ANALYSIS OF MECHANICAL BEHAVIOUR OF BANANA-COTTON WOVEN FABRIC/VINYL ESTER COMPOSITES

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CERTIFICATE

The research work embodied in the present Thesis entitled **"ANALYSIS OF MECHANICAL BEHAVIOUR OF BANANA - COTTON WOVEN FABRIC/VINYL ESTER COMPOSITES"** has been carried out in the Department of Textile Technology, PSG College of Technology, Coimbatore. The work reported herein is original and does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion or to any other scholar.

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ABSTRACT

Many researches have been carried out on natural fibres as replacement for traditional synthetic fibres in the field of composites materials. Recently the increasing interest in environment awareness motivates the researchers to carry out more studies on effective utilisation of natural fibres.

Due to the environmental challenges like pollution, land fills, rapid depletion of natural resources vitalised way for hunting an alternate source for synthetic fibres. Agricultural wastes which were thrown away uselessly after the plaintain cultivation can provide an ideal substitute. Usage of agricultural wastes drawn noticeable attention as individually or in combination with fibres can replace many synthetic fibres in stuctural applications. The most important criteria is the effective usuage of the natural fibres in composite materials for their multi-functionality is of prime importance. This happens mainly by the combination of natural fibres with a very suitable resin matrix.

In view of all these aspects in this current work, banana fibres considering as waste from pseudostems of plant family Musaceae locally known as ‘banana plant’ and vinyl ester, a moderate effective resin with suitable properties were selected and subjected to the research work. The effect of different forms (fibre, fabric) of banana fibres on mechanical properties of the composites were studied for the upgraded performances.

The present study is aimed to analyse the mechanical properties of banana fibre and banana cotton fabric composites. The composite laminates were prepared by random distribution of raw banana fibres (RBF) of different cut lengths 2,4,6,8 and 10 mm with vinyl ester matrix by compression moulding machine. Manufacturing process includes hand lay-up, random distribution followed by hot compression moulding techniques to produce banana fibre reinforced vinyl ester composite laminates under high temperature and pressure. RBF were surface treated and then made into composites using

the same procedure. Comparison of mechanical properties of treated composites with untreated one were observed. Treated fibre composites shows increased mechanical properties. SEM images confirms the surface clearance due to the effect of alkali treatment on fibres.

The study also aims to analyse the impact of various weave patterns of RBF. Four different weave structures of plain, twill, sateen and basket were weaved in a handloom as banana-cotton hybrid fabric and made into composite laminates using compression moulding machine. To produce banana hybrid fabric reinforced vinyl ester composite laminates layers were stacked alternatively and evenly distributed (warp and weft) using hand layup technique. Mechanical properties were found to be superior for the plain woven fabric, and were used for further process in carrying out the research work.

The study also includes the analysis of the effect of surface treatment process. In this conjunction, different chemicals such as sodium hydroxide (NaOH), potassium permanganate ($KmNO_4$) and sodium laryl sulphate (SLS) were used for the surface treatment process on the plain fabric. Composites were prepared from the surface treated fabrics using compression moulding method. Mechanical properties like tensile, flexural, impact and compression properties were determined through a Universal Testing Machine (UTM).

In addition to this, effect of nano particles on mechanical properties were also studied. Halloysite Nano Tubes (HNTs) were incorporated IN the resin solution at fixed proportion of 0,1,2,3 and 4 wt-% for the plain woven fabric. Preparation of the homogenous solution is done using sonicator and vaccum desiccation process. The mechanical properties were analysed and also surface morphology and chemical constituents were examined using SEM and FTIR. SEM images confirm the good interfacial bonding between matrix and reinforcements. It was also revealed that the

prime reason for the failure of composites was due to de-bonding and fibre pull outs in the test samples.

The over all results of the mechanical properties of composites shows better values which discloses the versatile amicability of banana fibre with matrix and filler materials as fibre and fabric reinforcements in composites. The fibre reinforced composites shows enhanced properties generally at 6mm level of fibre length. Tensile and flexural properties increased around 40% each and 23% increase in impact properties Better properties were observed in the case of plain woven composites than other woven structures. The highest values obtained were 27MPa, 51 MPa, 36 MPa and 1.0 J/mm of tensile, flexural, compression and impact strength at 30 wt.% of fabric reinforcement.

Alkali treatment shows improved properties than untreated and other chemical treated composites which are taken as a whole. The plain weave composites posses highest values of tensile, flexural, compression and impact properties as 27MPa, 51 MPa, 36 MPa and 1.0 J/mm respectively at 30 wt.% of reinforcement. Also HNT added composite results shows an overall peak elevation at 2% level of nano particles in the mechanical properties. The tensile, flexural, compression and impact strength increases with the addition of HNTs by 84.37 %, 50.65%, 32.51% and 62.71% respectively. From the results obtained, it was observed that the desirable compositions were suitable for structural applications in automobiles.