Investigating the effect of fiber concentration and fiber size on mechanical properties of rice husk fiber reinforced polyester composites

Abstract

The use of natural fibers to replace synthetic fibers as reinforcement in polymer composites has received growing attention in the 21st Century. This is occasioned by global campaigns for utilization of eco-friendly materials as substitute to the conventional non-biodegradable materials which adversely affect the environment. Academicians and researchers have focused on value addition to agro-waste fibrous materials by utilizing them as reinforcements in composites for low load structural applications such as ceiling boards, cardboards, partition boards, mirrors, and picture frames. This study focused on fabrication and mechanical characterization of composite materials made of rice husk fibers and unsaturated polyester resin matrix, with methyl ethyl ketone peroxide (MEKP) as hardener. The fibers were chemically treated with 4% NaOH then dried, milled and classified into three categories: small size (250 – 500 µm), medium size (500 – 1000 µm), and large size (1000 - 2000 µm), using standard laboratory sieves. For each size category, samples were prepared by varying fiber weight fraction (%*wt*) in increasing steps of 5% from 0% (lowest) to 20% (highest). Hand layup method was used to prepare the specimens, which were then sized in accordance with ASTM standards and subjected to tensile and impact testing. Statistical results for ANOVA two factor without replication at 5% level of significance showed that both fiber loading and fiber content affect mechanical behavior of the composite materials. Maximum tensile strength of 25.14 MPa was recorded by the small size rice husk fibers at 15 %*wt*, while large size rice husk fibers gave minimum tensile strength of 9.38 MPa at 5 %*wt*. Medium size rice husk fibers gave highest impact strength value of 7.75 J/mm^2 at 15 %*wt*, while lowest impact strength value of 3.08 MPa was registered by the large size rice husks at 20 %*wt*. It can therefore be deduced that composite materials made of rice husk fibers can be worthwhile alternatives to synthetic fiber materials for both household and industrial applications.