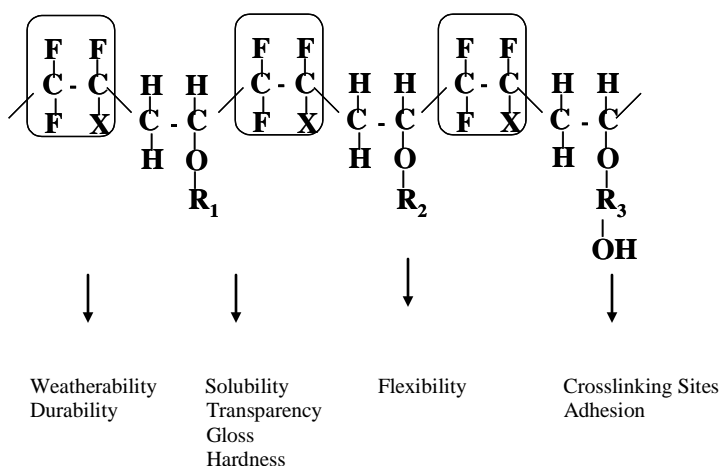




LUMIFLON® FLUOROPOLYMER RESINS Long Term Performance Vs. PVDF

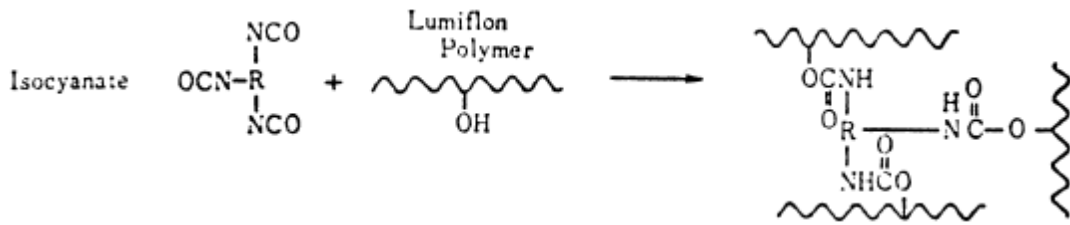
LUMIFLON resins are known generically as fluoroethylene vinyl ether (FEVE) resins. The name derives from the reactants used to form the polymer. These materials form the regularly alternating structure shown below. The alternating structure is critical to the weatherability of coatings made with LUMIFLON resins.



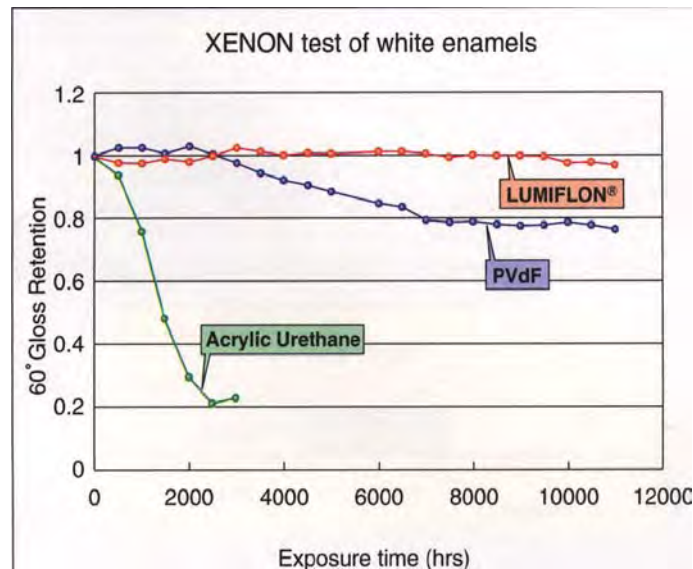
Physical properties of the LUMIFLON resin can be modified by changes in the nature of the vinyl ether units. Ultra-weatherability, durability, and chemical resistance are derived from the alternating fluorinated units. LUMIFLON resins are usually reacted with aliphatic isocyanates to form crosslinked fluorourethane coatings.

Recently, claims have been made that FEVE resins do not offer the same weatherability as PVDF coatings because they are lower in fluorine content. These claims are misleading, as explained below.

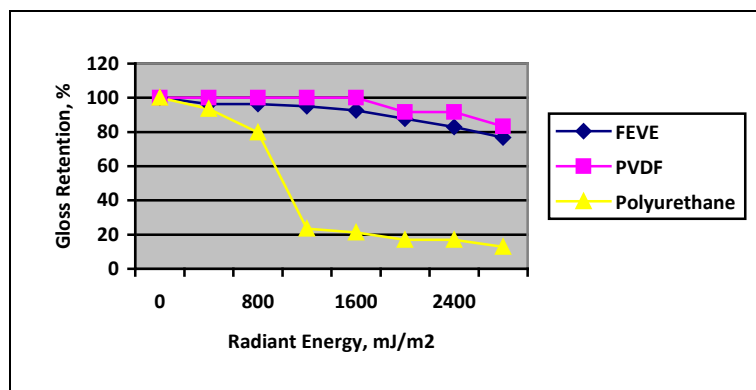
The fluorine content of FEVE based coatings is not directly related to their durability. Rather, it is the distinctive alternating polymer structure of LUMIFLON resins that enables the development of ultra-weatherable fluorourethane coatings. The chemical bond between carbon atoms and fluorine atoms is too strong to be broken by sunlight. This means that the polymer is not degraded by ultraviolet radiation from sunlight. The alternating structure of the LUMIFLON resin also increases the strength of other chemical bonds in the polymer, which protects the entire coating against degradation. The result is a fluoropolymer that is as weatherable as PVDF. The protective mechanism is illustrated in the figure below.



