What is Galanol™ ?

Galanol™ is a series of modified water-soluble polymers made from a galactomannan polysaccharide – Guar Gum including their derivatives for applications in oil, gas and other deep wells as:

- A thickener and fluid loss control agent in drilling muds and fluids.
- A friction reducing agent.
- A Gelling agent and propping medium carrier in fracturing fluids
- Flocculation of drill cuttings.
- Sand consolidation and lost circulation plugging.
- A general viscosifier for workover fluids.
- A Fluid Rheology modifier in sand control.
- A Pad fluid thickener in fracture acidizing.
- Gelling Agent in Hydraulic Fracturing Fluids.

Galanol™ is available in several grades with a variety of viscosities, particle size distributions, hydration rates and specific properties to suit every need. Detailed specification sheets are available on request. Specialised "tailor-made" products are possible.

Characteristics and compatibility

Galanol™ is effective in fresh water, sea water and complex brine low solids drilling systems. It is non-polluting, non-toxic and is compatible with other drilling fluid additives. Biodegradation of **Galanol™**solutions during long periods of drilling can be prevented by addition of a suitable preservative to the drilling fluid.

Recommended concentrations

Application concentrations of **Galanol™** vary according to drilling conditions, properties desired and the grade of **Galanol™** being used. We recommended pre-testing to arrive at the right concentration of **Galanol™** that must be used in any given system. In general, the following may be used as a guideline:

Application	Usage level
Thickener and fluid loss control agent in low solids saline muds. (will also act as friction reducer)	0.5% to 1.5 Lbs/BBL (1.43 to 4.28 Kgs/1000 Ltrs) = 0.14% - 0.43%
Friction reducing agent.	5.0 to 20.0 Lbs/1000 Gal (0.6 to 2.4 Kgs/1000 Ltrs) = 0.06% to 0.24%
Gelling agent and carrier in fracturing treatments.	0.2 to 2.5 Lbs/BBL (1.8 to 7.2 Kgs/1000 Ltrs) = 0.18% to 0.72%
Flocculation of drill cuttings in clear water and emulsion systems.	0.1 to 0.3 Lbs/BBL (0.29 to 0.86 Kgs/1000 Ltrs) = 0.029% to 0.086%
Temporary stiff gel lost circulation plugs.	Lbs/BBL (5.71 Kgs/1000 Ltrs) + 3% W/W Borates. Adjust pH to 8.5. Gives acid reversible gels.

In general addition rates of 0.5 to 1.5 Lbs/BBL (1.43 to 4.28 Kgs/1000 Ltrs.) are sufficient for most applications.

Dispersion

Galanol™ solutions require some care during dispersing, in order to achieve a homogeneous solution and to prevent the formation of lumps. Speciality dispersible grades are available. We recommend any of the following methods to achieve a uniform and lump-free dispersion:

- sprinkle **Galanol™** into the liquid under high speed stirring.
- add **Galanol™** slowly into the Vortex of a high-speed stirrer.
- drymix **Galanol™** with other solid ingredients before adding to the liquid.
- add **Galanol™** to solvents like diesel, glycols etc.

Galanol™ in Hydraulic Fracturing Fluids

Several types of **Galanol™** maybe used for applications in Oil and gas Hydraulic Fracturing Fluids:

- Modified **Galanol™** – several different grades.
- **Galanol™** Derivatives like **Hydroxypropyl Guar (HPG) and Carboxymethyl Hydroxypropyl Guar (CMHPG).**

The types and use of fracturing fluids have evolved greatly over the past 60 years and continue to evolve. The U.S. oil and gas industry has used fluids for fracturing geologic formations since the early 1940s. Available scientific literature indicates that hydraulic fracturing fluid performance became a prevalent research topic in the late 1980s and the 1990s.

The main goal of hydraulic fracturing is to create a highly conductive fracture system that will allow flow through the zone to the production well used to extract gas and oil. Hydraulic fracturing fluids are used to initiate and/or expand fractures, as well as to transport proppant into fractures. Proppants are sand or other granular substances injected into the formation to hold or “prop” open coal formation fractures created by hydraulic fracturing. The viscosity of fracturing fluids is considered when they are formulated, to provide for efficient transport and placement of proppant into a fracture.

Types of Fracturing Fluids and Additives

Service companies have developed a number of different oil-based and water-based fluids and treatments to more efficiently induce and maintain permeable and productive fractures. The composition of these fluids varies significantly, from simple water and sand to complex polymeric substances with a multitude of additives. Each type of fracturing fluid has unique characteristics, and each possesses its own positive and negative performance traits. For ideal performance, fracturing fluids should possess the following four qualities:

- Be viscous enough to create a fracture of adequate width.
- Maximize fluid travel distance to extend fracture length.
- Be able to transport large amounts of proppant into the fracture.
- Require minimal gelling agent to allow for easier degradation or “breaking” and reduced cost.

