Enhancing Mechanical Properties of Nylon – 6 Using Eggshell Powder as a Reinforcement

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This research investigates the formation and composition of eggshell powder (ESP) obtained through two distinct methods: one involving the inclusion of the inner shell membrane and the other without. Eggshells underwent washing, drying, and milling processes to produce ESP. The impact of milling time (6, 9, and 12 hours) and method (dry and wet) on particle size was explored for both types of eggshells. Thermogravimetric analysis determined the calcium carbonate composition of ESP, while scanning electron microscopy (SEM) and ImageJ software were employed for particle size analysis. Results indicate that ESP without the shell membrane exhibited thermal stability up to 600 °C, with subsequent decomposition releasing 44.39% mass due to calcium carbonate decomposition. The composition of calcium carbonate in ESP without the shell membrane was approximately 97.68%. Conversely, ESP with the shell membrane showed a weight loss of 5.2% around 350 °C, resulting in a calcium carbonate composition of 94.34%. SEM images revealed that increasing milling time led to a reduction in particle size within a certain range, while particles started to agglomerate after 12 hours. The presence of the inner shell membrane had minimal impact on particle size. Plastomilled nylon composites with different ESP percentages (10%, 15%, 20%) were tested for water absorption percentage and hardness. Additionally, plastomilled nylon composites were tested for tensile properties. Results indicate that optimal mechanical properties were exhibited in the 15% ESP composition, and the eggshell membrane had an impact on the bonding between polymer chains and powder particles inside the matrix voids. Having an inner shell membrane improved the overall mechanical properties at 15% composition.

Keywords: *Eggshell Powder (ESP), TGA, Ball mill, Scanning Electron Microscope (SEM), Plastomill, Durometer, Tensile Testing*