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Determination of significant factors for sugarcane fiber extraction as potential dielectric composite material

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Abstract
This study aims to determine the significant factors involved in the extraction of sugarcane fiber as a potential dielectric composite material. The factors include sugarcane waste weight (0.5 and 2.5 g), ratio of sugarcane waste to distilled water (1:15 and 1:20), boiling time (30 and 50 min), and cutting length (5 and 10 cm). The factors were analyzed using the Design-Expert software through a two-level factorial analysis to determine the significant factor. The extracted fiber was analyzed for cellulose content using a Kurschner-Hanack method, and the permittivity value was determined through an Agilent vector network analyzer (VNA). The results show that the ratio of sugarcane waste to distilled water and boiling time were the two most significant factors contributing to the cellulose content and permittivity value of the extracted fiber. The best conditions for sugarcane extraction were obtained at 2.5 g sugarcane waste, 1:20 ratio of sugarcane waste to distilled water, 50 min boiling time, and cutting length of 10 cm, resulting in 47.25% cellulose and 3.12 permittivity value. The findings of this study suggest that sugarcane waste could be a potent material for dielectric composite with a suitable application as a microwave absorber.

Keywords Dielectric materials · Sugarcane waste · Factorial analysis · Cellulose content · Permittivity value

1 Introduction

Sugarcane *(Saccharum officinarum* L.) is a perennial grass belonging to the Poaceae family. It is one of the important crops being cultivated globally due to its economic value [1]. Sugarcane is renowned as the primary sugar source, accounting for approximately 70% of the world's sugar production [2]. The by-products of sugarcane, such as sugarcane wax, are widely used in many pharmaceutical and beauty products, replacing the expensive carnauba wax due to its policosanol and sterol composition [1]. Also, molasses has been used to produce biogas and ethanol for a long time [3]. These and many more use of sugarcane will expand sugarcane plantations to many more acres to meet the demand, thereby generating more waste. In Malaysia, sugarcane plantations yielded 700,000 tonnes of sugarcane in 2009, in which 1 tonne of sugarcane typically produces 280 kg of bagasse after extraction, equivalent to approximately 1.6 barrels of fuel in terms of energy resources [4]. The demand for sugar will continue to increase with population expansion; hence, the accumulation of waste after harvesting and sugar extraction is inevitable.

Bagasse is one of the fibrotic residues of sugarcane after juice extraction, often regarded as waste material [3, 4]. Dumping these wastes could primarily harm the environment when not properly managed. Accumulating any agricultural waste, particularly sugarcane bagasse, will create severe land, water, and air pollution. Bagasse stockpiles can

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