

**Solvent Resistance – MEK Double Rubs**

ASTM D5402-15 was employed to test the resistance to a harsh solvent. Generally, this method correlates well to gel fraction, although can be influenced by monomeric composition and morphology. The test demonstrated that the developmental resin, ZEFFLE SE, performed similarly to the 2K solventborne resin in the white pigmented coating (Figure 2).

**Cleanability**

The coatings were applied to an aluminum coupon and cured. A xylene-based marker of black, red and blue colors were applied to the coating and dried ambient for 3 h. A Kimwipe was wet with ethanol and the marker was removed as much as would release from the coating. The results were recorded as removed or not (pass/fail).

All three markers were fully removed from the developmental resin in the white coating as tested by this method. The other two systems failed one marker color each (Figure 3). These resins are targeted for the industrial market, but it is expected that resistance to household stains and cleanability would be similar.

**Conclusions**

This study has shown that low-VOC waterborne fluorourethane paints can be formulated that are equal to the performance of solventborne fluorourethane paints when used on metal. These coatings are two-component waterborne polyurethanes consisting of a waterborne VdF copolymer with a water-dispersible polyisocyanate. The waterborne fluorourethane coatings show laboratory results equal to, or better than, standard solventborne polyurethane coatings in solvent resistance, adhesion to a difficult substrate, resistance to permanent marker and ease of clean up. It is expected that both natural and accelerated weathering testing in progress will exhibit the same trend and provide similar or better gloss retention and nonyellowing over a long period of time.

**Future Work**

Daikin is investigating the development of other resins of this type, varying the parameters for crosslink density, Tg/MFFT and monomer type. These variations are necessary to match the types of applications a high-performance resin can provide to the industrial coatings market. In addition, several of the other commercial fluorinated materials manufactured by Daikin have been found to be synergistic to the solventborne resin. It is expected that many of these same additives will have a similar combined effect and increase specific properties of interest and need. ■

For more information on Daikin surface modification technologies, please visit [www.daikin-america.com/surfacetechologies](http://www.daikin-america.com/surfacetechologies).

Note: The views, opinions and technical analyses presented here are those of the authors. The use of specific raw materials indicates a preference related to performance in the specific coating, and in no way is any indication of affiliation with the supplier.

**References**

<sup>1</sup> [www.g2mtlabs.com/?s=corrosion+costs](http://www.g2mtlabs.com/?s=corrosion+costs)

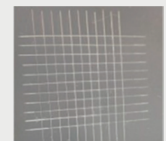
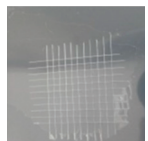
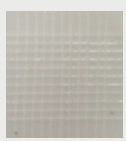
**Appendix**

**Formula 1C: Clear ZEFFLE SE-2K**

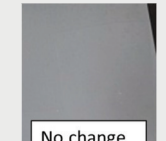
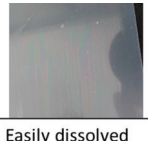
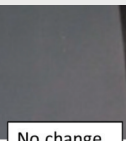
Raw Materials	Parts per Hundred (% by Weight)
ZEFFLE SE-2K (Daikin)	90.83
Coalescent (Dielthyl adipates)	4.54
Defoamer (BYK® 028, BYK-Altana)	0.09
Thickener, 10% solid (ADEKA NOL UH-420)	4.54
<b>Total</b>	<b>100.00</b>
<i>Add Bayhydur® XP-2700 to component A under moderate shear</i>	
A Component	95.69
Bayhydur XP-2700	4.31
	<b>100.00</b>

NCO/OH=1.3

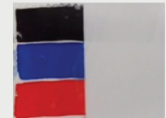


**FIGURE 1** » Cross-hatch adhesion results by ASTM D 3359-09e2.

	New X-Linkable ZEFFLE SE	Current 1 Kit Type ZEFFLE SE-310	Current 2 Kit Solvent Type ZEFFLE GK-570
<b>Appearance after testing on PET</b>	 2.5 mm width	 2.5 mm width	 2.5 mm width
<b>Adhesion (Remained square/100)</b>	○ (100/100)	X (0/100)	○ (100/100)

**FIGURE 2** » Solvent resistance – MEK double rubs.

Substrates	New X-Linkable ZEFFLE SE	Current 1 Kit Type ZEFFLE SE-310	Current 2 Kit Solvent Type ZEFFLE GK-570
<b>PET</b>	 No change	 Easily dissolved	 No change

**FIGURE 3** » Cleanability test.

Sample Name	New X-Linkable ZEFFLE SE	Current 1 Kit Type ZEFFLE SE-310	Current 2 Kit Solvent Type ZEFFLE GK-570
<b>Coating system Al plate/Sample (white)</b>			
<b>Result</b>	Fully removed	Blue and red removed	Black and blue removed