Chemically Modified Glass and Cotton Fibres Reinforced Polyester Resins

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Introduction

The major components of a composite material are the fibre, matrix and interface phases, these determine the physical, mechanical and chemical behavior of the composite. The interface critically controls composite properties through mechanical coupling or micromechanical interlocking of the two materials. These interactions create a three-dimensional interphase region with properties different from the components. Fibre-Matrix interface is a critical factor that determines the potential properties of the composite (Gorbatkina, 1992). This research investigates the use of high-molecular-weight carboxylic acid as a compatibilizer for glass/ cotton composite.

Results and Discussion

Water absorption

Figure 1 shows that modified glass fibre-reinforced polyester absorbs less water than the unmodified ones at different fibre layers. This reflects the presence of fewer voids in the former (Oksman, 1997).

The same trend is observed by the cotton fibre reinforced composite. However, upon modification of the cotton fibre surface, the fibre-matrix interface are now adhered strongly together, thereby reducing the volume of water that is permissible into the interface (Tiamiyu and Ibitoye, 2006).

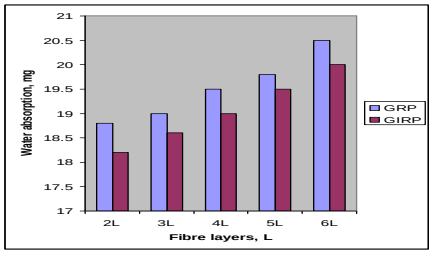


Figure 1, Relation between water absorption of GRP and GIRP against no. layers

Tensile strength

The tensile strength result in Figures 2 and 3 showed there is an improvement in the tensile strength upon modification of the fibres for glass and cotton fibres respectively.

The interaction mechanisms was expected between the hydroxyl group of the cotton fibre and the carbonyl group of the modifying agent, which brings about the increased in the tensile strength over the unmodified cotton fibre composite (Davies *et al*., 2005).

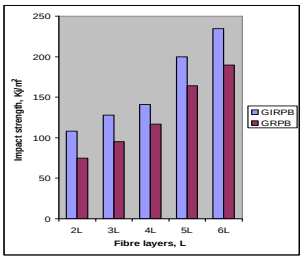


Figure 2, Variation in tensile strength of modified and unmodified glass fibre-reinforced polyester with no. fibre layers

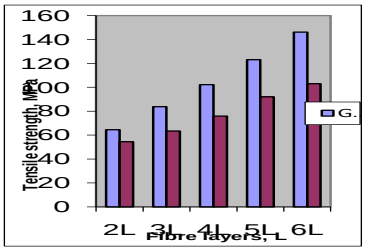


Figure 3:Variation in tensile strength of modified and unmodified cotton fibre-reinforced polyester with no. fibre layers

Impact strength

Figure 4 and 5, illustrate the variation of impact strength of the composites at different fibre layers composition. There is also a general improvement in the impact strength of the modified fibres compared to the unmodified one. This is associated with the increase in the adhesion strength at the fibre-matrix interface boundary (Otieno-Alego et al., 2001).

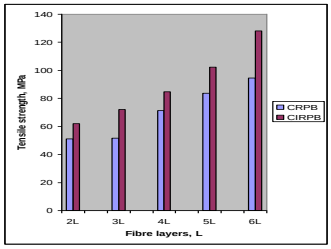


Figure 4, Variation in impact strength of modified and unmodified glass fibre-reinforced polyester with no. fibre layers

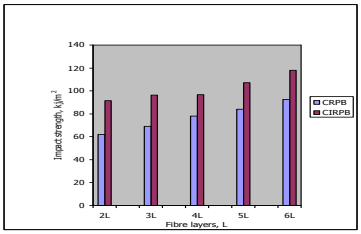


Figure 5. Variation in impact strength of modified and unmodified cotton fibre-reinforced polyester with no. fibre layers

Brinell hardness

Figure 6 and 7 depict the variations of Brinell hardness of the composites against number of Fibre layers and modification. This increased has been expected by the nature of the modified cotton fibre composite, as was observed in the tensile and impact strengths tests.

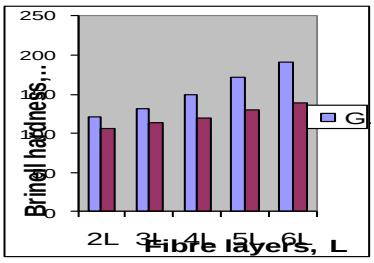


Figure 6.Variation in Brinell hardness of modified and unmodified glass fibre-reinforced polyester with no. fibre layers

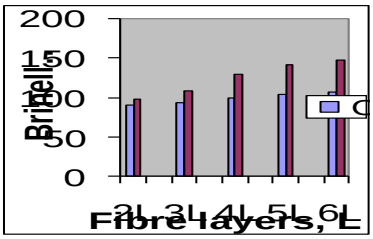
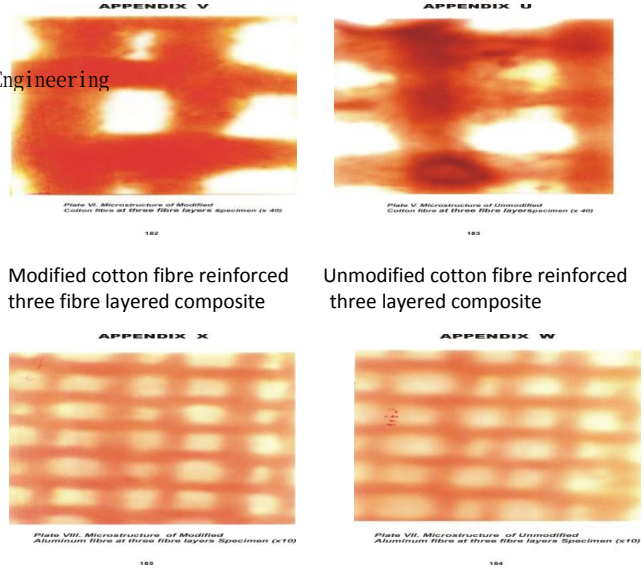


Figure 7.Variation in Brinell hardness of modified and unmodified cotton fibre-reinforced polyester with no. fibre layers

Microstructures of the specimens

Figure 8 shows the microstructures of modified and unmodified fibre composites at (X40) magnification. The modified glass fibre revealed the fibre-matrix interface with many void free spaces and less crystallined nature, while the unmodified glass fibre composite revealed few void free spaces and tans crystalline fibre-matrix interface boundary. The microstructures of cotton fibre composite (modified and unmodified) specimens observed at (X40), illustrated the modified cotton composite specimen's microstructure, which revealed many void free spaces within the whole fibre-matrix interface and less crystalline. These phenomena can be attributed to the hydrophilic nature of cotton fibre that gave more void spaces to moisture. While the unmodified cotton fibre composite microstructure revealed a less void free spaces and crystalline fibre-matrix interface.



Modified cotton fibre reinforced three fibre layered composite

Unmodified cotton fibre reinforced three layered composite

Modified glass fibre reinforced three fibre layered composite

Unmodified glass fibre reinforced three layered composite

Figure 8. Micrographs of the modified and unmodified cotton and glass fibre composites

Conclusion

The Physico-mechanical properties of modified fibre-reinforced polyester composite results obtained for water absorption, tensile strength, impact strength and, Brinell hardness revealed great improvement over unmodified fibre-reinforced polyester composites.

References

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