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Automatic Lubrication During Cable Pulling

The Problem

The savings and benefits of automatically applying lubricant during cable pulling depend on installation specifics. A contractor pulling a few hundred feet of building wire into small conduit will have quite different needs from a utility crew pulling several thousand feet of distribution cable underground daily. Yet in both cases, some level of automation in the lubrication operation may be cost justified.

Automated lubrication can:

1. Save time and manpower, usually by eliminating the need to dedicate a person to applying lubricant by hand.

2. Insure optimal lubricant quantity, that is, not using too much or too little lubricant

3. Provide thorough and consistent lubrication for lowest cable pulling tension.

How Much

We first need to know how much lubricant to use when pulling a cable. The equation below will tell us.

$$Q = K \times L \times D$$

Where

Q = Quantity of lubricant in gals (liters)
L = Length of conduit in feet (meters)
D = ID of the conduit in inches (mm)
K = Constant of 1.5×10^{-3} (English) or 7.3×10^{-4} (metric)

This equation determines the amount of lubricant needed to completely coat the interior wall of a conduit with a lubricant film of 0.009 inches (0.2 mm) thickness. The equation calculates lubricant quantities consistent with those used by experienced cable pulling crews.

How Much / How Fast

If we're going to pump the lubricant to the conduit entrance, we'll need the previous equation converted to a lubrication rate calculation:

$$R = K \times D \times S$$

Where:

R = Lubrication rate in gals/min (liters/min)
S = Pulling speed in feet/min (meters/min)

At typical pulling speeds of 10 to 60 ft/min (3 to 18 m/min) and duct sizes of 2 to 6 inches (50 to 150 mm), the rate calculation provides expected lubricant demand from a low of 0.03 gal/min to a high of 0.5 gal/min (0.1 to 1.9 l/min). These are low volume flow rates that can be produced by a number of low-power pumps.

But first, what about smaller and/or less frequent pulls, where automatic pumping is not practical. Is there any better way to apply pulling lubricant than dipping into the lube bucket and applying it by hand?

Conduit Lubrication Effective

In short pulls, the mess and time of hand application can often be avoided by just putting the proper amount of lubricant into the conduit before the pull starts. A rag can be attached to the winch line or fish tape to act as a swab. The lubricant is spread on the conduit walls in front of the advancing cable. Gel Lubricants like Dyna-Blue® or Polywater® J are best for this procedure if the pull is gravitationally up or starts overhead. On the other hand, if the duct is underground with stub-ups, liquid lubricants, like Polywater® F, Polywater® Plus Silicone™, or Polywater® PR pour easily into the conduit mouth.

To place larger quantities into a conduit, a small hand pump with the outlet hose inserted into the duct works well. While small, grease pumps mounted on a pail can be used (typically 30 to 40 strokes per gallon); such pumps are not very suitable with water-based pulling lubricants. A corrosion resistant pump, such as American Polywater's LP-3 (15 - 30 strokes per gallon) works well.

Front End Pack ä System

For larger conduits (2” and up), the Front End Pack™ system is a great way to prelubricate conduit. These “bags” of gel lubricant are attached to the winch line in front of the cable, and cut open as they enter the conduit. They slowly drop lubricant and lubricate in front of the cable as it is pulled. For more information on the Front End Pack™ system, see the web page references below.

Pump Selection

When choosing pumping systems for applying pulling lubricant, a pump should be selected that can handle both liquid and gel lubes at the needed flow rates. It is a mistake to compromise lubricant quality based on limitations in a pump’s capability. The most important characteristics of a pulling lubricant are that it is fully compatible with cable jackets and that it produces low friction in a broad range of field conditions, regardless of how it is applied.

A pump should not shear the lube or build pressure in the outlet hose when flow is reduced with a restriction valve. Pressure pots, low-ratio piston pumps and air-operated diaphragm pumps all meet these criteria.

High shear pumps that run at a high constant speed (rotary vane, gear) are usually not appropriate for field lubrication. The continuous shear from the blades causes deterioration in lubricant performance and builds high pressure in the feed lines.

The diameter and length of the outlet hose on a pump are also important. The hose and any other line restrictions should be large enough to support the desired flow rates.

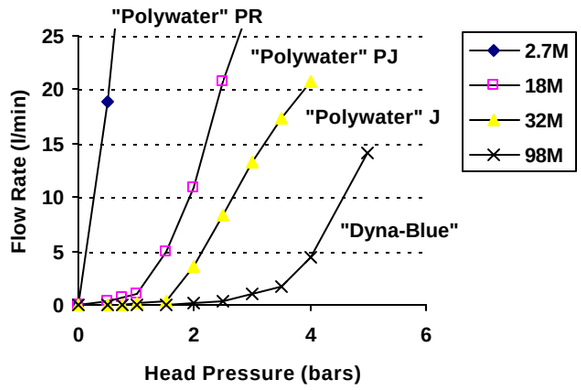
The usual question is whether a pump has enough draw to pull the liquid into the pump. One of the pump types we recommend, a “pressure pot”, has all the liquid “within” the pump, so priming, draw, and cavitation are not concerns.

Pressure Pot Performance Study

A pressure pot moves a liquid with a compressed air head over the liquid inside a pressure vessel. While common in industrial spraying operations, pressure pots are not often used as large-scale pumps. However, they have some very useful features for field pumping of cable pulling lubricants.

A pressure pot has no moving parts, and thus requires minimal maintenance. Pressure pot flow can be controlled with a restriction valve with no shear on the lube. Air compressors to “power” a small pot are readily available in the field. The actual air volume required to support a pull is very low, usually less than 3 cfh (< 0.1 m^3/hr).

As the following data shows, a pressure pot can pump even the thickest gel lubricants. In this study, the compressed air feed to the pot was regulated and flow rates were measured with various viscosity pulling lubricants.



Very low pressure (< 4 psi or 0.25 bars) would pump the 2,700 cps liquid Polywater® PR at adequate flow rates. The highest viscosity lubricant, Dyna-Blue® (98,000 cps) required 60 psi or 4 bars to flow at satisfactory rate. The outlet hose was 20 feet (6 m) in length with a 0.75 inch (19 mm) ID in this test.

These pressures are well within the range of commercially available pressure pots and compressors or hand air pumps. Pressure pots offer the flexibility to apply all types of lubricants.

Data and Support Available

While space limits the presentation here, American Polywater has gathered extensive lab and field data on the pumping and application of our pulling lubricants. This includes work with diaphragm pumps as well as pressure pots. If you have a particular interest, our applications experts would be happy to share this information with you.

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Web Site References for This Issue

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Polywater® J: **polyj.html**
Polywater® PJ: **polypj.html**
Polywater® Plus Silicone™: **polyplus.html**
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