FluoroEtch® Safety Solvent

TECHNICAL BULLETIN

Increases bondability and coefficient of friction, improves wettability and flow characteristics of PTFE, FEP, CTFE, ETFE, PVDF, PFA, and other fluoropolymers.

FluoroEtch® Safety Solvent, an activated form of sodium in solution, reacts with fluoropolymers, extracting fluorine atoms at the surface and forming a carbonaceous layer which is compatible with most adhesives. Fluoropolymers are thus made easily bondable to themselves and other materials with conventional adhesives.

STORAGE AND PREPARATION

Store ***FluoroEtch Safety Solvent*** at room temperature. DO NOT REFRIGERATE! ***FluoroEtch*** can be stored and used safely at room temperature and above. At room temperature and below, some of the excess active ingredient—sodium naphthalene—crystallizes and precipitates in the bottle. Before etching, we recommend heating the closed bottle in a hot water bath of 55–65°C and shaking it well. This dissolves the excess active ingredients that have precipitated during shipping and returns the etchant to the super-saturated condition at which it was manufactured. Using ***FluoroEtch*** at these elevated temperatures can provide better bond strengths than room temperature etching.

Standard industrial safety and hygiene practices are advised. When working with any chemicals, the use of rubber gloves, safety glasses and protective clothing is essential. Because of the very high flash point (70°C), the very low volatility (36 where n-butyl acetate=100) and the room-temperature stability of ***FluoroEtch***, there is typically no need for extraordinary precautions. Minimal localized ventilation (approximately 3–4 cubic meters/minute) is recommended for confined workplaces.

If the parts to be etched are soiled, it may be necessary to wash them before etching. If this is the case, it is absolutely necessary to thoroughly dry the parts before immersing them in ***FluoroEtch***. Water, alcohol, acetone and other cleaning solvents remaining on the surface of the part will very quickly deactivate ***FluoroEtch***. Fluoropolymers can also trap solvents that will inhibit the etching process so oven or forced hot air drying of the washed parts is essential due to the porosity of these materials.

Additionally, heated components etch faster and better than room temperature components.

TANK DESIGN

The etching vessel should be appropriately sized and shaped allowing for total immersion of the items to be etched and for additional head space for a nitrogen blanket. It can be made of polypropylene, polyethylene or stainless steel with a lid.

It should be of a vertical design to minimize the surface area of ***FluoroEtch*** exposed to the air. Air reacts with the active ingredient—sodium—thus weakening the etching solution. A tank made from 12mm thick polypropylene will keep the etchant warm for short production runs (up to 1 hour). A stainless steel tank, with a low watt-density blanket heater attached to the outside of the tank, is used for longer production runs.

PROCESSING

Pour the heated ***FluoroEtch*** into a clean, dry vessel. For best results and to prolong the bath-life of FluoroEtch, the space in the tank immediately above the etchant can be purged with nitrogen. Acton Technologies recommends that 99.99% nitrogen be introduced by gently sparging from the bottom of the etching vessel, thereby agitating and blanketing at the same time.

The flow rate should be determined by experimentation, considering the size and design of the tank. Remember the purpose: to prevent air from coming into contact with the surface of the ***FluoroEtch***.

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ETCHING

Immerse the item to be etched in the heated ***FluoroEtch*** (55–65°C) for 30–60 seconds, 'waving' the polymer in the liquid in order to cause a flow of etchant over the polymer surface. Depending upon the polymer and the size of the tank, several items can be etched at once. There is no danger of over-etching because the process is a self-limiting reaction. Exposure even for several minutes will not harm the polymer. Drain the item over an intermediate container for several seconds until the draining is minimal. Then proceed to the washing and rinsing procedure. For most effective cleaning, do not allow components to dry between etching, washing and rinsing steps.

WASHING

Rinse the polymer in alcohol (isopropyl or methyl) for 5–20 seconds. This is the most effective solvent to use because it deactivates the sodium and partially dissolves the naphthalene.

Rinse in clear, hot (approximately 70°C), non-chlorinated water for 15–30 seconds. The water used in the rinse step of the etching procedure is critical to the overall process and should be chlorine free. It is strongly recommended that carbon filtered, distilled or deionized water be used to preclude possible bond interference by the chlorine. Municipal water supplies frequently increase the chlorine dosage in their systems without notice. Chlorinated water has been directly related to bonding failures on etched materials.

Rinse in hot (approximately 70°C), mildly acidic (2%–5% acetic acid) water for 1 minute. The pH of the bath should be 4–6 and may have to be adjusted from time to time by adding more acid. The acidity of the wash neutralizes the alkalinity of the etchant residue and provides faster, more thorough and effective cleaning. This type of wash also contributes more acidic sites to the etched surface which increases bond strengths to basic adhesives.

Air dry or use forced hot air or an oven at 70–80°C until dry.

The component is ready for bonding and will remain bondable for several months if stored at normal room temperature and humidity. Exposure to ultraviolet light for long periods of time can degrade the bondability. If the etched items must be stored for many days before bonding, they should be protected from any ultraviolet light, high humidity or excessive heat. Some studies have shown that bond strengths continue to increase for the first 24 hours after etching.

NOTES

It is possible to store the used ***FluoroEtch*** in its original bottle (or other suitable container) for future re-heating and re-use. (Do not mix it with new FluoroEtch as this could possibly weaken the new ***FluoroEtch***.)

FluoroEtch will change color as its strength is diminished. Fresh ***FluoroEtch*** is dark green, almost black in color. As the active ingredient is consumed, the etchant will first become lighter green. At this point its strength is nearly depleted. FluoroEtch will continue through a series of color changes from green to brown to white and finally to a clear/amber color. The loss of etching strength is indicated by changes within the green colors. Partially spent ***FluoroEtch*** will still appear dark green in the tank but will turn clear on the polymer faster than fresh etchant. The faster that ***FluoroEtch*** turns clear on the surface of the polymer, the weaker the etchant. Very weak FluoroEtch will appear lighter green and will be somewhat less viscous.

White PTFE test strips provide a good method to determine the level of activity in a ***FluoroEtch*** bath. It is useful to establish a standard by etching a white PTFE test strip (approximately 1mm x 20mm x 100mm) in fresh, heated ***FluoroEtch*** for 10 seconds. This white, opaque PTFE will turn dark brown and provide excellent bond strength. Partially spent FluoroEtch will turn white PTFE to a lighter brown color. The weaker the FluoroEtch, the lighter the color change. The lighter the color change, the weaker the bond strength.

Many ***FluoroEtch*** users find it helpful to establish their own standards, relating color change to bond strengths, by experimentation. There is some art involved in the science of etching fluoropolymers. Most customers find considerable value in experimenting with ***FluoroEtch*** and some inexpensive PTFE scrap pieces before attempting to etch the final product.

This information is furnished gratuitously, independent of the sale of any product and only for your independent investigation and verification. The information contained herein is based upon many years of cumulative experience in etching fluoropolymers but, because processing equipment, conditions and procedures are different at each location, results may vary. While these data are believed to be correct, Acton makes no warranties or representations with respect to these data either expressed or implied.

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