Abstract

The characterization of long-term responses of materials and structures to complex and cyclic environmental conditions presents a difficult challenge. This long term response can be associated with the aging response of a component and/or structure. In most cases, service failures occurs due to inaccurate characterization of aging response which eventually results in potentially costly repairs and/or premature component replacement. In safety-critical applications such as nuclear reactors and commercial aircraft the downtime associated with the long-term degradation response of the structure and/or component can be significant. Thereby an approach based on a more fundamental understanding of materials response, its degradation methods will help us to comprehend the long term response of these materials and/or structure. Epoxy resin and glass fiber composites made with epoxy resin have been considered in this work at the material and component level respectively. The extreme environmental conditions considered in our study includes long term exposure to normal and saline water, cold temperature. Experimental investigations have been carried out both at stuctural and/or component level (GFRP composites) as well as material level (neat epoxy matrix).

In order to mitigate the degradation response of the material subjected to extreme environmental conditions, nano particles have been used in this work. Performance improvement at the material and/or component level has been observed in our study with the addition of nanofillers. Characterization at the material level has been done using spectroscopic studies (Terahertz-time domain (THz-TDS) and Infrared (IR)spectroscopy) along with thermal analysis (DSC), whereas characterization at structure/component level has been done based on tensile tests.

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