Abstract

Fiber reinforced polymer (FRP) composites are replacing the conventional materials for marine applications due to greater strength to weight ratio, superior resistance to sea water and other corrosive agents present in marine environment. However, the aggressive marine environment challenges even the superior chemical and corrosion resistance properties of FRP. The focus of the current study is to develop a new class of FRP composites incorporating nanoparticles in the polymer matrix (FRP-Nano) which is expected to have better lifetime in the marine environment due to the barrier properties of nanomaterials. The major challenges for the development of FRP-Nanocomposite laminates are the proper dispersion of nanoparticles in the resin, development of a suitable technology called Vacuum Infusion Resin Infusion Molding (VARIM) for manufacturing FRP-Nanocomposite laminates, ageing study to understand the effect of time, temperature and nanoparticles loading on the FRP composite laminates and establishing methodology for estimation of lifetime for FRP and FRP-Nanocomposite laminates. In this study, optimum dispersion technology was established for three sets of resins and corresponding nanoparticles combinations i.e., epoxy resin with Nanomer I30E, unsaturated polyester (USP) resin with Cloisite 30B and vinyl ester (VE) resin with Cloisite 15A system, which is key parameter for manufacturing FRP-Nanocomposites and nanodispersed resin plaques. Rheology and kinetic parameters were studied for all three resin systems with and without nano loading. In resin plaques, epoxy resin system is showing less reduction than the VE and USP resins. Ageing study confirms that VE-FRP composite laminates show better performance than epoxy and USP glass FRP composite laminates. It is evident that influence of nanoparticle on the ageing performance has improved with increasing loading levels of nanoparticles. The nanodispersed resin plaques are showing more reduction than FRP-Nanocomposite laminates in both VE and USP resin systems. The reduction in flexural strength is high in USP FRP-Nanocomposites than VE FRP-Nanocomposite laminates. Methodology for estimation of the lifetime has been established and lifetime of FRP and FRP-Nanocomposite laminates has been estimated. Estimated lifetime for different FRP composite laminates indicated that the VE resin was the best performing among the three resin systems studied. It has

also been found that the effect of nanoparticles on the lifetime of vinyl ester resin is the maximum compared to other systems.

Keywords: FRP-Nanocomposite laminates, Barrier properties, Dispersion study, VARIM, Ageing performance and Lifetime estimation