GasPerm 1000℠ Service
Helps Control Fracture Face Damage and Boost Production from Unconventional Gas Reservoirs

New GasPerm 1000℠ service provides important benefits to help get production from unconventional gas reservoirs on-line faster and at higher rates:
• Helps reduce damage due to phase trapping (Figure 1).
• Enhances mobilization of liquid hydrocarbons including condensate.
• Helps increase regained permeability to gas following treatment.
• Improves load recovery.
• GasPerm 1000℠ additive replaces methanol for water block applications.
• Improves environmental and safety performance over existing alternatives.

GasPerm 1000 additive is a patent-pending formulation available only from Halliburton.

Applications
GasPerm 1000 service is designed for unconventional reservoirs including tight gas, shales and coal bed methane. A microemulsion surfactant, GasPerm 1000 additive modifies the contact angle toward 90°. Upper temperature range of the GasPerm 1000 additive is greater than 330°F. It is compatible with both acidic and basic fluid systems and can be used as an acidizing additive or fracturing fluid additive. It has been shown to be substantially nondamaging to formation gas permeability (Figure 2).

Improved Environmental and Safety Performance
GasPerm 1000 additive is free of NPE components and can be used in place of methanol. When run as an additive at field use concentration, GasPerm 1000 additive reduces flammability risk as compared to methanol at concentrations typically used for water block treatment applications.

Fracture Face Damage – A Major Factor in Producing Ultra Low Permeability Reservoirs
Halliburton continues to focus on problem identification in order to define system and chemical requirements to help minimize damage to the formation. In fracturing, major research is focused on mitigating damage to the fracture face. Reducing the fracture face damage caused by wettability issues can substantially increase regained permeabilities in

Figure 1 - Photomicrograph shows the effects of phase trapping that can occur during a fracturing treatment. This process is especially pronounced in conjunction with water frac in ultra tight gas formations. The discontinuous phase greatly reduces the gas permeability. GasPerm 1000 service has been shown to help enable the trapped phase such as imbibed water to flow freely from the rock matrix and fracture system resulting in significantly improved permeability to gas.

Figure 2 - Summary results of tests conducted by a third-party laboratory showed that a crosslinked borate commingled nitrogen fluid containing GasPerm 1000 additive caused no damage to the formation gas permeability.
unconventional reservoirs. The proprietary GasPerm 1000 service agent is the initial result of this ongoing research. In addition, this research has resulted in the development of a numerical simulator that helps in understanding the complex relationship among relative permeability to gas, both imbibition and drainage conditions, relative permeability to water, capillary pressure curves, etc. Capillary pressure is well known to be permeability dependant. The increase of capillary pressure as a result of damage (loss of permeability) is responsible for the increase in water saturation in the damage zone, which ultimately results in low productivity. Figure 3 shows how GasPerm 1000 service outperforms conventional, methanol-based formulations in terms of wellhead pressure and regained permeability.

**Case History**

**GasPerm 1000 Service Helps Achieve a 14-Fold Increase in Wellhead Pressure**

Texas – A Cotton Valley tight gas sand well was fracture stimulated using Halliburton’s suite of products designed to help improve water frac results. The GasPerm 1000 service included a version of SandWedge® enhancer especially formulated for water fracs and OptiKleen-WF™ agent. Results: Over 14 times the wellhead pressure and almost twice the initial production.

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**Figure 3** - A comparison test performed in an ultra-low perm tight gas sand formation from the Rockies by a third-party laboratory showed that under comparable conditions, the formulation containing GasPerm 1000 additive outperformed a conventional methanol-based formulation. As shown in the graph, the fluid system containing GasPerm 1000 additive flowed at a much lower pressure and regained greater than 100 percent of the pretreatment gas permeability, indicating stimulation of the matrix permeability to gas.

**Figure 4** - The graph shows initial production results comparing a GasPerm 1000 service treated well and a conventionally treated offset well in a Cotton Valley tight gas formation in Texas. At an equivalent time on production, the conventionally treated well showed a wellhead pressure of 100 psi as compared to the GasPerm 1000 service treated well which exhibited a wellhead pressure of 1,400 psi. Gas production at the point of comparison was 862 MMcf/d for the conventionally treated well and 1,432 MMcf/d for the GasPerm 1000 service-treated well.

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For more information about how GasPerm 1000SM service can help make your unconventional gas assets more profitable, contact your local Halliburton representative or email stimulation@Halliburton.com.

www.halliburton.com