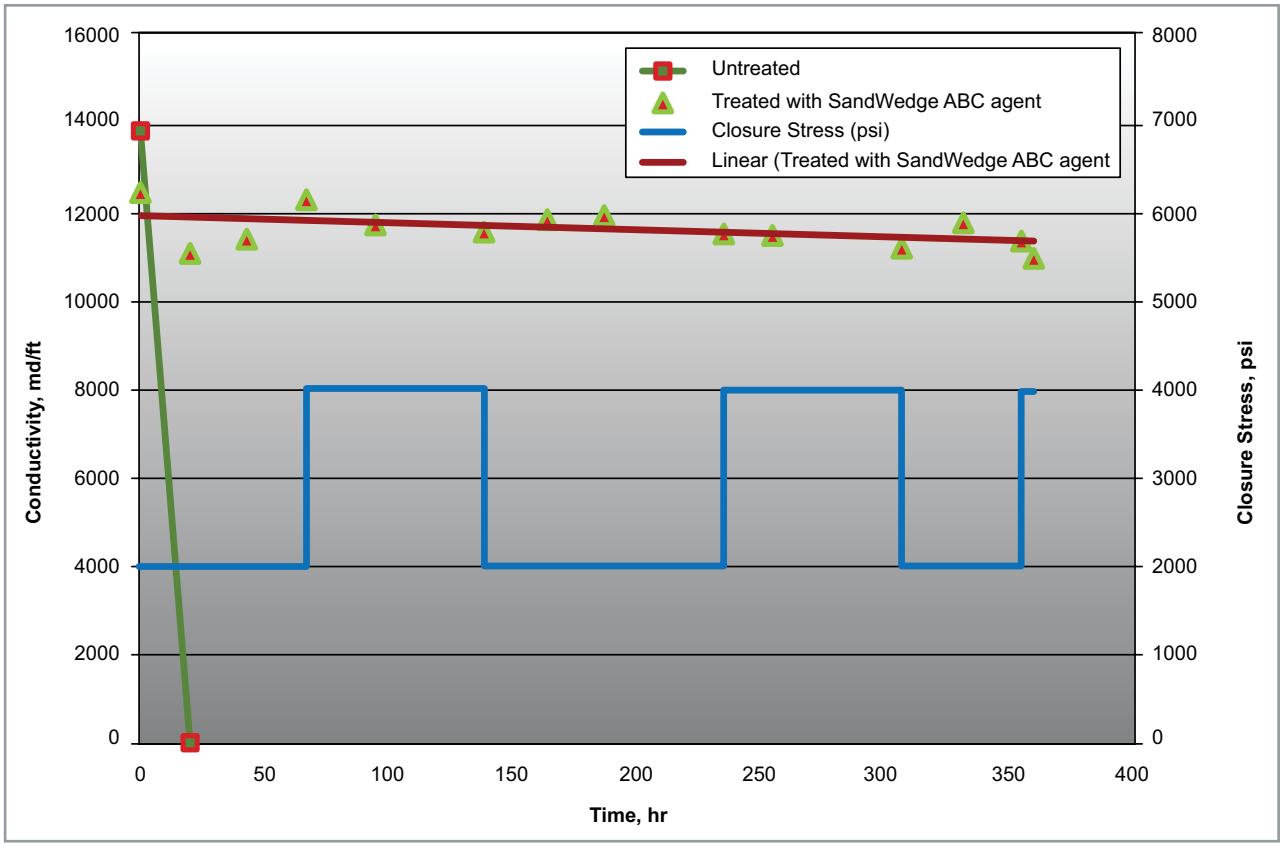

Figure 5—Using a standard API conductivity cell, conductivity was compared between unconsolidated sand packs with and without SandWedge ABC enhancer. Silica flour was used in simulating the unconsolidated formation. Lightweight ceramic proppant was used as a propping material with loading concentration of 5 lb/ft². Testing was performed at 180°F and closure stresses of 2,000 and 4,000 psi. The stress cycle was repeated several times with the results indicating that the treatments were effectively stabilizing the unconsolidated fines that made up the formation. Note that conductivity declined to zero after only about 20 hr in the untreated sample but remained high throughout the stress cycles in the sample treated with SandWedge ABC agent.

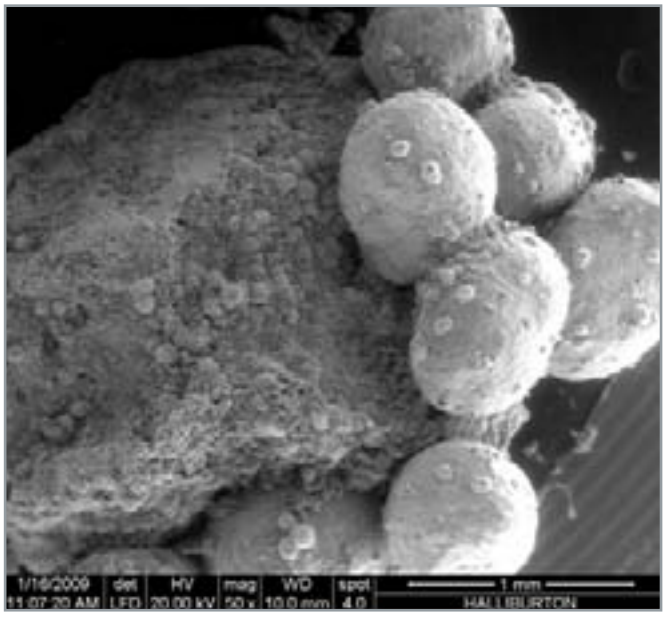

Figure 6– Geochemical scaling and proppant corrosion reactions can lead to permeability damage and rapid degradation of proppant strength as shown here for an alumina-based proppant fused to a Haynesville shale sample.

