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Study on the effect of banana peel fiber (BPF) as reinforcement in ABS/BPF composites.

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Concerns about plastic pollution have driven efforts to create unique, imaginative materials that are more biodegradable. As a result, natural fibers have attracted a great deal of attention over the years. These substances are currently widely employed as fillers or reinforcements in a wide range of polymer composites. One of the major challenges of employing natural fibers as fillers in composite materials is their incompatibility with polymeric matrices. In this study fibers derived from banana peel (BPF) were used as reinforcement in an Acrylonitrile Butadiene Styrene (ABS) polymer matrix. Different surface pretreatment methods, such as alkaline treatment, dicumyl peroxide treatment, and CTAB treatment, have been employed to enhance the compatibility between banana peel fibers and ABS polymer matrix. FTIR, XRD, and SEM techniques were used to characterize untreated and treated banana peel fibers. Then, utilizing the melt mixing process and compression molding technique, treated and untreated fibers were incorporated to ABS polymer matrix in order to produce banana peel fiber-ABS (BPF-ABS) composites. Tensile strength, flexural strength (3-point bending), impact strength, Shore D hardness, and water absorption capacity of prepared composite samples were tested according to ASTM standards. Laser cutting technique was used to prepare samples for these tests. Overall, the treated fiber incorporated composites outperformed untreated fiber incorporated composites in terms of mechanical properties. The tensile, flexural, and impact strength tests indicated that the treated banana peel fibers and ABS matrix had good interfacial interactions compared to untreated fiber incorporated composites. Out of the three pretreatment methods used in this study, CTAB treated fiber composites showed better mechanical properties compared to other treatment methods. 10%(wt) CTAB treated fiber composites showed the highest tensile strength value which was 28.348 MPa. This was a 25.37% increase compared to pure ABS sample. 15%(wt) CTAB treated fiber composite showed the highest flexural strength value of 15.55 MPa. This was a 5.07% increment compared to pure ABS sample. 10%(wt) CTAB treated fiber composite showed the highest impact strength value of 33300 Jm^{-1}. The optimal fiber concentration for tensile and impact strength was determined to be 10%(wt), whereas the optimal fiber concentration for flexural strength was 15%(wt). This behavior of optimal fiber concentrations was explained by SEM images of the cross sections of prepared BPF-ABS composites. SEM images of composites with optimal fiber concentrations showed a smaller number of voids and fiber pullouts where as other composites showed enhanced number of voids and fiber pullouts suggesting weaker interfacial bonding. Shore D hardness values of all prepared composites were less than pure ABS sample except for 15%(wt) CTAB treated sample which showed a value of 76.5. Water absorption capacities of treated fiber composites were less than untreated fiber composites and CTAB treated fiber composites showed the least water absorption capacity. It was evident that the CTAB treated fibers can improve the compatibility between natural fibers and polymer matrix, leading to enhanced mechanical properties.

Keywords: Banana peel fiber, Acrylonitrile butadiene styrene, Surface pretreatment, Composites