PhD Proposal

MULTILAYER SELF REINFORCED POLYPROPYLENE NANOCOMPOSITES: ENHANCED MECHANICAL AND FIRE RETARDANT CHARACTERISTICS

ABSTRACT

Polymeric materials are widely used as compared to traditional inorganic materials as they have excellent insulation characteristics, low electric losses and are easily mouldable. The commonly used wire and cable sheathing materials for low to medium voltage include HDPE, EVA, LLDPE, PVC and EPDM elastomer. However, PVC is gradually being replaced with other polyolefins as it is hazardous and releases chlorine containing compounds. Hence, the other polyolefins resins such as PP, HDPE, EVA, LLDPE and EPDM are in demand. However these polyolefins are inflammable and fire safety is a major issue. Generally, halogenated fire retardant additives are added but they are not environment friendly. Thus, non-halogenated fire retardants such as metal hydroxides are used. These metal hydroxides have to be used in large quantities to achieve adequate fire retardancy which lower the mechanical properties. However, a good cable jacketing materials need both good flame retardancy and mechanical properties. Thus, intumescent fire retardants and nanoparticles such as nanoclays and nanotubes are being used but dispersability and interfacial adhesion have to be improved. Intumescent fire retardant systems comprised of Ammonium Polyphosphate (APP) are used but they are moisture sensitive and can easily hydrolyze. Further it also tends to migrate to the surface.

Thus in this study, non-halogenated fire retardant PP nanocomposites with incorporation of Glass Fiber, Woven Cloth, Nano Clay, Charring Agent and Acid for automobile and electrical industries will be developed. The developed polymer nanocomposites will be characterized for its mechanical, flame retardant and thermal properties as well as its surface morphology and molecular interaction.

STATEMENT OF THE RESEARCH PROBLEM AND OBJECTIVES

The project aims at development and characterization of polymeric nanocomposites. The following intumescent flame retardant additives will be used in combination to study and improve fire safety.

a) Polypropylene reinforced with Glass Fiber, Nano Clay, Charring Agent and Acid Source
   - Synthesis of Triazine charring agent
   - Modification of Ammonium polyphosphate with silane (mAPP)
   - Preparation of nanocomposites
b) Polypropylene reinforced with Woven Cloth, Nano Clay and Acid Source
   - Modification of Ammonium polyphosphate with silane (mAPP)
   - Microencapsulation of mAPP and Dipentaerythritol in Melamine Formaldehyde
   - Preparation of nanocomposites

The effects of incorporation of Glass Fiber, Woven Cloth, Nano Clay, Charring Agent and Acid Source on synthesized polymer nanocomposites for its mechanical, flame retardant and thermal properties as well as characterization of nanocomposites for its surface morphology and molecular interaction shall be studied.

MATERIALS AND METHODS

- *Blend Preparation:*
- *Compression moulding:*
- *FTIR spectroscopy:*
- *Universal testing machine:*
- *X-Ray diffraction:*
- *Differential scanning calorimetry:*
- *Thermo gravimetric Analysis:*
- *Cone calorimtery:*
- *Morphology:*

EXPECTED OUTCOMES

➢ Improvement in the mechanical and flame retardant properties of multilayered reinforced nanocomposites used mainly in automobile and electrical industries for manufacturing of bumpers, tanks, carpet fibers, cable sheathing etc.

➢ Development of fire retardant materials would help to delay for the fire to occur which may takes place either due to short circuiting or any other type of mishap, thus saving human lives.