

POLYSLIP OF-50 Polymer

A Multi-Purpose Polymer

For oil field applications in:

- Drilling
- Completion
- Stimulation
- Production

A multi-purpose polymer for oilfield applications

POLYSLIP™ OF-50 Polymer is a nonionic polyethylene oxide homopolymer that is completely soluble in water and many organic liquids. POLYSLIP OF-50 Polymer is compatible with most Oil Field Polymers. Specifically designed for the oil field, POLYSLIP OF-50 Polymer is a free-flowing granular product that facilitates the preparation of clear homogeneous fluids. Disposal of POLYSLIP OF-50 Polymer is convenient because of its low toxicity and complete water solubility.

Drilling

There are significant drilling benefits to be gained in using POLYSLIP OF-50 Polymer as it increases penetration rate and reduces bit wear. This has been shown in the geological survey conducted in 1994 by the New South Wales Department of Mineral Resources Sidney (Australia) in which are illustrated an increase in the penetration rate of 24% during core drilling and 146% during open holing of granite as well as an increase of 95% in bit life during initial core drilling of volcanic sandstones sequences.

The ability of POLYSLIP OF-50 Polymer to resist biological attack while thickening and lubricating water-based drilling fluids is a unique advantage of this versatile polymer. The properties of solutions containing POLYSLIP OF-50 Polymer add the dimension of fluid loss control at the well bore interface. Not only is strata plugging and loss of valuable fluid minimized by the addition of POLYSLIP OF-50 Polymer, but minimal formation damage occurs due to the clean breaking properties inherent in POLYSLIP OF-50 Polymer.

Fracturing

POLYSLIP OF-50 Polymer offers specific advantages in acidizing and fracturing. The ability of POLYSLIP OF-50 Polymer to resist acid degradation, so common to natural and cellulosic polymers, offers the user a unique opportunity to thicken acids commonly used in stimulation applications in conjunction with minimal formation damage after breakage. POLYSLIP OF-50 Polymer reduces foam drainage by a combination of thickening efficiency and pseudoplastic behavior, resulting in foam stabilization. This advantage, coupled with POLYSLIP OF-50 Polymer's most unique and fascinating ability to reduce friction, due to its exceptionally long, linear polymer chains, provides high value in fracturing applications.

Flocculation

In flocculation applications where the polymer bridging mechanism controls the flocculation rate, such as flow line or reserve pit flocculation in drilling operations, POLYSLIP OF-50 Polymer excels. The polymer's high affinity for finely divided silicas and clays, in conjunction with its low level of toxicity and related EPA and FDA status, offer unsurpassed advantages as a flocculant.

POLYSLIP OF-50 Polymer offers the following advantages in Oil Field Applications:

- **Completely Water Soluble** — POLYSLIP™ OF-50 Polymer is completely soluble up to the boiling point.
- **Lubricating** — when wetted with water, the unique slippery property of POLYSLIP OF-50 Polymer enables to increase penetration rates and reducing bit wear during drilling.
- **High Thickening Efficiency** — POLYSLIP OF-50 Polymer is a linear high molecular weight polymer.
- **Non-Damaging** — Common oil field breakers yield non-damaging residues of POLYSLIP OF-50 Polymer, resulting in minimal damage to producing formations.
- **Acid Thickener** — POLYSLIP OF-50 Polymer is unique in its ability to thicken oil field acids.
- **Friction Reduction** – Molecular configuration results In dramatic reduction of hydrodynamic drag.
- **Flocculation** — By bridging, colloidal material is concentrated as larger particles which quickly separate from suspension.
- **Resistant to Biological Attack** — Superior resistance over natural and cellulosic polymers.
- **Foam Stabilization** – reduces foam drainage by a combination of thickening and pseudoplastic behavior
- **Compatibility with other Oil Field Products** — Wide range of polymers, defoamers, inhibitors, antimicrobials, etc. are compatible with POLYSLIP OF-50 Polymer.
- **Minimal Pollution** – POLYSLIP OF-50 Polymer offers a very low level of toxicity and environmental concerns.
- **Soluble in Organic Solvents** — POLYSLIP OF-50 Polymer is soluble in a wide range of organic solvents used in oil field applications.

