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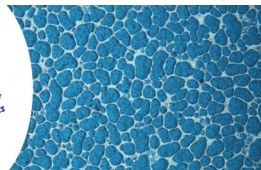
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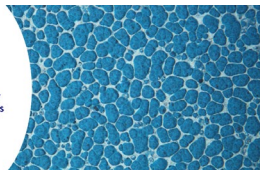
Non-destructive evaluations of water uptake in epoxy coating

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Water uptake can be considered as the first stage of organic coating ageing in humid conditions. Water can fill in voids –the free form and interact with polar groups in the binder[1]. The absorption of water molecules in organic coatings can cause severe defects such as polymer hydrolysis[2], leaching[3], swelling and blistering[4] therefore resulting in the reduction of the coating film's protective properties. Thus, understanding the mechanism of water adsorption to the coating is essential for improving coating barrier properties. Many studies have investigated the water absorption process in organic coatings using electrochemical spectroscopy (EIS) [5][6][7] which follows the change of dielectric constant of the coating through the estimation of the coating capacitance change. The most common approach is using Brasher-Kingsbury[8] equation to estimate the volume fraction of water absorbed. However, the accuracy of the Brasher-Kingsbury equation has been questioned where several papers[5][9] claimed an overestimation of water uptake compared to gravimetric evaluation. It was also proposed to use modified determinations of film capacitance [10][11][12] or incorporation of a coating swelling coefficient into the Brasher-Kingsbury equation to get compliance results to the gravimetric data. However, the discussion on the role of the swelling plays on water uptake of the organic coating remains open. In this study, Scanning Acoustic Spectroscopy (SAM) is applied as an additional non-destructive technique to study the water uptake in epoxy coatings by direct measurement of the coating swelling process through the evolution of height in real-time. The application of SAM introduces a new methodology to estimate the volume expansion in coating caused by the process of water uptake. SAM would provide a new benchmark to the existing way of monitoring the swelling process in organic coating and the impact of adding a swelling factor to the Brasher-Kingsbury equation derived from EIS measurement results can be determined.



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