American Polywater's
Technical Talk
A Publication for Engineers Involved in Cable Installations

Product Spotlight

Performance of Polywater® + Silicone™ NN/NB Versus Other Underground Lubricants

Polywater® + Silicone™ NN and NB are "next generation" Polywater® Lubricants. They demonstrate extraordinary effectiveness in underground pulling. Analysis shows superior performance in two areas:

1. Friction reduction on PE and PVC materials
2. Continous lubrication when pulling through water

The "Polywater® Plus" Series includes regular and winter grades in multiple packages. They are one of our most expensive cable pulling lubricants. When are they worth the money? Lab and field comparison data should help answer this question.

Underground Lubricant Comparison

The Polywater® + Silicone™ Lubricants are most often used in underground power cable installation. This includes long lengths or multiple sweep runs of heavy transmission or distribution cable. So, it is appropriate to compare Polywater® + Silicone™ to the best known underground pulling lubricant, our Polywater® Lubricant J.

Lab Measured Friction

Underground cables are most often pulled into PVC or HDPE duct. The cable jackets are generally some type of PE or PVC. Friction coefficients measured on the Friction Table for our comparison lubricants are presented in Table 1. This same data is listed in the Pull-Planner™ 3000 Software.

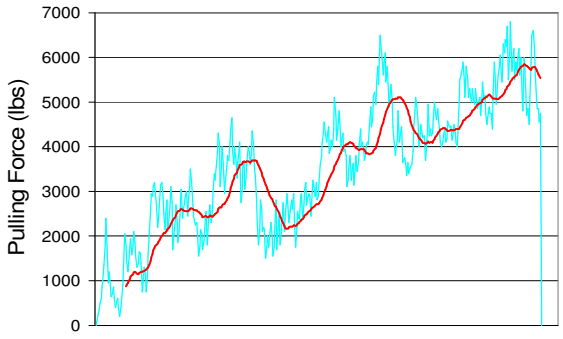
	PVC Conduit		HDPE Conduit	
Jackets	**J**	**NN/NB**	**J**	**NN/NB**
PVC	0.11	0.09	0.11	0.08
LLDPE	0.11	0.11.	0.10	0.05

Table 1. Friction Table Data for Polywater® J and Polywater® + Silicone™ NN/NB

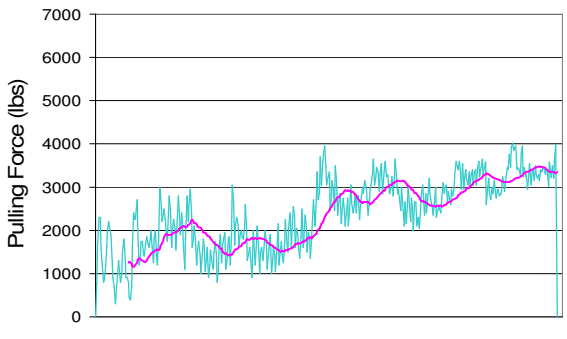
These are low friction coefficient values. The differences are small and both products are excellent lubricants. The NN/NB tests slightly lower, especially in HDPE duct. But do these small differences in laboratory measurements mean anything in field cable installation?

Side by Side Field Comparisons

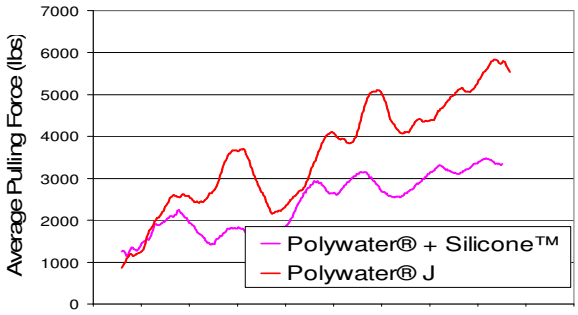
A recent transmission cable installation produced good field tension comparisons for these lubricants. The job involved a series of side-by-side pulls of 138 KV cable (weight of 14 lbs/ft) into PVC conduit. A different lubricant was used to lubricate the cable in side-by-side pulls into "identical" ducts in the duct bank. The comparison was repeated in several other duct runs with consistent results. The data below from one comparison pull are typical.



Graph 1. Polywater® J Tensions vs Pulling Time



Graph 2. Polywater® + Silicone™ WNN Tensions vs Pulling Time



Graph 3. Running Average Tension of Polywater® J vs Polywater® + Silicone™

Graphs 1 and 2 show the raw tension data (with a calculated running average) from the Polywater® J and Polywater® + Silicone™ WNN pulls. Graph 3 clarifies the comparison with a plot of the tension averages on a common axis. The differences were dramatic; 6800 lbs maximum tension and an average of 5750 lbs at the end of the pull for Polywater® J and 3475 lbs maximum tension and an average of 3350 lbs for the Polywater® + Silicone™ WNN.

Overall, this is a larger tension difference than we might intuitively expect based on Table 1. Small differences in friction coefficient can make big differences in pulling tension when there are multiple bends in the conduit run.

