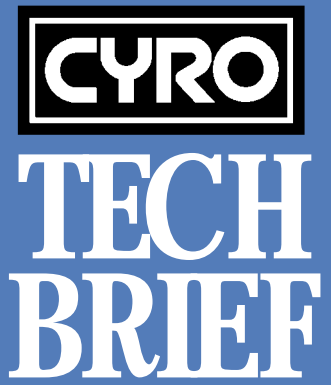


Applications



Cleaning Solutions for CYROLITE[®] acrylic-based multipolymer compounds

TB00198-LLH

This brief gives advice for:

- **Alternatives to FREON CFC-113 and Methyl Chloroform (1,1,1-Trichloroethane) Cleaning Agents.**

Due to the phaseout of FREON CFC-113 and methyl chloroform (1,1,1-Trichloroethane) as cleaning solvents, new processes, cleaning solutions and equipment have become available as acceptable alternatives.

There are alternative cleaning options offered by DuPont Company, 3M Company and ATCOR as replacements for the above solvents.

DuPont, a major producer of FREON, has suggested:

VERTREL[®] 245 as a replacement for FREON CFC-113 because it is nonflammable, has a low order of toxicity and is TSCA listed.

There are three additional DuPont products recommended for cleaning molded or extruded parts made of CYROLITE[®] compounds:

AXAREL[®] 56 - a semi-aqueous cleaner recommended to replace FREON CFC-113 and methyl chloroform.

AXAREL[®] 6000 - recommended to replace methyl chloroform.

AXAREL[®] 2200 - recommended to replace methyl chloroform and other solvents such as toluene, xylene, acetone, terpenes and alcohols.

Information regarding the resistance of CYROLITE compounds to the above three AXAREL products is discussed later in this brief.

3M Company offers a process that provides high performance cleaning without the use of ozone-depleting chemicals or water. However, the 3M chemicals must be used in approved equipment. ATCOR designs and manufactures a full line of cleaning and de-greasing equipment to replace CFC-solvent processes. ATCOR also manufactures equipment for aqueous processes and provides a service to clean plastic parts for medical applications. Information regarding these companies and their products can be obtained by contacting the respective company.

ACRYLITE[®] acrylic molding & extrusion compounds

ACRYLITE PLUS[®] impact acrylic molding & extrusion compounds

CYREX[®] alloys

CYROLITE[®] acrylic-based multipolymer compounds

CYROVU[®] HP multipolymer compound

XT[®] polymer acrylic-based multipolymer compounds

Evaluation of Chemical Resistance to DuPont Cleaning Solutions

Table 1 shows the resistance (measured in weight change after immersion) of several types of plastics, including acrylic, to AXAREL 56 and AXAREL 6000. The information in this table indicates that most of the materials listed have similar resistance to the two cleaning solutions. A low change in weight indicates greater resistance to the cleaning solution.

Table 1

| Chemical Resistance of Various Plastics with DuPont Cleaning Solution | | |
|---|-----------------|-------------|
| | % Weight Change | |
| | AXAREL 56 | AXAREL 6000 |
| ABS | -0.2 | -0.2 |
| Acetal | -0.1 | -0.1 |
| Acrylic | -0.2 | -0.2 |
| Cellulose | 2.0 | 2.0 |
| PC | -0.2 | -0.2 |
| PS | 5.0 | 5.0 |
| Nylon | -0.2 | -0.2 |
| PP | -0.2 | 0.1 |
| PE | 1.0 | 0.1 |

^aImmersed for 24 Hours @ 50°C.

The resistance of CYROLITE® G-20 HIFLO® acrylic-based multipolymer compound and CYROLITE® GS-90 acrylic-based multipolymer compound to AXAREL 56, 2200 and 6000 cleaning solutions is further defined by performing an environmental stress cracking test. This test method involves exposing tensile test specimens to the specific chemical for 10 minutes, then measuring the tensile properties of the specimen. Two types of samples are tested: stressed and unstressed. The stressed samples are placed into a 7" radius fixture prior to exposure to the chemical. This imparts approximately 3500 psi stress to the surface of the tensile bar, accelerating any degradation/crazing the chemical may cause in the material. The tensile properties after exposure to the cleaning

solutions are compared to unexposed control specimens, and the percent retention of both tensile strength and elongation (at yield and break) is calculated.

