– JAMES KOHL –

INTERVIEW

James Kohl has research interests in mechanical properties and failure analysis of polymer materials as well as adhesion of silicone coatings and tribology. In the 1990s he worked at the Navy Research Laboratory where he was part of a group that performed progressive scratch tests on elastomer coatings. He performed scratch testing on foul release coatings which contained a silicone topcoat and a silicone base coat and are currently being used on ship hulls. Professor Kohl and his team were the first to perform progressive scratch tests on silicone bilayer coatings.

He then worked for Chromalloy in Dallas, Texas on repairing compressor blades and vanes of aerospace engines where he also held the position of Vice President of Airfoil Operations and Engineering. After his career at Chromalloy he became Assistant Professor at the US Military Academy. After two years at USMA, he started working at the University of San Diego.

What specific problem do you want to solve?

I continued my research on silicone coatings at USD because they were easy to make. I asked myself, what would happen if the silicone coating was not uniform? I intentionally made silicone coatings with a thickness gradient. Scratch tests were then performed on these coatings with a constant normal load, both going from thick to thin direction and vice versa. Another study that was performed using an Anton Paar scratch tester was investigating the scratch speed and its effect on scratch failure on epoxy and polyester composites.

What results did you get from the scratch testing instrument?

The scratch testing on coatings with the silicone coating thickness gradient was very interesting: We found out that the scratch behavior (adhesion, cohesion) was different going from thin to thick when compared to from thick to thin. This study was published in the Journal of Applied Polymer Science in 2012.

We also investigated constant load scratch tests at different speeds on polyester/fiberglass composites. There we could see a clear change in the failure mechanism. For the slow speed you would see these nice repetitive mounds on the scratch track, and for the high scratching rates these mounds did not have time to form, so it looked more like a regular scratch. That was published in Wear (An International Journal on the Science and Technology of Friction, Lubrication and Wear) in 2016.

How did testing help you solve the problem?

Using these tests has helped me understand the scratch behavior of several different types of polymeric materials. In the case of silicone coatings we found that the scratch behavior of coatings with a thickness gradient depended on the direction of the scratch, i.e., from thick to thin or vice versa.

The testing provided by Anton Paar also allowed us to apply Dr. Norbert Schwarzer's (coauthor on many of our papers), new phenomenological model to determine the viscoelastic parameters of epoxy and polyester from continuous microindentation tests and the stress dependence on sliding speed during a scratch test.

What aspect do you like most about the Anton Paar instrument?

I like the fact that you can see great pictures of the wear track as well as record the measurements of the tangential force as it proceeds with the test. The interface is very user-friendly.

Would you recommend this instrument to other people dealing with similar applications? If yes, why?

Yes, because – as we have shown in previous studies – the scratch tester is a very good instrument for characterizing the wear, scratch, and frictional behavior of different polymeric materials. The micro/nanoindenter provides a very good method of determining the mechanical properties of very thin polymer coatings.