Additional Field Experience

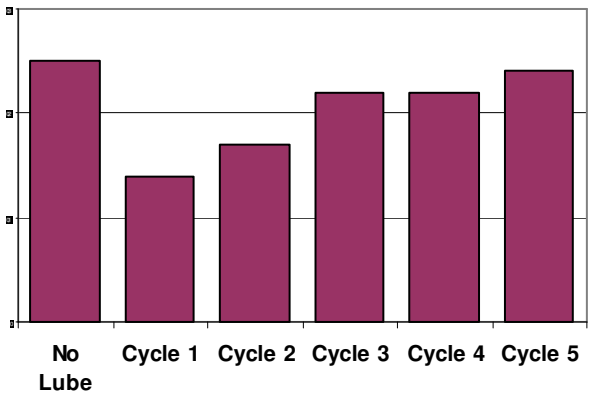
Two regular users of Polywater® + Silicone™ were interviewed for this article. Both calculate the tension on their pulls using the Pull-Planner™ 3000 and then compare the calculations to the actual measured field tension. One is a large California contractor pulling mostly low and medium voltage cable; the second is a cable installation engineer advising on EHV transmission cable pulls.

Even with the differences in the type of installation, their experiences are remarkably similar. Both consistently measure a friction coefficient of 0.08 to 0.09 (some peaks to 0.11) for their Polywater® + Silicone™ pulls. Generally, they see the highest friction when starting the cable moving (static friction) and early in the pull (mostly winch line in the duct). But even these higher static friction points are rarely over 0.11.

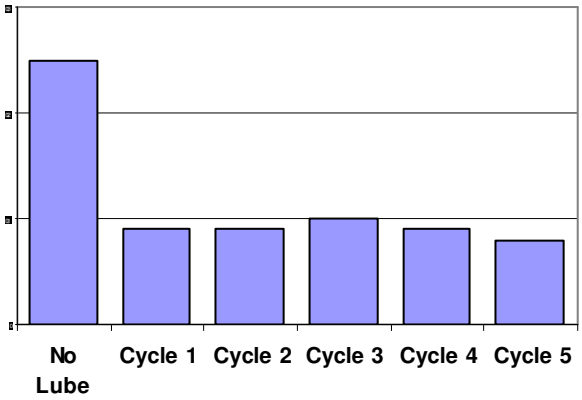
Water Performance

Performance of a “water-based” lubricant through water would not seem possible. One would expect the lubricant to wash off the cable and just dilute into the water. Without going into chemical detail, not all ingredients in Polywater® + Silicone™ are water soluble, and certain ingredients adsorb on the jacket surface. Polywater® + Silicone™ shows continued friction reduction even through water.

Water performance is not easy to replicate in the lab. In the data below, polyethylene duct is wrapped around a large cylinder and then the duct is half-filled with water. A lubricant coated cable is pulled into the duct with a controlled back tension (for cycle 1). From the measured pulling tension, a friction coefficient can be calculated. The cable is then removed, the water is dumped, the duct is swabbed with a sponge, and clean water is added. The same cable is pulled again with no additional lubrication, and the measurement and calculations are repeated (for cycle 2). Data from 5 cycles of this test are shown below.



Graph 4. Polywater® J Water Cycle Test



Graph 5. Polywater® + Silicone™ Water Cycle

Graph 4 shows that Polywater® J type lubricants wash off and, over time, the friction coefficient approaches the “no lubricant” control. This does not happen with the Polywater®+ Silicone™ (Graph 5), where the friction does not change through the “wash-off” procedure. It should be noted that lubricant was not “visible” on either cable after several cycles. The lubricant does not have to be visible for it to work. The limits on this performance through water are not known and more research is needed, though field experience confirms Polywater®+ Silicone™ superiority.

Application Differences

Polywater® + Silicone™ is thickly pourable. Pumping is the preferred method for larger volume applications

One difference between Polywater® J and the Polywater® + Silicone™ is viscosity. The J is a medium strength gel that can be lifted and thus is practical to apply by hand.

The Polywater® + Silicone™ is a gel/liquid. It is difficult to carry a significant amount to a cable by hand. Alternative application methods are recommended for Polywater + Silicone™ including pumping or pouring. Inexpensive manual pumps or drill powered pumps are available from Polywater. Consult with your Polywater representative for additional details on the application possibilities.

NN Versus NB – The "Mini-Rollers" Story

The only difference between Polywater® + Silicone™ NN and NB is the small plastic spheres in NB. These spheres are intended to act as rollers. In our research at Polywater, we can only determine rolling of the spheres in "light" cable pulling situations. That means lightweight cable in straight runs without bends. When the cable gets heavy, or it is being pressed into a bend by the pulling tension, the spheres stop rolling as they dimple and then embed in the cable jacket. In some situations, we do not recommend the NB (spheres) lubricant because of their mild abrasiveness, (eg. graphite coated transmission cable). Generally, we leave it to the user to decide if Polywater® + Silicone™ NB or NN is most appropriate based on their use. For additional details or advice, contact your Polywater representative.

Topic Related Links

Polywater® NN/NB Literature
Polywater® NN/NB Engineering Specification
Lab Report on Pulling Cable Through Water

Polywater Home Page Link

2/2009