

### 1.5.18. FAILURE OF THIN ORGANIC FILMS: ELECTROMAGNETIC VERSUS ELECTRONIC TECHNIQUES

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In the present work, the temperature versus thermal deformation (strain) with respect to time, of different coating films were studied by a non-destructive technique (NDT) known as shearography. Organic coatings such as ACE Premium-grey Enamel, a yellow Acrylic Lacquer, and a gold Nail Polish on a metallic alloy, i.e., a carbon steel, was investigated at a temperature range simulating the severe weather temperatures in Kuwait especially between the daylight and the night time temperatures, 20 – 60°C. The reason of selecting such organic coatings for this investigation, on a solid substrate, i.e., the carbon steel, because the coatings are well known of their common use on diverse structures (1 – 3). The investigation focused on determining the in-plane displacement of the coating, which amounts to the thermal deformation (strain) with respect to the applied temperature range. Furthermore, the investigation focused on determining the thermal expansion coefficients of coatings, the slope of the plot of the thermal deformation (strain) versus the applied temperature range. In other words, one could determine, from the decreasing value of the thermal expansion coefficients of coatings, a critical (steady state) value of the thermal expansion coefficients of coatings, in which the integrity of the coatings can be assessed with respect to time. In fact, determination of critical (steady state) value of the thermal expansion coefficients of coatings could be accomplished independent of parameters, i.e., UV exposure, humidity, exposure to chemical species, and so on, normally are considered in conventional methods of the assessment of the integrity of coatings. In other words, with the technique of shearography, one would need only to determine the critical (steady state) value of the thermal expansion coefficients of coatings, regardless of the history of the coating, in order to assess the integrity of coatings. Furthermore, results of shearography indicate that the technique is very useful NDT method not only for determining the critical value of the thermal expansion coefficients of different coatings, but also the technique can be used as a 2D-microscope for monitoring the deformation of the coatings in real-time at a submicroscopic scale. Also, the obtained data of the shearography technique were compared to data obtained by electrochemical impedance spectroscopy (EIS) in 3% NaCl solution.

#### References:

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