

ABSTRACT

Natural fibre composites have become a popular new material because of their low raw material cost, easy availability, better strength, stiffness, and recyclability, renewable with environmental friendliness. Natural fibre composites are likely to be environmentally superior to glass fibre composites in most cases and natural fibre production has lower environmental impacts compared to glass fibre production. The tensile, flexural, impact and water absorption are the important properties of the natural fibres. This investigation is focused on Bamboo/Sisal reinforced unsaturated polyester hybrid composite. The objective of this research work is to study the mechanical and water absorption behavior of sisal fiber reinforced polyester composites and to estimate the condition that enables optimum mechanical and water absorption characteristics and to find out the effect of hybridization of bamboo fiber reinforcement with untreated and NaOH treated conditions.

Initially, the tensile, flexural, impact properties and water absorption characteristics are estimated for sisal/unsaturated polyester composite material and optimum fibre length and weight percentage are determined. To improve the tensile, flexural, impact properties, sisal fiber is hybridized with bamboo fiber. This research work shows that addition of bamboo fibre in sisal/ unsaturated polyester composites of up to 50% by weight results in increased mechanical properties with low water absorption property. Further, Morphological analysis is applied to observe fracture behavior and fibre pull-out of the samples using Scanning Electron Microscope (SEM).

In this research work, the effects of fiber treatment and concentration on the mechanical properties of short natural fiber reinforced polyester hybrid composite are investigated. The fibers are treated with 10% sodium hydroxide solution for 24 h. The mechanical properties of composites with alkali treated sisal/bamboo fibers are compared with untreated sisal/bamboo fiber hybrid

composites. The fractured surface of the treated fiber composite specimen is also studied using SEM. The NaOH treatment increased 30% of tensile strength, 27.49% of flexural strength, and 36.9% of impact strength and decreased 11.51% of moisture absorption behavior compared with untreated hybrid composite.

In order to overcome the limitations of the conventional methods such as wastage of materials and time consumption in experimental methods, optimization method using Neuro fuzzy and Genetic Algorithm (GA) is proposed in this research work. In this proposed methodology, the parameters (Fiber content, matrix proportion, fiber length) of materials are chosen in a random manner which provides the numerical data for the regression model. A mathematical model to estimate the mechanical properties of bamboo/sisal fiber hybrid polyester composite using experimentally observed data was developed. Adaptive Neuro Fuzzy Inference System (ANFIS) classification approach along with GA algorithm using MATLAB software was made in order to obtain the optimum condition that enables maximum mechanical properties

The developed Regression and ANFIS model were validated using six different experimentally observed values and it was found that both Regression and ANFIS model showed less average absolute error and hence these models can be used to predict the mechanical properties of sisal/bamboo hybrid polyester composite using the known values such as fiber length and fiber weight percentage.

When a MATLAB program is written to find out the optimum conditions which enable maximum mechanical properties using the genetic algorithm approach, the GA results substantiated the fact that better mechanical properties are possible with a fiber length of 15cm and fiber content of 20% in the case of sisal/bamboo hybrid composite.