Non-Damaging

The non-damaging properties of POLYSLIP Polymers have been well documented¹. Completion fluids made up of POLYSLIP Polymer solutions were shown to regain 100 percent of their permeability after reverse flow. The data are shown in Table 1.

Table 1

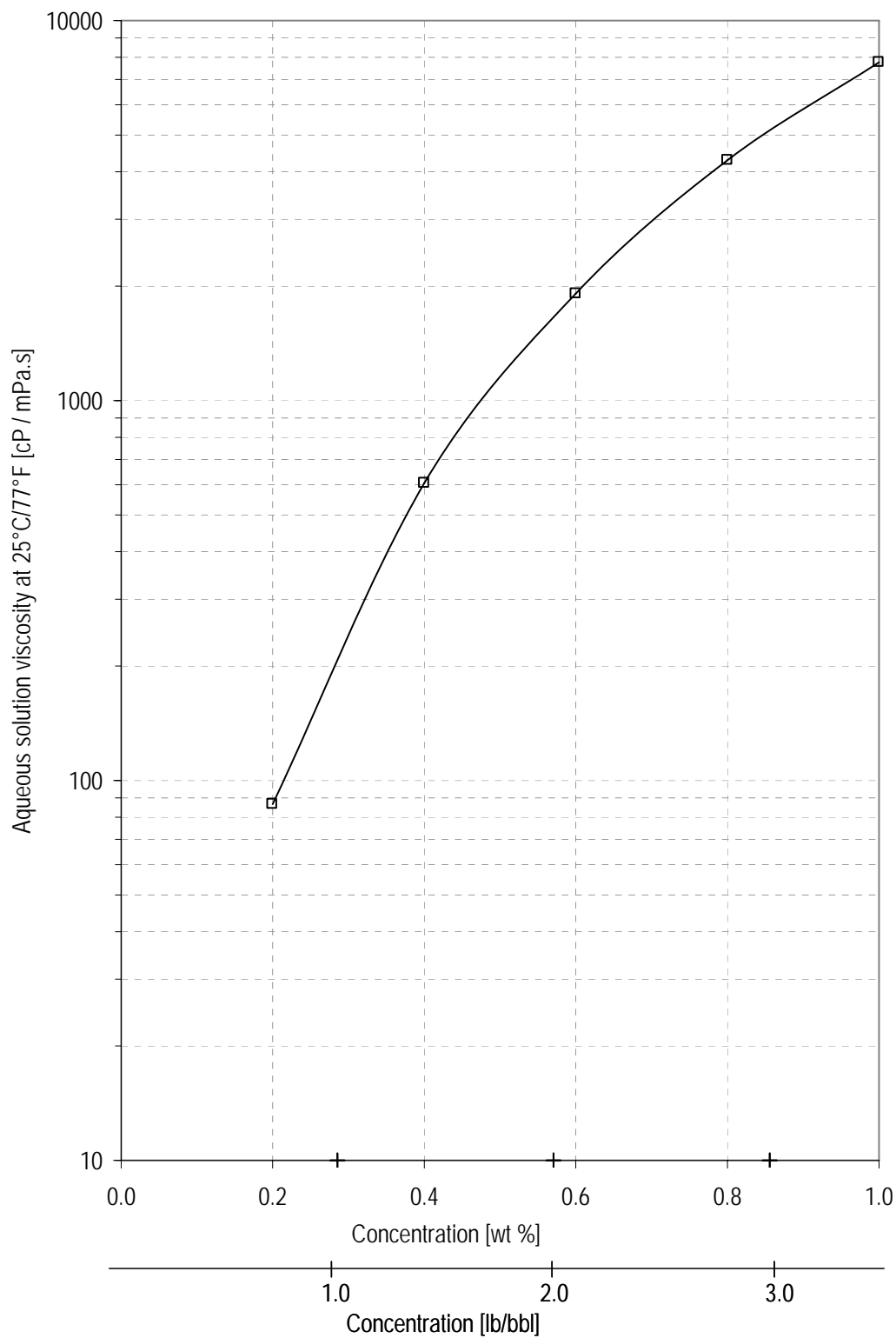
Core Type	Polymer Solution (in 5% brine)	% of Original Permeability to Brine ² (forward)	% of Original Permeability to Brine ² (reverse)
2400 md Cypress sand	0.3% POLYSLIP Polymer*	100	100
740 md Cypress sand	0.3% POLYSLIP Polymer	100	100
230 md Berea sand	0.3% POLYSLIP Polymer	100	100
4 md Bedford lime	0.3% POLYSLIP Polymer	100	100

