INDUSTRIAL PILOT PROJECT

Study of film forming process of polymer-based coatings with neutron reflectometry

THE INDUSTRIAL CHALLENGE

Film-forming products such as polymer-based coating systems contain components with several different functions such as film durability, water resistance, dirt repellence and increased flatness of the formed surface of the film. By better understanding of the processes that can take place in soft thin-films of sub-micron thickness one can improve product properties and optimize product composition. The properties can also be improved by an increased understanding of how different components affect the final dry film, such as film over-all thickness and formation of internal structure on the nanometre scale within the film.

WHY USING A LARGE SCALE FACILITY

Neutron reflectometry is a surface sensitive technique, suitable to study very thin films. The technique can provide valuable information on the thickness and composition of a film on a molecular length scale and increase our understanding of how different components in a commercial formulation affect the final dry film. Due to the properties of neutrons we also get information of structures inside the solid soft film, which in our case is formed from a water-based emulsion. This ability to see inside the film and to measure formation and deformation of structures on the nanometer scale in-situ makes this technique very valuable.

HOW THE WORK WAS DONE

The SuperADAM reflectometer at the neutron source Institute Laue Langevin (ILL) in Grenoble, France, was used to study the structure of a film forming formulation. The films were measured directly after deposition and changes with time (hours and days) were observed. These results were also compared with films that had aged for several months. We also exchanged some components in the formulation to learn about their effect on the final film. Researchers from both Gipeco AB and RISE Research Institutes of Sweden were present at the measurement, and the team received excellent support from the SuperADAM instrument team prior to and during the measurement. We also used lab-based X-ray grazing-incidence small angle scattering and profilometry to characterize our thin films prior to neutron measurement. Complementary measurements using ellipsometry were performed on a selection of films on-site prior to and after neutron measurements. The Figure displays the experimental station with four samples mounted on a holder specifically modified for the needs of this experiment

Figure. Mikael Kjellin, RISE, checking the mounted samples.

THE RESULTS AND EXPECTED IMPACT

This study of a commercial film forming formulation has provided increased understanding of its properties. We have seen that neutron reflectometry can be an important technology in the process to find new more efficient components in an already existing formulation. We also envisage that the technique can be a relevant tool in late development work of completely new formulations. As a result of this experiment we expect to improve the properties of one of our products when it comes to wear resistance, cleanability, and dirt repellent properties. During the time at ILL we also met many other scientists and had several fruitful discussions.

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