

ABSTRACT

The globalization of world market has put sufficient pressure on manufacturers to diversify their products and develop some new technique to provide various technical products, different than traditional textile use for apparel purpose. For the use of textiles in technical or industrial applications, the textile materials needs to be more functional, flexible, high temperature resistance, more stronger etc. than just looking beautiful or feeling good. But to adopt this concept is difficult for people, who are in traditional textile business since ages. They are reluctant for changes and not ready to discard their existing machine or set up. The demand of producer is to diversify the products with some modifications in existing process or set up. The present research work has attempted to modify existing mingling process to produced technical yarn for thermoplastic composite applications.

Advance technology creates a need for various materials having combinations of properties that no individual material can provide; therefore today, composites become the material of choice. Composite can be defined as combination of dissimilar materials to perform a task that neither of the individual constituent material can perform alone. A textile composite is made of textile reinforce and a matrix material in form of fibre, yarn or fabric. These textile materials are transformed into certain structures called textile preforms. The consolidation of preforms with matrix materials results into textile composite. Recently these long fibre-reinforced composites have become very popular in providing the aerospace, automotive and engineering industry with extremely strong and lightweight composite structures. Also use of thermoplastic fibre such as polypropylene, in a commingling form, provides a cost-effective route to composite production of composites.

In present study, the work was initiated with concept of mixing the two dissimilar materials to be use in composite. First, the hollow spindle wrapping technique has been used for yarn formation to combine two dissimilar materials in core and sheath structure. The hollow spindle wrapping machine was fabricated as part of this work. The various materials such as glass or

carbon as reinforced material and polyester and polypropylene as matrix have been used to study the characteristics of hollow spindle wrapped hybrid yarn. Further, the same technique has been explored to design and develop various application base study of conductive hybrid yarns. The conductive yarns were prepared incorporating copper wire with glass in core and wrapped by polypropylene filament. To study the various characteristics, the conductive yarns made have been with different proportion of glass, polypropylene and copper. These yarns have been used to make knitted preforms and finally consolidated in laminate using hot press. The different properties of conductive hybrid yarn laminates viz. dielectric strength, flexural rigidity, surface resistivity and volume resistivity have been evaluated for characterisation of conductive materials. The structure of yarns and laminates also has been analysed by Scanning Electron Micrograph(SEM) to study mixing behaviour of glass and polypropylene within yarn.

The another method for hybrid yarn formation viz. commingling process was selected to study the different yarn passages for commingling technique. Based on this study, the commingling machine has been modified to produce commingled hybrid yarns. The hybrid yarn properties of resultant yarn mainly depend on pre-opening and intermixing of component elements. As the commingling characteristics of the yarns are important for its end use, the effect of process parameters on structure and properties of hybrid yarns has been studied.

Further work was extended mainly to emphasis the development of new type of commingling machine to producing hybrid yarn using two different techniques viz mingling technique and hollow spindle wrapping technique on only one machine. The effect of processing parameters on commingled yarn has been studied to get homogenous mixing in final yarn. The commingling machine has been modified and fabricated to produce hybrid yarn. The effect of main parameters on commingling process viz. design of jet, proportion of component yarn and processing parameters has been studied. This present study has been carried out using glass and polypropylene to produce commingled hybrid yarns prepared on this machine.

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The important processing parameters that influence commingled hybrid yarns are air pressure, overfeed and take-up speed. The influence of process variables on characteristics of glass/polypropylene hybrid yarns has been studied using Box-Behnken response surface design. The characteristics of these yarns are evaluated for its optimum behaviour in terms of homogeneous mixing of component yarns by visual inspection of SEM micrograph.

Different methods of hybrid yarn manufacturing also have been studied to compare the mixing behaviour of glass/polypropylene in the hybrid yarn. Four different methods have been used to prepare hybrid yarn viz. friction spinning, hollow spindle wrapping, commingling and combination of wrapping/commingling technique for this purpose and various mechanical characteristics of these yarns have been evaluated.