1. Tuttle and Bartman, SPE Paper 1741. "The Need for Non-Damaging Drilling and Completion Fluids"
2. Permeability measured to 5% brine after resaturating core with brine for a period ranging from 2 to 24 hours following the polymer flood.
3. A close parent grade of POLYSLIP OF-50 Polymer has been used in these tests.

Viscosity

POLYSLIP™ OF-50 Polymer is soluble in fresh water, sea water and 8 lbs/ bbl potassium chloride brine. A typical viscosity efficiency curve measured with a Brookfield viscometer is shown in Figure 1.

Figure 1 • Brookfield Solution Viscosity vs. POLYSLIP OF-50 Polymer Concentration

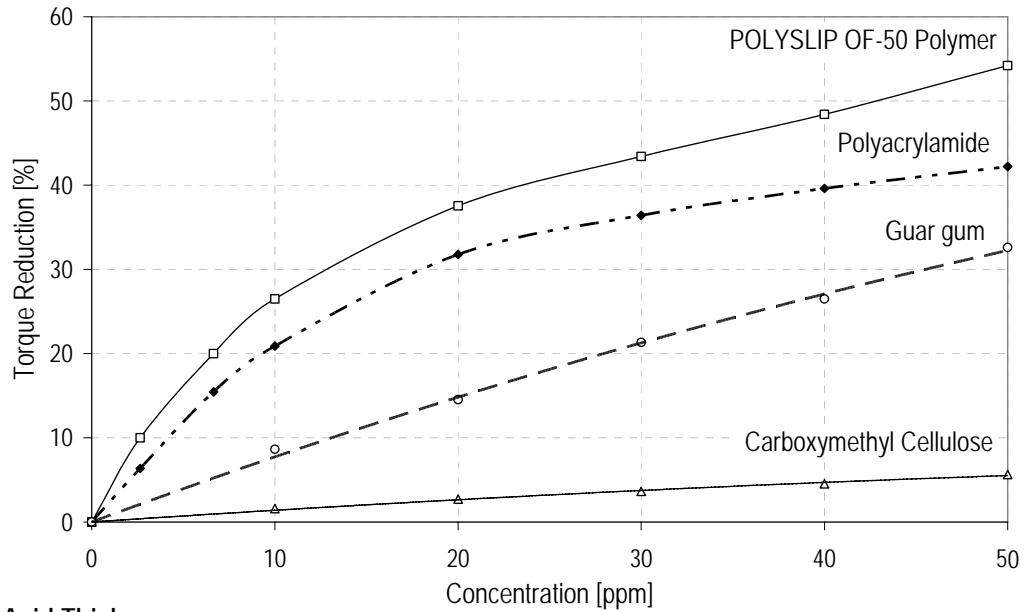


Friction Reduction

Low concentrations of POLYSLIP OF-50 Polymer will improve the flow properties of water-based fluids. The ability to reduce drag is a property of many polymers, but POLYSLIP OF-50 Polymer is especially efficient in this respect.

In Figure 2 the friction reduction property of POLYSLIP OF-50 Polymer is compared to other polymers. The data were determined by measuring the decrease in torque necessary to rotate an immersed disc at constant RPM.

