

ABSTRACT

The thesis encompasses the development of suitable acoustically transparent polymeric materials in the strategic sonar frequency range for encapsulation of underwater electroacoustic transducers. Underwater electroacoustic transducers are used for transmitting and receiving acoustic signal. Before underwater usage, these electroacoustic transducers are required to be encapsulated with an acoustically transparent material in the desired frequency range. Polymeric materials developed for above said applications are based on **Neoprene rubber, Castable Polyurethane, Polyurethane-POSS nanocomposites, neat Epoxy and Epoxy-silica nanocomposites** considering different operating frequency and depth of operation of transducers. These materials are selected for making acoustically transparent and subsequently used for transducer encapsulation applications as their acoustic impedance can be made to match with the acoustic impedance of sea water. Other properties like mechanical, viscoelastic, electrical, environmental and ageing properties are designed and modified as per requirements of operating frequency, temperature and depth of operation of transducers. Neoprene rubber based compounds are developed with different hardness to withstand the hydrostatic/hydrodynamic pressure exerted on them i.e to use the encapsulated transducers at different depth of water. Transducers were encapsulated with developed material by two stage-transfer moulding technique. Neoprene rubber compounds filled with different fibers like glass, cotton and nylon were developed to withstand more hydrostatic pressure and to give better structural rigidity and dimensional stability to the encapsulated transducers. The acoustic window for accommodating transducers are fabricated with developed material by compression moulding technique. The castable polyurethane with four different compositions were developed to encapsulate transducers through open and pressure casting technique. Similarly five different compositions of epoxy material were developed and used to encapsulate transducers by open cast technique. Four types of Polyurethane-POSS nanosilica composites and four types of Epoxy-Nanosilica composites were prepared and used for encapsulation of transducers using open cast technique. Acoustic properties like sound speed, acoustic impedance, insertion loss, echo reduction for all the developed material were tested in acoustic tank and found satisfactory to be used as transducer encapsulation applications. Encapsulated transducers were evaluated for acoustic performance (TVR and RS) and pressure withstandability revealing very good results. Different encapsulated transducers developed are used for different underwater applications.

Keywords: Polyurethane, Epoxy, Neoprene, nanosilica, transducer, sound speed, acoustic impedance, insertion loss, echo reduction, transmitting voltage response, receiving sensitivity, modeling