It should be noted that the stressed samples may not represent the actual stresses a part will encounter during its performance life. However, the chemical resistance of the material could be affected by internal and external stresses in the part. Internal stresses may be created during processing, including injection molding and extrusion. External stresses can be created by secondary processes, such as drilling and welding, or the environment in which the part is used. Minimization of internal and external stresses could significantly increase the life of a part when exposed to specific chemicals.

The results of the stress cracking test are summarized in Tables 2 - 4. As expected, the cleaning solutions cause a significant loss of both tensile strength and elongation in the stressed samples. However, with the exception of an increase in elongation at break for CYROLITE GS-90 compound, the solutions have little effect on the properties of the unstressed samples. A properly molded or extruded part should perform similarly.

The AXAREL 56 and AXAREL 6000 causes no crazing in both stressed and unstressed specimens. AXAREL 2200 causes fracture when

placed in contact with CYROLITE G-20 HIFLO compound (stressed specimens) and cracking for CYROLITE GS-90 compound (stressed specimens).

CYROLITE® CG-97 acrylic-based multipolymer compound exhibits greater chemical resistance than GS-90 compound and G20 HIFLO compound. Axarel 56 and Axarel 6000 can be used safely with CG-97 compound. Axarel 2200 should be tested in contact with molded specimens to determine whether it can be safely used. Performance of CYROLITE compounds in the presence of these cleaners will be partially dependent on molded-in stresses.

Table 2

| Unexposed Properties | | |
|--|--|----------------------------|
| Property | CYROLITE G-20 ^a COMPOUND | CYROLITE GS-90 COMPOUND |
| Tensile Strength ^a , psi | 7150 | 7200 |
| Tensile Elongation at Yield ^a , % | 3.3 | 3.6 |
| Tensile Elongation at Break ^a , % | 4.8 | 6.7 |

^a ASTM D 638

Table 3

| CYROLITE G-20 HIFLO compound Resistance To Various Cleaning Solutions | | | | | | |
|--|----------------------------------|------------|-------------|--|-------------|------------|
| | AXAREL 56 | | AXAREL 2200 | | AXAREL 6000 | |
| | Stressed | Unstressed | Stressed | Unstressed | Stressed | Unstressed |
| Tensile Strength Retention, % | 48 | 98 | Fractured | 102 | 73 | 101 |
| Elongation Retention, % | | | | | | |
| At Yield | 32 | 99 | Fractured | 95 | 55 | 97 |
| At Break | 24 | 90 | Fractured | 96 | 43 | 98 |
| Cracking | <- - - - - No Cracking - - - - > | | Fractured | <- - - - - - - - - No Cracking - - - - - - - - > | | |

*Not Available - Samples Fractured in Radial Fixture.

Table 4

| CYROLITE GS-90 compound Resistance To Various Cleaning Solutions | | | | | | |
|---|----------------------------------|------------|-------------|--|-------------|------------|
| | AXAREL 56 | | AXAREL 2200 | | AXAREL 6000 | |
| | Stressed | Unstressed | Stressed | Unstressed | Stressed | Unstressed |
| Tensile Strength Retention, % | 100 | 100 | 60 | 105 | 100 | 102 |
| Elongation Retention, % | | | | | | |
| At Yield | 103 | 100 | 52 | 98 | 100 | 98 |
| At Break | 64 | 146 | 24 | 106 | 94 | 119 |
| Cracking | <- - - - - No Cracking - - - - > | | Fractured | <- - - - - - - - - No Cracking - - - - - - - - > | | |

Equipment & Material Suppliers

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Fax: 408-629-9009

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3M Center, Building 223-6S-04

Dept. RAM

St. Paul, MN 55144-1000

Tel: 1-800-833-5045

DUPONT COMPANY

Customer Service Center, B-15305

Wilmington, DE 19898

Tel: 1-800-441-7515

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contact CYRO or visit our TechKnowledge Center at www.cyro.com.

Degussa

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Web site <http://www.cyro.com>

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