
ABSTRACT

Advanced composites are excellent alternatives relative to conventional materials due to high specific strength; ease of manufacture, tailor-made properties and also due to the superior resistance to other corrosive agents. Distributed Optical Fiber Sensors (DOFS) can be a very good tool for monitoring the health of the composites under numerous service conditions. Based on the key performance requirements of the composites for various industrial applications, this research work investigates the performance and health monitoring of advanced composites under corrosive media and impact load along with the performance of defective zones under load. During this technology development a significant knowledgebase is generated related to the types and working principles of optical fiber sensors and their limitations along with the signal processing techniques. In this work, a fabrication technique is developed by instrumenting the DOFS in the composite structure without affecting its integrity. The long-term performance of the composites in aqueous 10% sulphuric acid and 28% hydrochloric acid solutions has been studied by evaluating the transport kinetics, the chemo-mechanical properties as well as the mechanistic changes in the composite structure with the exposure time. This research also investigates a health monitoring system based on Internet of Things (IoT) architecture to evaluate the health of DOFS instrumented composites subjected to corrosive media. The performance and health monitoring of composite structures under impact load has been carried out using the spherical and conical impactors which has been numerically validated. IoT architecture has been developed for detection of the impact incidents with quantification of the severity of the impact on the composites. The performance and health monitoring of the defective zones under load in Distributed Optical Fibre Sensors (DOFS) instrumented composites has been studied as they are the worst-performing part of the entire composite structure. Also, a health monitoring system based on IoT architecture has been established for the detection of the defective zones under load in the composite structure. The research work demonstrated that the signal response of the DOFS instrumented in the composites can be effectively used for evaluation of the performance and health of the composites.

Key words: Health monitoring system, Distributed Optical Fiber Sensor (DOFS), Corrosive media, Impact load, Defective zones under load, Internet of Things (IoT) architecture.