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Study and development of low density polyethylene (LDPE) based biodegradable polymer materials using Kitul flour

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Abstract

Natural and synthetic polymers play a huge role in everyday life and a life without polymers might actually not exist today. Unfortunately, these useful products make a real menace to the environment after the usage. The environmental impact of persistent plastic wastes is raising general global concern and disposal methods are limited. Therefore, biodegradable polymers can provide a clear solution to the polymer waste generation problem. Polymers are made of petroleum-based materials (i.e Low Density Polyethylene [LDPE]) that are not readily biodegradable. One of the viable alternatives to accelerate the attack of microorganisms to LDPE is the addition of natural polymers; like Kitul flour (starch), to guarantee at least a partial biodegradation. The objective of this research was to develop a biodegradable polymer material with the help LDPE and Kitul flour. Kitul is a majestic palm tree found in Sri Lanka. The botanical name of the tree is Caryota urens. Kitul tree has been providing several uses and thus a multipurpose tree including the kitul flour. Kitul flour was extracted using pith of the trunk in this research. Extracted product was analysed and characterized using Fourier Transform Infrared Spectroscopy (FTIR). The well-dried kitul flour less than 3%wt moisture was incorporated into the LDPE and melt blended using laboratory scale internal mixture at 150^{o}C for 10 minutes and the speed of the mixing unit set to 30 rpm. Mixing process was performed by varying the kithul flour concentration. In this study, kitul flour was physically blended with LDPE via internal mixture to produce LDPE - kitul flour biodegradable products. The blended samples were then pressed in ordered to form thin sheets by hydraulic press. Soil burial test was done to analyse the biodegradability of the product. The tensile strength and elongation at break of samples were determined by using tensile testing machine. Weight loss in kitul flour containing samples gradually increased with time during the soil burial test. Experimental results showed that biodegradability of the products increased as the kitul flour content increased. The mechanical properties such as tensile strength and elongation also decreased as the kitul flour content increased. The main reason of the reduction of tensile strength and elongation properties might be due to weakness of interfacial bond attributed by incompatibility of hydrophilic nature of kitul flour and hydrophobic nature of LDPE. These results showed that addition of kitul flour in LDPE is a good way to increase the biodegradability of the LDPE – kitul flour blends. It can conclude that these biodegradable products can be used to create a green environment.

Key words: kitul flour, LDPE, biodegradable