American Polywater's

TeleTopics

A NEWSLETTER COVERING TECHNICAL SUBJECTS
OF INTEREST IN TELECOMMUNICATIONS CONSTRUCTION

ROUTE TO:

Volume 9

Trichloroethane (and CFC) Alternatives Part 2

The last issue of "TeleTopics" (Volume 8) described the 1990 Clean Air Act, which mandates the elimination of 1,1,1-Trichloroethane (Type B Solvent) and CFC-113 (Contact Cleaner) based on their ozone-depletion character. Telephone maintenance and construction operations must find suitable alternatives to these common cleaning and degreasing solvents.

Several key properties of alternative solvents were reviewed in the last issue. These included solvency power, evaporation rate, and combustion character. This "TeleTopics" will describe another important property of cleaning solvents: their "compatibility" with the plastics used in terminal blocks and connectors.

Stress Crack Failure - What is it?

Certain plastics can weaken and crack under stress. This cracking is caused by contact with an outside substance (such as ozone, solvent, adhesive, bug spray, etc.). The cracking is dependent on both the solvent and the plastic. In other words, a solvent that causes cracking in one type of plastic may have no effect on another type. Conversely, one solvent may aggressively crack a plastic while a different solvent does not. Inherent stresses are molded into plastic parts, making molded parts susceptible to stress cracking, and possible functional failure.

Stress cracking is easy to see, especially in a non-pigmented sample of plastic. It can vary from minor crazing on the stretched plastic surface; to cracks all the way through the sample's thickness; to the sample breaking into several pieces.

Testing for Stress Cracking

One common stress crack test is to bow a bar of the subject plastic in a three-point jig (Figure 1).

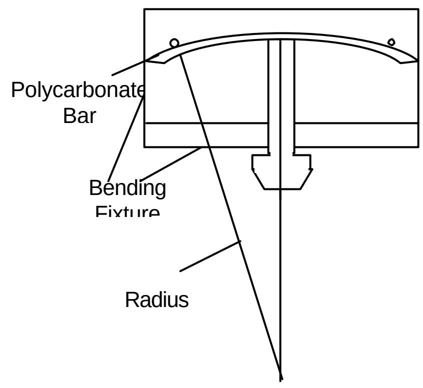

Figure 1

By altering the configuration of the jig, different amounts of stress can be put on the plastic. Surface strains of 0.2% to 1.2%, produced by the radius of curvature, are common in stress-crack testing.

There is no defined, "acceptable level" for stress cracking. Some telephone standards establish 0.5% strain with no cracking as a minimum for solvent "compatibility." Other standards define cracking at 0.5 to 1.0% strain as "limited resistance," and 1.0% and above as "highly resistant".

The studies described below evaluate various cleaning solvents on the common plastic polycarbonate. The polycarbonate used was not a solvent resistant type, and thus had a tendency to crack. This should produce "conservative" results as we're investigating various kinds of solvent cleaners.

Cleaning or Contact Method

In the field, cleaners can come into contact with plastic parts in several ways. The first set of experiments tried three different ways of using a solvent on the bowed plastic.

(1) A wipe with a solvent-soaked cloth (room temperature drying.)

(2) An aerosol spray of the solvent (room temperature drying).

(3) A 15-minute soak in the solvent (room temperature drying after removal).

This applications test was run using several common cleaners on a polycarbonate bar at 0.5% strain. Results follow on the next page:

Solvent	Application Method		
	Wipe	Spray	Soak
1,1,1-Trichloroethane	Some crazing covering 1/3 of bar	Bar cracked into 2 pieces	Plastic dissolved
Citrus Distillate	Very slight (1 or 2 cracks) surface cracking	Slight surface cracking	Severe crazing covering 1/3 of bar
Isopropanol Alcohol	No effect	No effect	Very slight (1 or 2 cracks) surface cracking
Plain Water	No effect	No effect	No effect

The effect on the polycarbonate plastic varies with the way the solvent is used. We see that the short-term contact of a "wipe" has much less effect than a 15-minute soak.

We also note that the chlorinated solvent (trichloroethane) and the citrus distillate-type solvent are both fairly aggressive stress crackers. As we'll see later, many effective "degreasing" solvents are.

Type of Cleaner

By testing polycarbonate bars with different surface stresses, we can establish the stress percentage where a solvent begins to crack the plastic. The data below represent a 15-minute soak test on bars that were stressed at 0.0%, 0.3%, 0.5%, 0.7% and 0.9%. In this test, the higher the stress before cracking is observed, the better. Anything above 0.5% is good and above 0.9% is excellent.

Solvent	Minimum Crack %
1,1,1-Trichloroethane	0.0%
Acetone	0.0%
HCFC 141b	0.0%
Citrus Distillate	0.3%
Isopropanol	0.7%
American Polywater's Type HP™	0.7%
Freon® 113 (Contact Cleaner)	0.7%
American Polywater's Type KC™ (Contact Cleaner)	>0.9%
Water	>0.9%

We see that Contact Cleaner 113 (CFC), Isopropanol, and American Polywater's Cleaners HP™ and KC™ do not cause cracking under 0.5% stress, even under the severe soak conditions. We see water does the same, but it is not an effective cleaner, at least for grease-like materials.

Cleaning Effectiveness Versus Stress Crack Behavior

How can you choose a solvent that efficiently removes grime without adversely affecting the plastic?

The table below rates from 1 to 10 (10 is best) the effectiveness of cleaners at removing hydrocarbon grease from a surface.

Solvent	Maximum Strain Limit	Cleaning Effectiveness (Grease)
1,1,1-Trichloroethane	.0%	10
Acetone	.0%	3
HCFC 141b (Contact Cleaner)	.0%	10
Citrus Distillate	.3%	9
Isopropanol	.7%	2
Type HP™	.7%	9
Freon® 113 Contact Cleaner)	.7%	5
Type KC™	>.9%	2
Water	>.9%	0

By comparing the tables, it's possible to choose a replacement for trichloroethane; Type HP™, which is almost as effective a degreaser, but with less stress cracking tendency. Also, for the less severe cleaning required of a spray contact cleaner, the Type KC™ can replace CFC-113, without ozone depletion or stress cracking concerns. The HCFC alternative for CFC-113 is an aggressive cracker.

Summary

While the data above are "conservative" (from stress-crack-prone polycarbonate), they show the important considerations in choosing a cleaning solvent that may contact a plastic part.

These are:

(1) The effects of the specific solvent on the specific plastic.
(2) The way the solvent will be used in the field.
(3) The effectiveness of the solvent at removing the target dirt or grime.

Why clean?

It would seem an alternative is not to clean at all. However, many greases, oils, and filling gels have the same effect on plastic parts as the cleaning solvents; and if they are not removed, the contaminants themselves can cause cracking and deterioration of the plastic.

Call 1-800-328-9384 if you would like a more detailed laboratory report on the stress cracking study, or if you would like **FREE** samples of alternative cleaners to replace chlorinated solvents and CFC's.

Comments or questions, please contact:

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