Water-based fracturing fluids have become the predominant type of fracturing fluid. However, fracturing fluids can also be based on oil, methanol, or a combination of water and methanol. Methanol is used in lieu of, or in conjunction with, water to minimize fracturing fluid leakoff and enhance fluid recovery. Polymer-based fracturing fluids made with methanol usually improve fracturing results, but require 50 to 100 times the amount of breaker (e.g., acids used to

degrade the fracturing fluid viscosity, which helps to enhance post-fracturing fluid recovery). In some cases, nitrogen or carbon dioxide gas is combined with the fracturing fluids to form foam as the base fluid. Foams require substantially lower volumes to transport an equivalent amount of proppant. Diesel fuel is another component of some fracturing fluids although it is not used as an additive in all hydraulic fracturing operations. A variety of other fluid additives (in addition to the proppants) may be included in the fracturing fluid mixture to perform essential tasks such as formation clean up, foam stabilization, leakoff inhibition, or surface tension reduction. These additives include biocides, fluid-loss agents, enzyme breakers, acid breakers, oxidizing breakers, friction reducers, and surfactants such as emulsifiers and non-emulsifiers. Several products may exist in each of these categories. On any one fracturing job, different fluids may be used in combination or alone at different stages in the fracturing process. Experienced service company engineers will devise the most effective fracturing scheme, based on formation characteristics, using the fracturing fluid combination they deem most effective.

A substantial number of fracturing treatments are completed using thickened, water-based linear gels. **Galanol™** is typically used as the gelling agents in these fracturing fluids.

To formulate a viscous fracturing gel, **Galanol™** is dissolved in a carrier fluid such as water or diesel fuel. Increased viscosity improves the ability of the fracturing fluid to transport proppant and decreases the need for more turbulent flow.

Diesel fuel has been frequently used in lieu of water to dissolve **Galanol™** because its carrying capacity per unit volume is much higher. Diesel is a common solvent additive, especially in liquid gel concentrates, used by many service companies for continuous delivery of gelling agents in fracturing treatments. Diesel does not enhance the efficiency of the fracturing fluid; it is merely a component of the delivery system. Using diesel instead of water minimizes the number of transport vehicles needed to carry the liquid gel to the site.

The percentage of diesel fuel in the slurried thickener can range between 30 percent and almost 100 percent. Slurried diesel and gel are diluted with water prior to injection into the subsurface. The dilution is approximately 4 to 10 gallons of concentrated liquid gel (**Galanol™** slurried in diesel) per 1,000 gallons of make-up water to produce an adequate polymer slurry.

Cross-linked Gels

One major advance in fracturing fluid technology was the development of cross-linked gels. The first cross-linked gels were developed in 1968. When cross-linking agents are added to linear gels, the result is a complex, high-viscosity fracturing fluid that provides higher proppant transport performance than do linear gels. Cross-linking reduces the need for fluid thickener and extends the viscous life of the fluid indefinitely. The fracturing fluid remains viscous until a breaking agent is introduced to break the cross-linker and, eventually, the polymer. Although cross-linkers make the fluid more expensive, they can considerably improve hydraulic fracturing performance, hence increasing well production rates.

Galanol™ cross-linked gels maybe cross-linked with sodium tetraborate decahydrate, Titanium and Zirconium salts etc. The cross-linking techniques are well known to those skilled in the art. The final concentration of cross-linkers is typically 1 to 2 gallons of cross-linker per 1,000 gallons of gel.

Fluid Additives

The Fracturing Fluid may contain several fluid additives to enhance the efficiency and increase the success of fracturing fluid treatments.

Breakers

Breaker fluids are used to degrade the fracturing fluid viscosity, which helps to enhance post-fracturing fluid recovery, or flowback. Breakers can be mixed with the fracturing fluid during pumping, or they can be introduced later as an independent fluid. There are a variety of breaker types including time-release and temperature-dependent types. Most breakers are typically acids, oxidizers, or enzymes.

Biocides

One hydraulic fracturing design problem that arises when using organic polymers in fracturing fluids is the incidence of bacterial growth within the fluids. Due to the presence of organic constituents, the fracturing fluids provide a medium for bacterial growth. As the bacteria grow, they secrete enzymes that break down the gelling agent, which reduces the viscosity of the fracturing fluid. Reduced viscosity translates into poor proppant placement and poor fracturing performance. To alleviate this degradation in performance, biocides, bactericides, or microbicides are added to the mixing tanks with the polymeric gelling agents to kill any existing microorganisms (e.g., sulphate-reducing bacteria, slime-forming bacteria, algae), and to inhibit bacterial growth and deleterious enzyme production. Typical dilution in the make-up water is 0.1 to 0.2 gallons of microbicide in 1,000 gallons of water.

Fluid-Loss Additives

Fluid-loss additives restrict leakoff of the fracturing fluid into the exposed rock at the fracture face. Because the additives prevent excessive leakoff, fracturing fluid effectiveness and integrity are maintained. Fluid-loss additives of the past and present include bridging materials such as 100 mesh sand, 100 mesh soluble resin, and silica flour, or plastering materials such as starch blends, talc silica flour, and clay.

Friction Reducers

To optimize the fracturing process, water-based fluids must be pumped at maximum rates and fluids must be injected at maximum pressures. Increasing flow velocities and pressures in this manner can lead to undesirable levels of friction within the injection well and the fracture itself. In order to minimize friction, friction reducers are added to water-based fracturing fluids.

Acid Corrosion Inhibitors

Corrosion inhibitors are required in acid fluid mixtures because acids will corrode steel tubing, well casings, tools, and tanks. The solvent acetone is a common additive in corrosion inhibitors. These products are diluted to a concentration of 1 gallon per 1,000 gallons of make-up water and acid mixture.

Proppants

The purpose of a proppant is to prop open a hydraulic fracture. An ideal proppant should produce maximum permeability in a fracture. Fracture permeability is a function of proppant grain roundness, proppant purity, and crush strength. Larger proppant volumes allow for wider fractures, which facilitate more rapid flowback to the production well. Over a period of 30 minutes, 4,500 to 15,000 gallons of fracturing fluid will typically transport and place approximately 11,000 to 25,000 pounds of proppant into the fracture.