Abstract

Bones make up the human skeleton. Human skeletons have various functions, some of which include protecting the body's important organs such as the heart, kidneys and liver, offering structural support to the body, storing mineral ions such as calcium and magnesium and producing blood cells, among many other functions. Bone fractures occur when the force exerted on the bone is stronger than the bone itself. The most common method of treating bone fractures is casting. Casts are molded around the fractured area to offer stiffness and proper alignment of the broken bone during the healing period. Two types of casts commonly used today are Plaster of Paris (POP) cast and fiberglass cast. POP casts used have been characterized by heaviness, non-biodegradability and hygroscopic nature, which results in easy cracking when they are exposed to water. Fiberglass casts, on the other hand, have been associated with a relatively higher cost and non-biodegradability. The objective of the research was to design and manufacture an alternative cast that minimizes or eliminates the drawbacks of the two types of casts commonly used. The aim is to manufacture a lighter, less costly and eco-friendly cast using materials that are readily available. Sisal fibres together with unsaturated polyester resin were selected as the best materials for the design. Sisal reinforced UP samples were manufactured using a simple lay-up technique followed by press molding during the curing stage. An experimental design varying the sisal and resin mass fractions in the samples was created. Three mechanical properties, namely, tensile, flexural, and compressive strength, were tested using a universal testing machine. A sisal reinforced unsaturated polyester cast made with an optimum mass fraction of 10% sisal and 90% UP resin gave the best strength properties. This cast had better tensile, flexural and compressive strength than a plaster cast. It also proved to be lighter than a plaster cast from the analysis of their densities. In comparison to fiberglass cast, sisal reinforced UP cast showed lower tensile strength and flexural strength than fiberglass cast. It also proved to be denser than fiberglass cast. These results show that fiberglass cast remains superior among the three casts in terms of the physical and mechanical properties under consideration in this study. However, this new cast proved to have the best compressive strength, a key property in this application, as compared to the two casts.