

Epoxy-Graphene composite reinforced with bamboo biochar powder: Effect on mechanical properties

ABSTRACT

Epoxy-graphene composites have been widely used in many applications due to their exceptional properties, such as excellent mechanical strength, thermal ability, electrical conductivity, and chemical resistivity. Bamboo is a natural resource that could be regarded as a high-performance material that involves low production costs. It is grown easily and is quicker to harvest than other natural resources. Bamboo biochar (BB) can be produced using the pyrolysis method. Studies on the effects of using biochar as filler in epoxy composites have proven that this approach can increase the mechanical strength of the material. The role of BB has been studied by researchers, but only as fertilizer. Little research has been undertaken on the mechanical properties of BB, especially when used as filler in a composite material. This research aimed to determine the effects of adding BB as filler in epoxy-graphene composites. Using pure epoxy and epoxy-graphene composites (EG) for reference, the mechanical properties of an epoxy-bamboo biochar composite (EB) and an epoxy-graphene-bamboo biochar composite (EGB) were investigated. Thus, the role of BB in enhancing the mechanical properties through its matrix was properly observed and studied. The composites were fabricated using the solution blending method, whereby all the mixtures were mixed homogeneously before being degassed in a vacuum chamber. Curing took place in an oven at 70 °C for 24 hours, and post-curing occurred at room temperature for an hour before demolding. Tensile and three-point bending tests were conducted to analyze the tensile and flexural properties of the composites. The tensile strength of EB showed a 56.216% increment compared to that of pure epoxy, while BB filler increased the tensile strength of EGB by 12.350% compared to that of EG. The flexural strength of EB increased by 0.258% compared to that of pure epoxy, while EGB had 6.535% higher flexural strength compared to EG. Scanning electron microscopy (SEM) was conducted on the sample EB, EG, and EGB at magnifications of 100x, 500x, and 1000x. Graphene agglomeration could be observed on the sample containing graphene. The dispersion of graphene and BB could be observed clearly. The study indicates that bamboo biochar altered the mechanical properties of the epoxy-graphene composite by increasing the tensile strength and stiffness, although it reduced the flexibility of the material.