Theoretical and numerical approaches for determining the reflection and transmission coefficients of OPEFB-PCL composites at X-band frequencies

ABSTRACT

Bio-composites of oil palm empty fruit bunch (OPEFB) fibres and polycaprolactones (PCL) with a thickness of 1 mm were prepared and characterized. The composites produced from these materials are low in density, inexpensive, environmentally friendly, and possess good dielectric characteristics. The magnitudes of the reflection and transmission coefficients of OPEFB fibre-reinforced PCL composites with different percentages of filler were measured using a rectangular waveguide in conjunction with a microwave vector network analyser (VNA) in the X-band frequency range. In contrast to the effective medium theory, which states that polymer-based composites with a high dielectric constant can be obtained by doping a filler with a high dielectric constant into a host material with a low dielectric constant, this paper demonstrates that the use of a low filler percentage (12.2%OPEFB) and a high matrix percentage (87.8%PCL) provides excellent results for the dielectric constant and loss factor, whereas 63.8% filler material with 36.2% host material results in lower values for both the dielectric constant and loss factor. The open-ended probe technique(OEC), connected with the Agilent vector network analyzer (VNA), is used to determine the dielectric properties of the materials under investigation. The comparative approach indicates that the mean relative error of FEM is smaller than that of NRW in terms of the corresponding S21magnitude. The present calculation of the matrix/filler percentages endorses the exact amounts of substrate utilized in various physics applications.

Keyword: Bio-composites; Oil palm empty fruit bunch (OPEFB) fibres; Polycaprolactones (PCL)