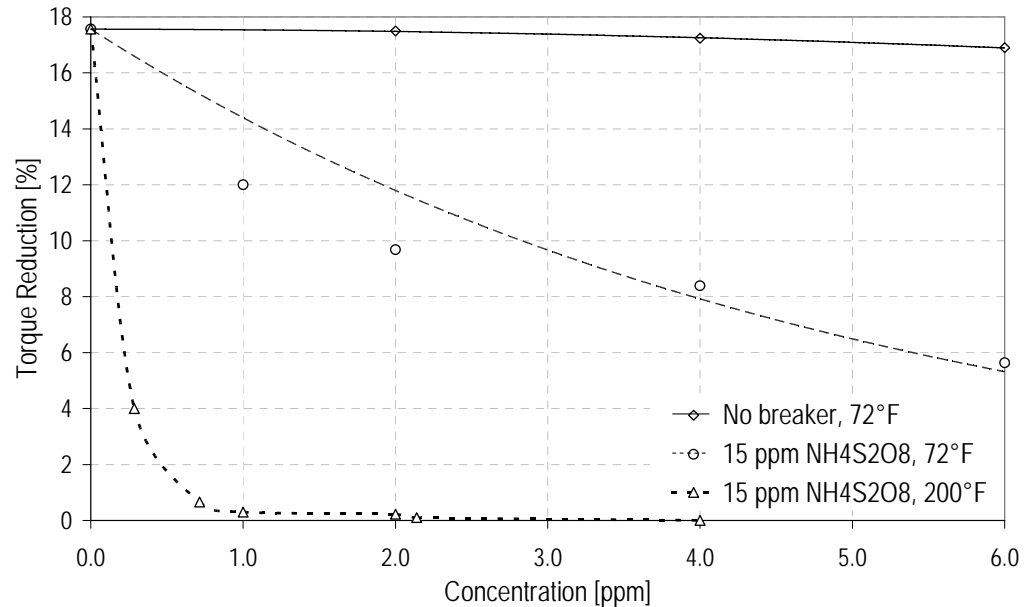
Figure 2 • Friction Reduction of Various Polymers Compared to POLYSLIP OF-50 Polymer Solutions (Disc)



Acid Thickener

POLYSLIP OF-50 Polymer will thicken common oil field acids. These solutions can be easily broken to yield a low viscosity non-damaging fluid upon the additions of breakers (such as ammonium persulfate) or by increasing the temperature, as seen in Figure 3.

Figure 3 • Viscosity Retention of POLYSLIP OF-50 Polymer in 15% HCl



Brine solubility

POLYSLIP™ OF-50 Polymer has been demonstrated soluble in brines as calcium chloride or zinc bromide, at concentrations up to 400 ppm since it is a very efficient chemical. The formulation of 10 lbs/gal (420 lbs/bbl) calcium chloride or 20 lbs/gal (840 lbs/bbl) zinc bromide brines with POLYSLIP OF-50 Polymer remains clear until temperatures of 300°F. At high brine concentrations, It is recommended to add it prior to the salt for easy and clear mixing. Stirring times can vary from one to four hours depending on chosen salt.

Flocculation

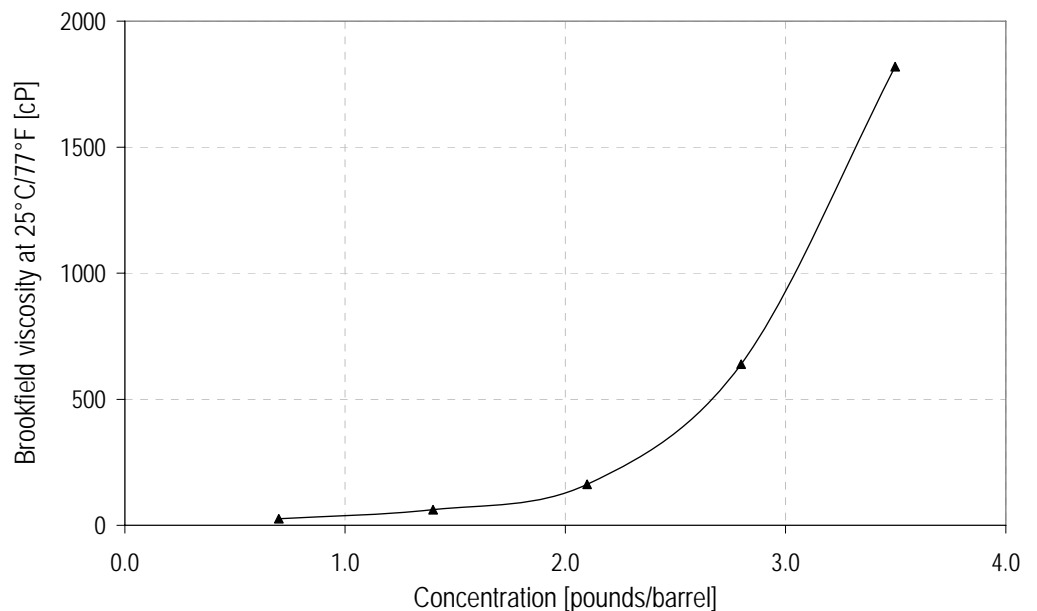
POLYSLIP OF-50 Polymer is an effective flocculant for clays and shales encountered in drilling operations. POLYSLIP OF-50 Polymer is a selective flocculant which can be used as an additive for clear-water drilling to flocculate the fine drilled solids not normally removed by surface handling equipment. This will greatly reduce the solids content of the fluid, and therefore increase the penetration rate. The polymer also provides shale stabilization which also helps to prevent solids build-up. The flocculation of drilled solids by POLYSLIP OF-50 Polymer can be accomplished under conditions which will not cause bentonite to gel or flocculate. This latter property is quite important when it is necessary to quickly "mud-up" in order to improve shale cleaning properties.

