American Polywater's
TechnicalTalk
ROUTE TO:
A PUBLICATION FOR ENGINEERS INVOLVED IN ELECTRICAL CABLE INSTALLATION

Volume 15

Electrical Cleaning The Interaction Mystery

This "Technical Talk" continues the discussion of electrical cleaning solvent properties. In the last issue (Volume 14), the status of 1,1,1-trichloroethane (methyl chloroform) and CFC 113 as ozone-depleting chemicals under the "Montreal Protocol" was explained. Trichlor was a common multi-purpose electrical and cable cleaning solvent and CFC 113 was the primary component of many electrical contact cleaners. Both these solvents have been phased out of production, and are becoming hard to find. Volume 14 described the relationship between evaporation rate and flash point in alternative hydrocarbon solvent cleaners. We saw that, with hydrocarbon type cleaners, the faster they evaporate, the more combustible they are. End users must balance these two properties based on their specific environment and cleaning needs.

This issue will discuss the effect of electrical cleaning solvents on the rubbers and plastics they contact when used. How can potential effects be determined? Are these interactions harmful? Do cleaning methods make any difference in the interaction?

Cleaning

Electrical cleaners are used to remove contaminants that could provide a path for tracking or arcing, or conversely, to remove grime that may be insulating and cause overheating. When splicing high voltage cables, insulation shield residue, corrosion inhibitor contamination, and handling grime should all be cleaned from the insulation. For electrical contacts, airborne oils and carbon deposits should be removed.

Unfortunately, not all cleaners are equally "effective" at removing contaminants. There are no standard ways to measure this, but simple tests show a lot. For instance, we measure a cable cleaner's effectiveness at removing semi-con shield picks with a simple wipe test. After a few wipes, the amount of "black" (semi-conducting material) picked up by a cleaner-saturated white cloth varies significantly, depending on the cleaner. In our test, we rate it from a zero (no visible black residue on the cloth) to ten (a lot of residue).

Cleaning rating results from a series of semi-con wipe tests are presented in Table 1. Seven mystery solvents are analyzed, labeled A to G. Remember that the higher ratings reflect the fastest, most effective cleaning.

Solvent	Cleaning Rating	Solvent	Cleaning Rating
A	9	E	9
B	9	F	4
C	4	G	0
D	5		

Table 1. Cleaning Ratings

Table 1 shows significant differences in the cleaners; some were excellent (8 to10 rating); some were OK (4 to 6 rating); and one was awful (0 rating). We'll identify the solvents later.

Rubber Interaction

How do these same solvents affect rubber splice materials? One way to measure this is to determine the effect on semi-conducting EPDM polymers. These semi-conducting rubbers are very sensitive to solvent migration, which disrupts their carbon black network and raises their resistivity. Table 2 shows the effect on volume resistivity of a one-hour, room temperature soak of semi-conducting EPDM in solvents A thru G.

	Initial	After Soak
Solvent A	3 x 10^2 ohm-cm	7 x 10^5 ohm-cm
Solvent B	3 x 10^2 ohm-cm	1x 10^4 ohm-cm
Solvent C	3 x 10^2 ohm-cm	8 x 10^4 ohm-cm
Solvent D	3 x 10^2 ohm-cm	1 x 10^5 ohm-cm
Solvent E	3 x 10^2 ohm-cm	6 x 10^5 ohm-cm
Solvent F	3 x 10^2 ohm-cm	8 x 10^2 ohm-cm
Solvent G	3 x 10^2 ohm-cm	3 X 10^2 ohm-cm

Table 2. Soak Effect on Volume Resistivity

Comparing Tables 1 and 2, we see that the most effective cleaners generally also have the most effect on the rubber. Several cleaners raise the volume resistivity several orders of magnitude, to above the 10,000 ohm-cm maximum allowed in power cable standards.

Plastics Interaction

A different concern arises in contact cleaning. Is the cleaner compatible with the plastics in and around the contact? Table 3 presents stress cracking results from the same seven electrical cleaners on the common plastic polycarbonate (tradenamed Lexan®, Macrolon®, etc.). The test is run by bowing a strip of plastic in an adjustable jig (surface stretching), and determining the maximum stretch before the strip cracks when immersed in the cleaner.

Solvent	Max Stretch	Solvent	Max Stretch
A	0.0%	E	0.0%
B	0.9%	F	0.9%
C	0.9%	G	0.9%
D	0.9%		

Table 3. Stress Cracking Effects on Polycarbonate

In this cracking test, common standards define a stretch above .5% before cracking as an indication the cleaning solvent is satisfactory for use with the specific plastic. We see that two solvents (A & E) are extremely aggressive towards polycarbonate, and dissolve it even with no surface stress. The rest of the cleaners are much more satisfactory.

The Mystery Revealed

Let's reveal the solvents.

Solvent A	Trichloroethane
Solvent B	Type HP™ Electrical Cleaner*
Solvent C	CFC 113
Solvent D	Type NF™ Electrical Cleaner*
Solvent E	HCFC 141b
Solvent F	Type KC™ Contact Cleaner*
Solvent G	Water

Table 4. Cleaner Identities

* Electrical Cleaners From American Polywater

We see that the solvent that didn't affect anything, but also didn't clean anything, was water (Solvent G). Table 3 clarifies why trichloroethane (Solvent A) was not used as a contact cleaner, where it could come into contact with plastics, while CFC 113 (Solvent C) was. We also note that the use of HCFC 141b (Solvent E) as a contact cleaner will be severely limited by its aggressiveness towards plastics. American Polywater's KC™ Contact Cleaner (Solvent F), on the other hand, does not affect these plastics, nor did the CFC 113 the KC™ replaces.

Use Methods Important

We can discover the importance of cleaner use method via similar testing. For instance, the common cable cleaning solvent trichoroethane shows a dramatic effect on the rubbers used in splices in Table 2. How could trichlor be used successfully?

The answer is that the cable and splice components are not immersed in cleaner for an hour, and they shouldn't be! When the solvent is a slower evaporating type, like HP™, it should be used sparingly, and should be wiped dry once the surface is cleaned. The data below show volume resistivity change when a semi-conducting material is *wiped* with these cable cleaners. None of the cleaners shows a detrimental effect when used properly.

	Before Wipe	15 Mins.	1 Hour
Trichloroethane	9x10^{1}	10x10^{1}	10x10^{1}
Type NF	9x10^{1}	9x10^{1}	9x10^{1}
Type HP	9x10^{1}	9x10^{1}	9x10^{1}

Table 5. Wiping Effect on Semi-Con Properties

Help Available

Space limits this discussion to only a few specific compatibility tests and materials. A good electrical cleaner manufacturer should be able to help you with information on compatibility issues during your transition to alternatives for trichloroethane and CFC 113. Here are some of the materials available from American Polywater.

1) Detailed technical literature presenting data on the interaction of our electrical cleaning solvents with many common plastics and rubbers.
2) Videos showing proper cable cleaner use methods during cable termination or splicing.
3) Cable cleaner packages with both drying wipes and wet wipes to provide convenient and proper field use of the product.
4) Research papers analyzing the common engineering plastic polycarbonate and its interaction with a broad variety of solvents.
5) Electrical property data, residue data, and much more on electrical cleaner characteristics

If you want to receive any of this information, please call Polywater®'s Customer Service at 1-800-328-9384. Product samples are also available.

Comments, questions, or editorial requests, please contact:

"Technical Talk" Editor
American Polywater Corporation
P.O. Box 53
Stillwater, MN 55082
800-328-9384
651-430-2270
http://www.polywater.com
custserv@polywater.com