Chapter 5

Conclusions

5. CONCLUSIONS

There are several conclusions that can be derived from this study:

1. Mixing torque is found to vary with fiber type and also fiber content. The torque was found to increase with fiber content due to an increased obstruction to fluid flow. Addition of fibers hinders mobility of chain segments in flow. As a result, normal flow of polymer matrix is perturbed, and an increase in torque during processing is observed. Fibers chemically treated for better fiber/matrix interaction tend to adhere more strongly to polymer molecules, and this results in increased polymer melt viscosity. Steam exploded fibers, which have already undergone post treatment prior to compounding, distinctly affect mixing torque. AAEF was found to produce the highest increase in torque followed by AEF and WEF. Since torque is related to melt viscosity, the significant increase in torque following AAEF addition to CAB may be due to improved fiber/matrix interaction.

2. Tensile properties were also found to be strongly influenced by fiber type and fiber content. Whereas strength decreased consistently with WEF, AEF and COF, AAEF revealed increased strength when fiber content rose above 10%. When added to CAB, all fibers caused significant reductions in elongation at break. Modulus, on the other hand, increased with fiber content. AAEF showed the highest increase in modulus.

3. Fracture surfaces of CAB/AAEF composites hardly showed any indication of fiber pull out or interfacial delamination. Instead the fibers were coated with CAB matrix, and they

distinctly fractured into fibrils during the tensile test. As for other composites, i.e., CAB/WEF, CAB/AEF, and CAB/COF, interfacial delamination with gaps of 2-4 μm and, smooth fiber pull out, including holes (fiber shape), were observed. The fibers also were hardly damaged during testing. Distinct fracture surfaces shown by CAB/AAEF composites were attributed to acetylation that promotes fiber/matrix adhesion.

4. At 20% fiber content, a significant correlation between the 'standard deviation of gray level' (i.e., quality of fiber dispersion) and mixing torque was observed (R^2 of 0.87). AAEF was found to have the lowest value of 'standard deviation of gray level' or the best fiber dispersion, followed by AEF, WEF, and COF. The improved fiber dispersion shown by AAEF can be attributed to acetylation that also was found to significantly improve the interfacial adhesion as revealed by SEM.

5. The performance of steam exploded fibers as reinforcing agents depends on their post-treatment. Acetylated fibers significantly contribute to composite properties. Strong interfacial adhesion is indicated by torque measurements during processing, by mechanical properties, and by SEM.