POLYSLIP OF-50 Polymer can be used to flocculate most reserve pit fluids. Treatment of reserve pits can be accomplished by circulating the pit with a centrifugal pump while adding the polymer to the circulating stream and, subsequently, allowing a brief time for settling. This treatment clarifies the water for reuse or more environmentally acceptable disposal, and compacts the solids for easier burial.

Methanol thickening

POLYSLIP is useful as a thickener for methanol to remove moisture from pipelines. The polymer is soluble in methanol/water or in anhydrous methanol containing 0.5 percent potassium iodide. The thickening efficiency curve is shown in Figure 4.

Figure 4 • Thickening Efficiency of POLYSLIP OF-50 Polymer in anhydrous methanol (0.5% KI)



End use applications

POLYSLIP™ OF-50 Polymer offers unique advantages in the following Oil Field uses:

<p>Drilling Drill Bit Lubricant Friction Reduction Flocculation Non-Damaging Efficient Thickener Shale Stabilizer</p>	<p>Cementing Friction Reduction Fluid Loss Control</p> <p>Acidizing Acid Thickener Non-Damaging Efficient Thickener</p>	<p>Production Water Clarification / Flocculation Friction Reduction Low Toxicity / Environmental Concerns Organic Solvent Thickener</p>
<p>Completion, Workover Non-Damaging Efficient Thickener</p>		<p>Enhanced Oil recovery Biological Resistance Efficient Thickener Non-Damaging</p>

Table 2 • Typical Properties of POLYSLIP OF-50 Polymer

Item	Value
Appearance	White Powder
Particle Size, through a No. 20 US Sieve	96 % by weight, minimum
Viscosity ¹ , 1% aqueous solution	5000-10000 cP
Melting Range (crystal X-Ray)	62-67°C, 143-153°F
Loss on Drying	<1.0 % by weight
Alkaline Earth Metals, as CaO	<1.0 % by weight
Powder Bulk Density	31 lb/ft ³ , 500 kg/m ³
Solution pH, 1% aqueous at 25°C	8-10

1. Brookfield, LVT FI Spindle, 2 RPM

Shipping Data, Storage and Handling

POLYSLIP™ OF-50 Polymer is shipped in 140-pound / 63.5-kg net polyethylene-coated fiber drums. The resin should be stored in a covered area, and container should be kept sealed to prevent pickup of atmospheric moisture. Containers of POLYSLIP OF-50 Polymer should not be stored immediately next to steam lines or other hot surfaces; storage temperatures should preferably not exceed normal room temperatures.

When POLYSLIP OF-50 Polymer is handled in a closed system, the possibility exists that the concentration of dust could build up to such a degree that a dust explosion could occur. This fact should be considered in designing handling systems, such as bulk storage bins, pneumatic conveyors, and the like. In open handling systems, this hazard is negligible.

Complementary Product Offering

To serve your oil field needs, Dow Wolff Cellulosics also offers CELLOSIZE™ HEC, ANTISOL™ FL PAC Polymers. Other performance products of interest, as cellulosic derivatives, exist, featuring properties such as surface activity (METHOCEL™ HPMC, WALOCEL™ HEMC), water or solvent soluble films (ETHOCEL™) and other performance items.

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[http:// www.dow.com/inspecpolymers/](http://www.dow.com/inspecpolymers/)

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