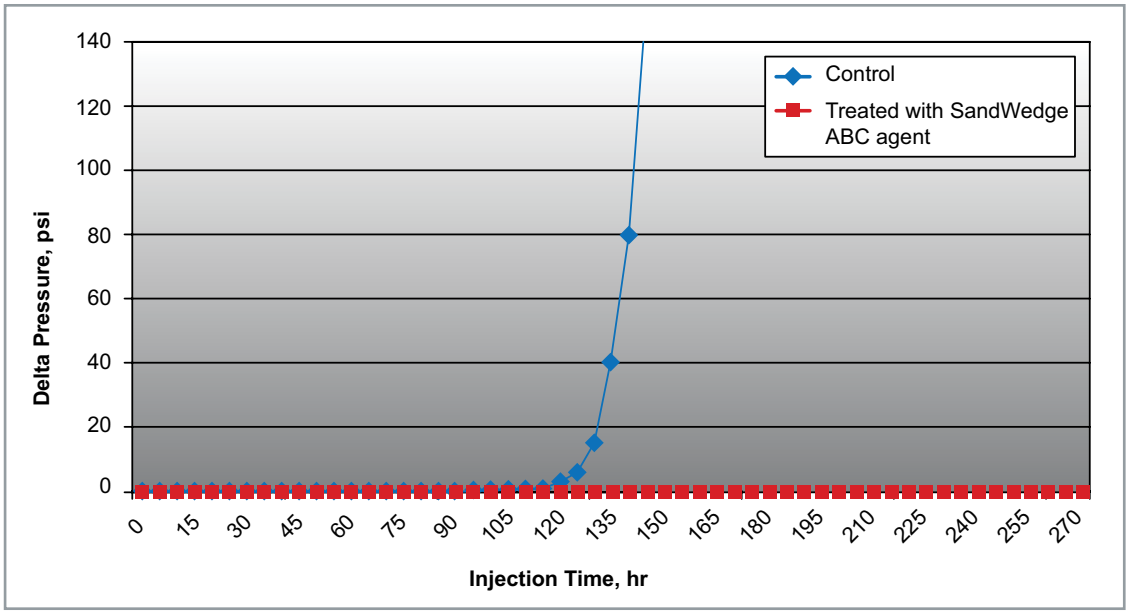

Figure 7—Pressure profiles resulting from flowing scale-forming brines through a control proppant pack (i.e., without treatment) and through a proppant pack treated with diluted SandWedge ABC solution. Brady sand (20/40-mesh) was packed in the Teflon flow cell to simulate the proppant pack. As scale was formed in the control proppant pack, delta pressure increased rapidly indicating scale solids were plugging the pore space within the pack. In contrast, no increase in pressure drop across the SandWedge ABC agent-treated proppant pack was observed.*

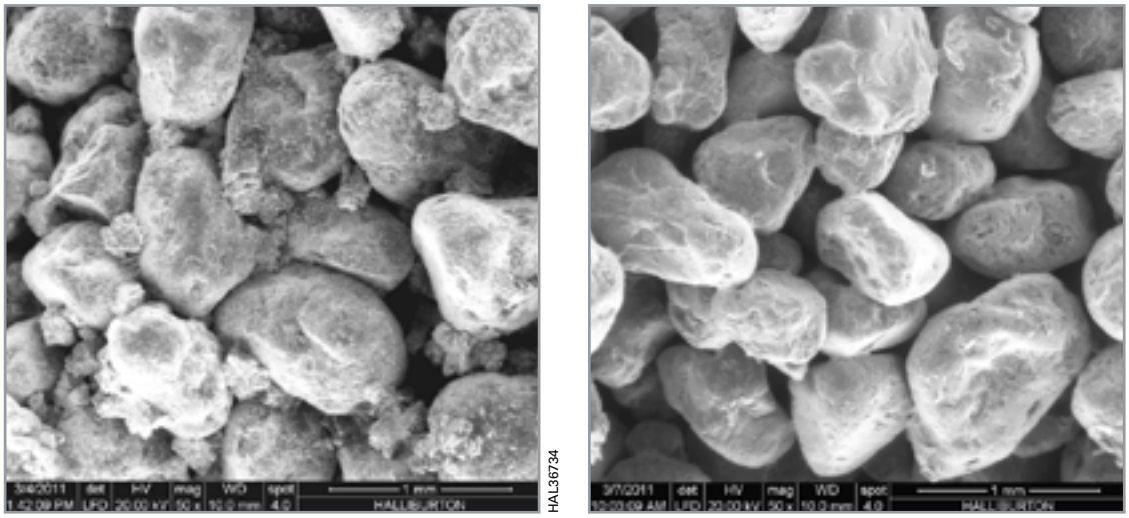

Figure 8—Scanning electron microscope (SEM) images of the control and the SandWedge ABC agent-treated proppant packs used in the scale testing show that in the untreated proppant pack (left) scale precipitate formed in the pore spaces. The precipitate solids were confirmed by energy-dispersive x-ray (EDX) analysis to have formed resulting from the reaction between two injected scale-forming brines. The treated pack (right) subjected to the same conditions showed that SandWedge ABC solution helped control the formation of scale within the proppant pack.

For more information about how SandWedge® ABC conductivity enhancer can help you achieve improved long-term production and your HSE profile, contact your local Halliburton representative or email stimulation@halliburton.com.

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