WATER ABSORPTION AND EFFECT OF TEMPERATURE ON THE CHARACTERISTICS OF FLAX/HEMP REINFORCED COMPOSITES

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ABSTRACT

Composite are now accepted in various structural application; but the current emphasis has shifted towards environmental issues, which gives natural fibres the advantage as they are eco-friendly and biodegradable. This study involved the water absorption behaviour of flax/hemp combined natural fibres and the bending characteristics of flax/hemp polyester composites treated at various temperatures. The stiffness of the composite was observed to reduce at 110°C. The moisture absorption profile did rise to a variable plateau.

INTRODUCTION

The present day regulations as regards protection of the environment requires the development and understanding of the characteristics of eco-friendly structures such as natural fibre reinforced composites. Natural fibres offers both the benefits of weight reduction and cost savings compare to glass or carbon fibres; these are the primary drivers for the automotive industries interest on the research and use of natural fibre reinforced composites for some of the interior and exterior parts

Hart and Summerscales [1] subjected jute reinforced composites to various levels of temperature and different time durations; and tested for the mechanical properties. The degradation of the properties at elevated temperatures were reported; while Mustata et al [2] reported about the increase in tensile strength of flax and hemp yarns in the wet condition and decrease in the electrical resistance under the same condition. Mizera et al [3] investigated about the effect of water and temperature on the tensile properties of Ensete fibres and reported that the strength was stable within the range of 0 to 100°C and the moisture content only showed little changes on the strength values.

Tajvidi et al [4] used dynamic mechanical analysis technique to assess the thermal and mechanical properties of natural fibre composites and reported on the increase of the storage and loss moduli and the reduction of mechanical loss factor. Singh et al [5] investigated on the effect of curing temperature (80°C to 130°C) on jute fibre reinforced epoxy composites and noted the decrease in impact strength; and increase in both tensile and flexure strength till about 100°C.

The study of the water absorption characteristics and transition processes are of great importance in respect of the performance of natural fibre composites. This paper reports about the moisture absorption of flax/hemp combined fibres and the comparative strength of the composites with polyester as matrix material for sample at ambient temperature (17°C) and ones heated to elevated temperatures.

RESULTS AND CONCLUSIONS

The natural fibres available and used for this study was a mixture of both (hemp/flax) in an equal ratio of 50% each. The fibres were immersed in 500 cm^3 of distilled water and weight measurement taken after every 24 hours. The water absorbed calculated as the percentage change in weight and the result presented in Fig. 1. The plot rise to a peak values and then gradually stabilise to a variable plateau; this is thought to be because of the variabilities in natural fibre architecture and properties.

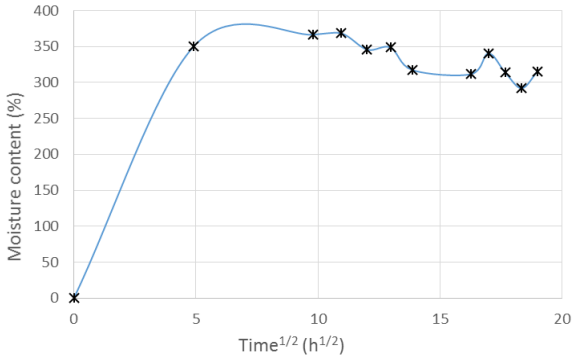

Fig. 1: Fibre water absorption over time.

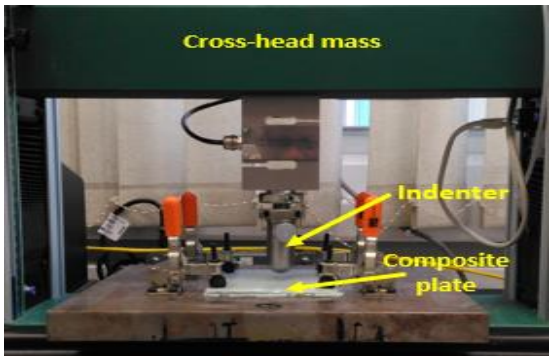

Fig 2: Composite plate under quasi-static loading.

Samples of hemp/flax reinforced polyester composites measuring 105 x 145 x 4 (mm^3) manufactured by hand lay-up and atmospheric curing, with approximate fibre volume fraction of 37% were tested under quasi-static loading upto 450 N using a Tinus Olsen 25 kN universal testing machine (Fig. 2) at the cross head speed of 20 mm/min. Four samples were manufactured and three of them were heated to 50°C, 80°C and 110°C respectively for 2 hours and then cooled to room temperature. A representative load – displacement graph is as presented in Fig. 3 obtained from the quasi-static test. The minor sharp drop in load is thought to be because of matrix crack.

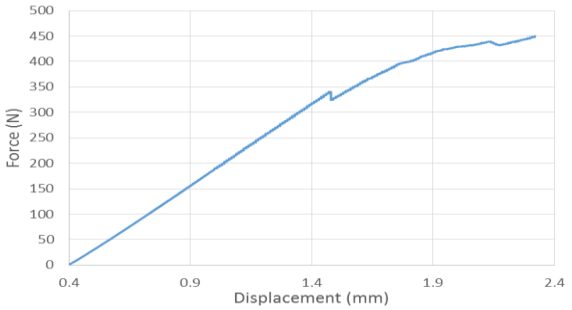

Fig. 3: Representative force – displacement test result.

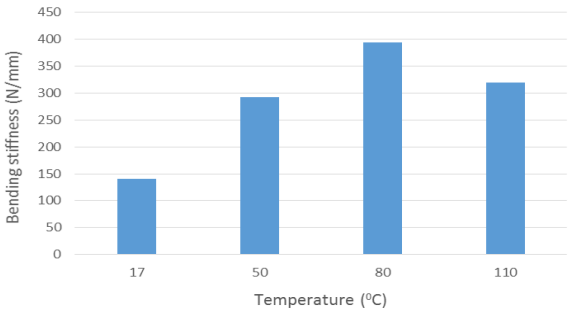

Fig. 4: Comparison of composite plate bending stiffness.

The gradient of the loading curves as estimate of the bending stiffness were calculated and compared in Fig. 4. The bending stiffness increases from sample prepared at room condition only, to the ones heated at 50°C and 80°C. The sample heated at 110°C has the drop in bending stiffness compared to the one heated at 80°C; this is likely because of changes in the matrix and fibre strength properties.

ACKNOWLEDGMENTS

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