American Polywater's

# TeleTopics

A NEWSLETTER COVERING TECHNICAL SUBJECTS
OF INTEREST IN TELECOMMUNICATIONS CONSTRUCTION

ROUTE TO:

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## Environmental Stress Cracking Past or Present?

Soaps, waxes, detergents, and oils have, historically, not been used to lubricate telephone cable pulls because such materials can "stress crack" polyethylene cable jacket. This cracking causes gaps through the jacket. This can allow ingress of water into the cable and lead to cable failure.

Some three decades ago, the stress cracking problem was first noticed when polyethylene-jacketed cables pulled into conduit using soap lubricants showed jacket cracking failure. For years, the primary, and sometimes only, telephone engineering requirement for pulling lubricants was that "they not cause stress cracking." With the advent of fiber optic pulls of both long duration and distance, other lubricant properties moved to the forefront, like friction coefficient, drying character, and coating character.

Is stress cracking still a problem with modern polyethylene cable jackets and lubricant? Today's jacket grade polyethylenes are much less prone to stress cracking than those used 20 to 30 years ago, and POLYWATER® polymer/water lubricants don't cause such cracking. It would seem, then, that stress cracking might no longer be a problem or consideration. Some recent tests show this is not so. The possibility of cable jacket damage from stress cracking caused by lubricants is still very real!!

### What is Stress Cracking?

Numerous misconceptions exist about stress cracking; more formally called "environmental stress cracking." What is stress cracking, what does it look like, why does it occur, and how is it evaluated?

Stress cracking is a mechanical failure (appears as visible, jagged cracks) characteristic of ethylene-containing plastics in certain environments. Soaps, oils, waxes, detergents, and other surface-active agents are typical environments (reagents) that "cause" stress cracking.

Note that those stress-crack-producing reagents (soap, wax, or whatever) do not weaken polyethylene through absorption and swelling. There is, in fact, very little physical property deterioration (tensile loss) from immersion in stress cracking reagents. The reagents cause the cracking from the outside (surface.)

Environmental stress cracking occurs in polyethylene under stress. The appearance of cracks is dependent on the actual stresses in the plastic. In cable, such stresses involve the thermal and extrusion history of the jacket. In a specific cable, both the jacket polyethylene type and these extrusion stresses determine susceptibility to cracking.

### Laboratory Testing of Stress Cracking

The most common test method for stress cracking is described in ASTM D-1693 “Standard Test Method for Environmental Cracking of Ethylene Plastics.”

ASTM D-1693 is an accelerated test that introduces bending stress into a plastic polyethylene sample. In the standard test, a flat molded piece of polyethylene (jacket material) is notched and bent (introduces localized stress), immersed in a test tube of reagent, aged at a high temperature, and periodically visually observed for cracking.

ASTM D-1693 includes several different sample thicknesses, notch depths, and aging temperatures (called conditions A, B, and C), depending on polyethylene type. The test method does not provide specific aging times or pass/fail criteria.

## Jacket or Lubricant

We see that there are two main variables in stress cracking. Does the environmental reagent (lubricant, cleaner, whatever) cause stress cracking, or is the jacket polyethylene responsible for the cracking by being susceptible.

The answer is both!! Certain polyethylenes are much more susceptible to cracking than others, and certain reagents are much more prone to cause cracking than other reagents.

To evaluate and understand environmental stress crack tests results on pulling lubricants, we must know not only what lubricant was used, but also what polyethylene!! We could be misled by test results from stress-crack-resistant polyethylenes, especially if the tested polyethylenes were more crack resistant than those in our cable jacket.

To interpret or compare stress crack results, we must also know the ASTM D-1693 Condition (A, B or C) and the heat-aging time.

## Grand Canyons

We were surprised and somewhat dismayed at the results from a stress crack evaluation conducted in our lab recently. We were testing two newly introduced liquid "fiber optic pulling lubricants" being promoted as "same thing" or "just as good" as American Polywater's POLYWATER® F. As the data shows, they are not!!

The following table shows the percent of 10 specimens cracked at various observation times when tested on type DYNK polyethylene (via ASTM D-1693 Condition A). The lubricants were used full strength as the reagents.

**Percent of 10 Samples Cracked**

| | Time (hours) | | | |
|---|---|---|---|---|
| **Reagent** | **4** | **24** | **48** | **168** |
| Polywater® F | 0% | 0% | 0% | 0% |
| Look-Alike #1 | 100% | 100% | 100% | 100% |
| Look-Alike #2 | 0% | 100% | 100% | 100% |

The results show Look-Alike #1 to be a voracious stress cracker with 100% failure in the first four hours. Look-Alike #2 is almost as bad with complete failure in one day. The POLYWATER® F showed no failure over the one-week duration of the test.

To be sure our testing wasn't biased, we sent these same samples (polyethylene and lubricants) to an independent lab to run the 1693 test. The results were similar: the two look-alikes produced cracking and the POLYWATER® F did not.

While we learned enough so far not to over generalize the meaning of these results, we can see that the two look-alikes have a much greater tendency to cause stress cracking than POLYWATER® F. They could eventually produce cable jacket failure in the field.

## Let the User Beware

Environmental stress cracking should still be a consideration when choosing a lubricant for use on polyethylene jacket cable. This key property is sometimes ignored today, with potential adverse effects on the life of the installed cable.

There are, of course, many other important properties for a pulling lubricant: coefficient of friction (high shear and low shear), coating properties, and residue amount, to mention a few. The safest engineering course is to use POLYWATER® Lubricants. They are proven over time, thoroughly tested, and well known in the cable industry. After all, there is no humor to look-alikes that crack-you-up!

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