WAVE ABSORBING PROPERTIES OF POLYMER COMPOSITE MATERIALS WITH MAGNETIC PROPERTIES

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Annotation: The application of wireless electronic devices is increasing nowadays; hence, there is a necessity for electromagnetic waveabsorbing material, which is mechanically stable. Polymer composites with magnetic wood as filler material were fabricated by hand lay-up methods of 6 mm thickness. For the proposed immersion duration, magnetic wood was developed by in situ chemical co-precipitation methods. The microwave absorbing phenomenon is evaluated based on the complex permeability, complex permittivity, dielectric tangent, and magnetic tangent losses. Validation is done for the electromagnetic wave-absorbing properties and mechanical properties by regression analysis, and the experimental data are in close agreement with the regression data.

Key words: *polimer composite, magnetic properties, wireless communication, EM waves, strength, flexural strength, hardness.*

The usage of the wireless communication devices is escalating day by day, and also the rapid growth of electronic appliances leads to generate electromagnetic (EM) waves. These EM waves have an impact on human health and also on the durability of electronic instruments. Hence, there is a need to reduce the intensity of EM waves by using a shielding material. There are two different approaches for processing shielding material for EM waves, and the first one is that the material should absorb or reflect the EM waves when placed in specific applications. The second one is reinforcing the dielectric and magnetic particles in the material to act as a shielding material. Mechanical strength is also an essential parameter for this shielding material when placed in application [1–3]. The shielding material as a composite can be preferable, as the composites can be fabricated by involving the properties like dielectric and/or magnetic losses. Hence, these are influenced by the reflection losses (RLs), which reflect the EM wave’s performance.

Based on the above literature study, it is clear that only a few researchers reported on the hand lay-up technique in magnetic wood-based polymer composites. It was also observed that most of the works focused purely on EM waveabsorbing behaviour. But in the present work, an attempt has been made to improve the EM properties as well as mechanical strength. The experimental results have been validated with the regression analysis, and the values have high accuracy. In the present work for the development

of magnetic wood, the impregnated method is chosen [2], i.e., Fe2+ and Fe3+ solutions are used to immerse specimens. Hence, Fe3O4 particles were developed using the wood's in situ chemical reaction method [3]. The main aim of the fabricated composites should have a strong absorbing nature and more strength.

Fabrication of Magnetic Wood-Based Polymer Composites. The E-glass mat is placed one after the other for all three specimens with polymer as per the proposal. But, placing the magnetic/oak wood at the centre of composites with a sequence of order after 2nd, 3rd, and 5th glass mat for specimens 1, 2, and 3, respectively. A hand lay-up technique was chosen for the fabrication process for the proposed specimens, as shown in Figure 1.

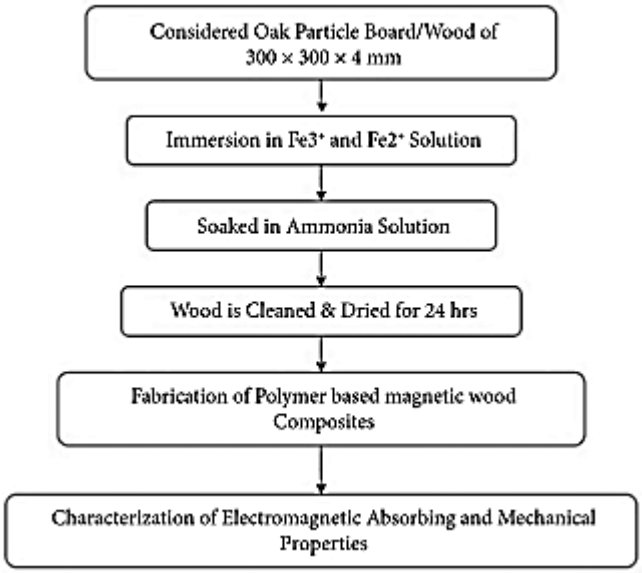

Figure 1. Flowchart of fabrication process.

Finally, three composites were fabricated with 300 × 300 mm dimensions. Characterization. The tensile test was done at room temperature on a universal testing machine based on American Society for Testing and Materials (ASTM) D 638-89 standards. The stiffness property was determined by conducting the flexural test on a universal testing machine with ASTM D 790-86 standards, and the impact test was performed using ASTM D 7136-15 standards.

An EM wave absorber is needed to protect humans and the environment. The polymer composites of EM wave-absorbing ability with stable mechanically are essential in the application. Based on Equations (1) and (2), the EM wave-absorbing properties were calculated in terms of relative complex permeability, relative complex permittivity, tangent losses, and RLs. After that, a morphological study is required to study the failure of the composites.

Regression analysis is one of the simple techniques for finding the functional relationship among the variables and the influence of the variables on the response.

The relation between the variables and the response will be generated based on the equation. In the present work, the input variables reflect losses and mechanical properties. In that process, the regression equation was developed for tensile strength, flexural strength, hardness, and EM waveabsorbing properties.

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