Utility Structural Systems

Corporate Sales Office
2201 N. Collins St., Suite 240
Arlington, Texas 76011

Voice 800.367.9273
Fax 817.277.3441

Houston Sales Office
9430 Telephone Rd.
Houston, Texas 77075

Voice 877.765.3738
Fax 281.890.6913

www.utilitystructural.com

March 3, 2006

Scope:

This report covers an actual installation of Poly-Set® Polyurethane Backfill System and Poly-Ground®, Utility Structural Systems' newest line of engineered backfills.

Poly-Set® is a polyurethane backfill, created by our company in 1964, and is considered by any utility currently using foam backfill as the benchmark for all backfill urethanes.

Poly-Ground® has all the same benefits as Poly-Set®, but has the additional bonus of being highly conductive. We believe Poly-Ground® has various benefits, such as worker safety and enhanced grounding, but perhaps one of the most significant benefits that can be noted is the lower impedance, which decreases line loss of the system. Poly-Ground® also provides a safer, faster, and more effective path to ground for electrical discharges of all types and will potentially greatly reduce the incidence of nuisance tripping.

Conditions and Installation:

The main focus of the effort was to reduce the amount of "on-site" time and to provide a solid backfill alternative that is superior to native backfill materials. Normal backfill for the installation of these structures would have been concrete and accessibility would certainly have been as issue. Native spoils were apparently not considered as appropriate. See below photos for installation site:

Photo showing the remote location of the initial Poly-Set® installation.

When I met the personnel at the site it was obvious Poly-Set® would be beneficial at this location. It would have been very difficult to get any type of backfill truck in this right-of-way especially a concrete truck.

The Poly-Set® demonstration was fairly straightforward and I will not take up space discussing it in this report. I think all persons present observed the obvious benefits that Poly-Set® has to offer.

On February 1, 2006, at a subdivision to perform the Poly-Ground® portion of the demonstration on new construction feeder poles. The structures were 45' Class 2 wood poles. According to field personnel, the soil conditions composed of heavy limestone and rock with an apparent lack of moisture was typical for the geographical area. Several attempts to obtain soil resistivity were made, but due to the extreme rock content of the area, it was not possible (see photo on the next page):

Photo showing Werner 4-Point Method for testing earth resistivity. The spacing was 2' in width representing a 2' depth. We could not get the probes deeper then the first incremental mark to go deeper so further evaluation was not possible. The 2' reading was 69 ohms but the reading was in essence inconsequential since no further readings were taken.

Several poles were scheduled to be set that day so we shifted our focus to the poles themselves. One was an angle pole initially going to be set by hand with concrete. I had extra Poly-Set® with me, so we set the angle pole with Poly-Set® and saved the time it would have taken to hand mix concrete. There was another tangent pole in the line and I asked the crew if they wanted to set with Poly-Set® as well. I oversaw the entire process to ensure correct installation. During this time, another crew was setting up for the Poly-Ground® pole installation. A 20" auger was used on all poles in this area but due to the nature of the soil, the holes were actually closer to 22" (see photo of jobsite below):

Photo of jobsite

Photo of jobsite

Left: Photo of the angle pole prior to installation

Below: Photo showing another view of the jobsite.

Once the test pole was in place, we began the process of installing the Poly-Ground®. The Poly-Ground® was installed in “lifts” because we wanted to see at what point the Poly-Ground® had achieved all of the lower resistance obtainable. See photos below of the actual process:

Close up of hole. Notice the location of the ground rod in the annular space

Photo of supplied Poly-Ground

Photo of mixing process for Poly-Ground

Photo of Poly-Ground being poured

Once the first Poly-Ground® kit was poured, it is necessary to allow the Poly-Ground® to cool because of the exothermic reaction. Because heat is read as resistance, an accurate reading would take a little time. To illustrate the point of heat and resistance, we took immediate readings. The initial reading was 263 ohms and after 5 minutes, the reading was 201 ohms. After an additional 5 minutes, a reading of 181 ohms was taken. This shows the lower resistance as the foam cools. Then the next kit was poured into the void. After 5 minutes a reading of 121 ohms was taken and after an additional 5 minutes a reading of 78 ohms was observed. Our estimation at this point was that pouring additional Poly-Ground® would not be highly beneficial other than as backfill for the pole. However, we decided to continue to “top off” the hole. An additional kit was poured and in 5 minute increments readings of 72 ohms, and 65 ohms were observed (see photo below of megger reading on the final reading):

