

CHAPTER V

CONCLUSIONS AND RECOMENDATIONS

The diamine-based benzoxazine was synthesized by condensation of ethylenediamine, phenol and formaldehyde. The chemical structure of the monomer was characterized by FTIR and NMR techniques. From the thermal characterization, the monomer showed the melting temperature at 110 °C and the multiple polymerization was observed at 180 °C and 207 °C. The polybenzoxazine was not degraded until 240 °C with the char yields of 41%.

The alkali treatment promotes the partial removal of the hemicellulose and makes the surface of the treated sisal fiber rougher and more crevices can be seen on the surface than the untreated one. The APS-treated sisal fibers showed the Si-O-Si bond and the Si-O-C bond in FTIR spectra which confirm the occurrence of a condensation reaction between the silane coupling agent and the sisal fiber. There is no dramatic change in the surface morphology of the silane treated fiber. Contact angle results revealed that the amino-functional silane coupling agent provided hydrophobic character on fiber surface. The silane was deposited on the fiber surface resulting in the increase of water contact angle and the alkali treatment enhanced the efficiency of the deposition.

The mechanical properties were found to improve significantly by incorporating sisal fibers in the benzoxazine/epoxy resin. Tensile properties, flexural properties and impact strength increase when fiber volume fraction increases. In terms of matrix composition, benzoxazine improves tensile and flexural modulus of the composites whereas epoxy improves tensile and flexural strength, toughness and processability of the composites. In general, fiber-matrix adhesion is better after the fiber surface treatments leading to improved mechanical properties of the composites.

Although the effect of matrix composition on mechanical properties of composites was studied, the understanding of interaction between benzoxazine and epoxy is limited. The future work should study this aspect in more detail. Moreover, other fiber-surface treatments such as graft copolymerization and isocyanate treatment should be investigated.