

Abstract No: PS-33

Fabrication and characterization of environmentally friendly packaging materials using banana agricultural waste

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Polythene and plastic usage has been increased rapidly all over the world during recent decades because of their unique properties such as low electrical and thermal conductivity, low density, resistance to most solvents, strong and tough nature, and low cost. However, the waste plastics cause serious environmental pollution due to their low biodegradability. To reduce the aforementioned pollution, eco-friendly alternative products are essential. Use of banana fiber has been investigated in producing alternative eco-friendly materials by many research groups. The main objective of this work is to investigate the thermal conductivity of banana fiber composite made from agricultural waste. Wood ash, which is a natural bonding material, was used to modify the bonding and coherence between the banana fibers in the pulp, whereas chemical treatment was used in other studies reported. To prepare the pulp, a known amount of chopped banana pseudo stems and wood ash were boiled together with adequate amounts of water. Ten such specimens were made using 100 g of banana pseudo stem by varying the wood ash in 10 g multiples (100 banana stems: 10n wood ash; where n=1 to 10). Each pulp was poured into molds of dimensions $30 \times 12 \times 1 \text{ cm}^3$ and kept in a moderate environment to make a dry sheet. The dried sheet specimens formed were smooth, flexible and of low weight. The thermal conductivity of the specimens was measured by *Lee's disc* method. The thermal conductivity was observed to be increased gradually with temperature (75 to 132 °C) and with increasing the amount of wood ash (10 to 100g) in the composite. The density of each specimen was calculated, and it was observed that the thermal conductivity of the sample in the above-mentioned temperature range was minimum in samples containing 40 g and 50 g of wood ash. The minimum thermal conductivity observed was 0.05 W/mK at 75.3 °C. The results of this study show that banana fiber composite can be a replacement for Polystyrene packaging material because of their low thermal conductivity and low density.

Keywords: Banana fiber, Lee's disc method, Thermal conductivity, Wood ash