

## Investigation of polymer coating morphology with XRD

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Fluoropolymer based coatings offer numerous advantages in terms of weatherability, color, and gloss retention, long term durability, and high resistance to dirt pickup. These coatings are typically applied to metal panels on an industrial scale through a coil coating process. Fluoropolymers have been a material of choice for decades for architectural exterior applications such as metal roofing, metal curtain-wall systems, windows, skylights, panel systems, storefronts, and doors<sup>(1)</sup>. Poly(vinylidene difluoride) or PVDF, manufactured by Arkema under the Kynar<sup>®</sup> trade name, is a fluoropolymer that has been successfully used for exterior architectural coatings for more than 50 years<sup>(2)</sup>. Kynar<sup>®</sup> resins can be formulated in a 70/30 ratio with an acrylate phase to increase bonding of the coating to the substrate, and also typically include pigments such as titanium dioxide.

In this paper we illustrate the impact of coil coating processing conditions and the effect of processing condition deviation on final coating properties. Of particular interest in our study is to define crystallinity and polymorphism in a PVDF/PMMA polymer blend as it relates to process conditions combining solution casting and annealing. Several published studies touched on individual aspects of conditions occurring in coil coating operations such as the impact of PMMA on PVDF morphology under melt processing conditions<sup>(3)</sup>, effect of various solvents on PVDF<sup>(4)</sup> and PVDF/PMMA<sup>(5,6)</sup>, thermal treatment, as well as the influence of inorganic additives<sup>(7)</sup>, but none have combined all the factors typically used in coil coating processing conditions.

A series of analytical tests such as t-bend test, rheology testing and X-ray diffraction have been combined to relate coating morphology to performance. The analytical characterization is further challenged by the fact that coatings are relatively thin (typically 25  $\mu\text{m}$ ) and that some coatings can present a very low degree of crystallinity. The approach taken for the X-ray diffraction study required using known PVDF crystallographic data from well crystallized samples to more reliably quantify crystallinity and identify the various PVDF phases in the coatings.

### References

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