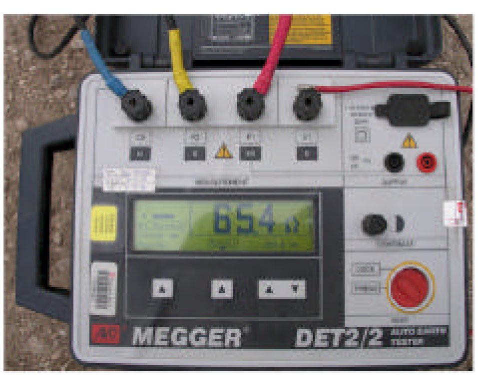

Photo showing final reading of the Poly-Ground installed pole. Reading is 65.4 ohms.

While we were setting and reading this structure, the second crew was at the next pole setting it with native backfill (see photo below of that structure and reading). We also took a megger reading of that structure to show the "pole for pole comparison". What we witnessed, was astounding:

Photo showing pole set with native spoils with megger wires attached to ground rod.

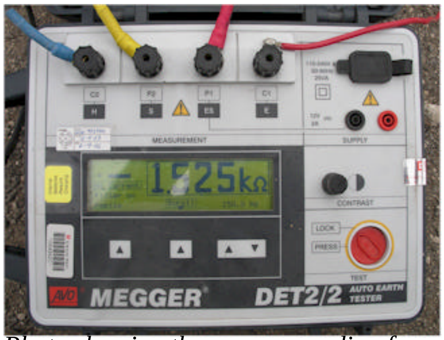

Photo showing the megger reading for the natively set pole. Megger reading is 1.525 K-Ohms or 1,525 ohms.

The actual reading of 1,525 ohms was extraordinarily high in regards to all the customer testing we have done. I thought perhaps our probes were in a bad part of the soil, so I decided to rotate the angle of measurement 90 degrees. The resulting reading actually rose to 1,533 ohms. The method employed to measure the resistance for all structures we do is the "Fall-of-Potential" Method. We find it to be the most accurate method of resistance testing. As you can see from the photos, we use the AVO International Megger DET2/2 Digital Earth Tester that is calibrated yearly to ensure accuracy. This method is also only for testing single-made electrodes, meaning there is no static, neutral, or phase wire influence when testing. The electrode being tested is completely isolated. To test these while connected in parallel would be inaccurate due to the fact we would be reading the entire line resistance and not the electrode by itself. This is done to show direct improvement on a pole-by-pole basis in the same location.

Results and Thoughts:

The final results we recorded area as follows: the pole set with native backfill measured 1,533 ohms and an identical pole set with Poly-Ground® measured 61 ohms.

Several things come to mind when reviewing this particular installation. First being the soil (in general) in the area is extraordinarily high (according to field personnel). Although this particular installation may not be representative of the entire region, I would speculate that it would not differ by much with the exception of low river bed type areas or farm areas of heavy irrigation.

Let's assume for a moment heavy rain would saturate the ground and readings would be taken afterward. We would expect the natively installed pole to decrease in resistance but the Poly-Ground® pole would get those benefits and decrease as well. Let's also assume the theory that over time, the soil would compact around the natively set pole and that contact area would increase thus reducing resistance more. Again, Poly-Ground® would benefit from the same effect. For arguments sake, let's say that over time the pole set with native backfill, decreased by 50% (which is highly unlikely, but some improvement would be expected) and the Poly-Ground® pole did not decrease any from the readings represented here. The Poly-Ground® set pole would still have a 1200% lower resistance than the natively set pole. Now all of this is speculation and theory, but we do know the Poly-Ground® installed pole, on initial and subsequent readings, was far superior to the natively set pole.

We feel quite confident, as evidenced by the numbers, that Poly-Ground® had a significant, positive effect on the grounding of these types of poles. Furthermore, it indicates surface area is playing a key role in the grounding of structures when Poly-Ground® is used. The reason we conducted the test in this fashion was to prove that very theory.

Jason Davenport
Utility Structural Systems