LUMIFLON based coatings have been in use for more than 25 years in the field, and have proved themselves to offer outstanding weatherability. Shown below are results from accelerated weathering tests in which LUMIFLON fluorourethanes are compared with 70/30 PVDF coatings.



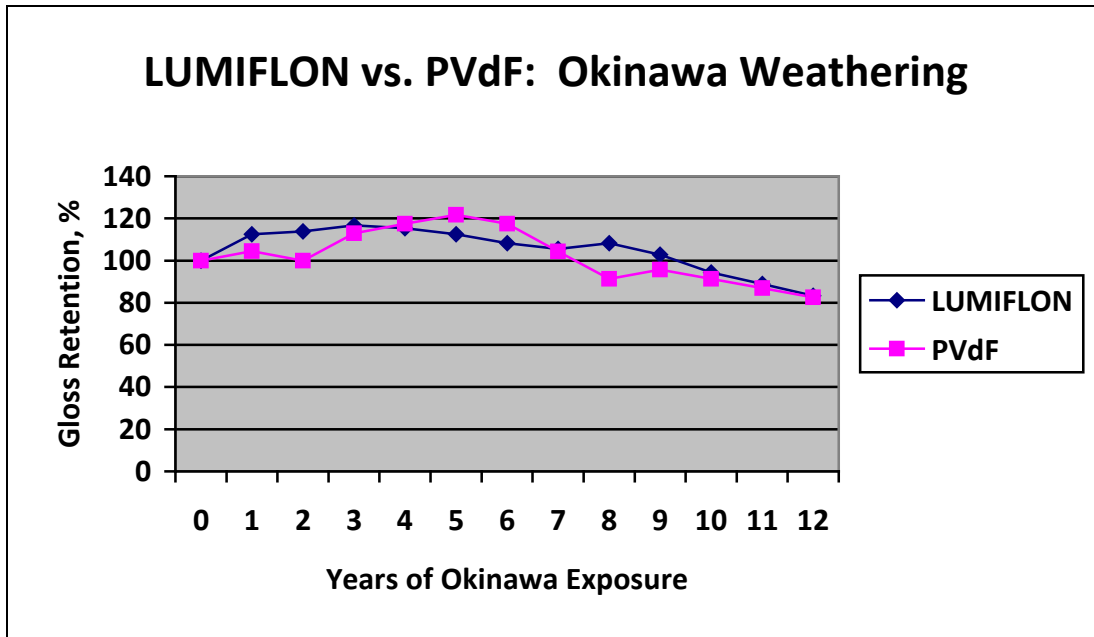
Xenon Arc Accelerated Weathering Test, 11,000 Hours



EMMAQUA Accelerated Weathering Test, 2,800 mJ/m²

Both the Xenon Arc test and the EMMAQUA test show that crosslinked FEVE coatings match the weatherability of 70% PVDF coatings. It is believed that in the EMMAQUA test, 100 mJ/m² of energy imparted to the test panels is equivalent to about one year of actual outdoor exposure.

Crosslinked LUMIFLON coatings have also been compared to PVDF in actual weathering tests on Okinawa. Results are shown below.



As the chart above shows, both LUMIFLON and PVDF have excellent weatherability in the harsh marine environment found on Okinawa.



Shown above are photographs of panels that were weathered for 10 years. These photos show that the LUMIFLON coated panels weather extremely well.

In summary, both accelerated and natural weathering tests show that LUMIFLON FEVE resins offer the same excellent weatherability as do coatings based on PVDF.

While the weatherability of crosslinked FEVE coatings matches that of PVDF, FEVE coatings offer advantages over PVDF coatings. The table below summarizes these advantages.

LUMIFLON	PVdF
Thermoset Polymer Better mechanical properties	Thermoplastic Polymer Poor mar resistance Higher elongation
Solution Polymer Bright, clean, crisp colors Excellent pigment compatibility Can use organic pigments Wide range of gloss	Polymer Dispersion Limited colors Low to medium gloss
Ambient or Elevated Temperature Cure Versatility in application Easy to repair and recoat	Elevated Cure Temperature Shop application only Poor recoatability
Unique Chemical Structure Ultra-weatherability derives from structure Better corrosion resistance without primer	Fluoropolymer/Acrylic Blend % fluorine drives weatherability Acrylic degrades over time

This paper focuses on the weatherability of resins in coating systems. Weatherability can be affected by other coating components, including pigments, additives, and other resins. It is crucial that all coating components be chosen carefully so as to not adversely impact weathering of the entire coating system.