Sustainable MSLA 3D Printing of Accessories from Hemp Oil and Cellulosic Textile Waste

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Abstract

The production of polymers now requires the use of renewable and biodegradable resources in place of petroleum-based compounds due to the environmental issues like climate change, global warming, and the depletion of fossil fuels. Particularly among biodegradable resources, vegetable oils stand out for their non-volatile structure, widespread natural supply, and affordable price. Its biodegradability, low toxicity, absence of volatile organic chemicals, and ease of availability have made vegetable oils and modified vegetable oils ideal sustainable substitutes for petroleum-based products (1, 2). Depending on the climate, seed type, and geographic area of growth, hemp seeds can have an oil content of 28–35%. Furthermore, hemp seed oil permits a wide range of chemical changes, including epoxidation, maleinization, and acrylation, because of its high unsaturated fatty acid concentration (3). The fashion and textile industries are thought to be among those where production and consumption are growing most rapidly in the modern world. In this regard, it is critical to use sustainability successfully for both producers and consumers as economies expand. A considerable amount of waste is produced by the textile industry, including yarn and fiber discharge, fabric trims, cut ready-to-wear items, etc. In recent years, industrial and academic circles have looked into and created solutions for the recovery and reuse of these wastes for new purposes using sustainable methods (4, 5). This study aims to produce sustainable textile accessories produced with bio-polymer based MSLA 3D printer by pulverizing pre-consumed textile factory wastes. For this purpose, unsaturated groups of hemp oil were epoxidized by a method given in the literature, and then these epoxide groups were opened with itaconic acid, which is also considered as one of the green chemicals. The obtained oligomer was chemically characterized by Fourier transform infrared (FTIR) spectroscopy. Using the synthesized hemp oil-based photocurable oligomer, reactive diluent, and cellulosic textile waste powder in various amounts, test samples for mechanical testing and button design were created on 3D MSLA printer. The effects of the textile waste amount in the formulation on the tensile, hardness, and Charpy impact properties of the biocomposites were all searched.

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