NATURAL FIBER REINFORCED BIO-BASED EPOXY RESIN COMPOSITES DEVELOPED FOR AERONAUTICAL APPLICATIONS

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Introduction

The tendency of the replacement of traditional mineral oil based resins with bio-based systems is nowadays characteristic for many segments of the industry. In case of polymer composites, not only the matrix materials are available or can be synthesized from renewable sources, but also natural fibres can be applied as reinforcement to replace the traditionally used glass or carbon fibers in order to obtain an all bio-based composite. For aeronautical applications (interiors and/or structures) the challenge is much larger than elsewhere, therefore it is a common practice to combine the bio-based components with synthetic ones[1] to approach the characteristics of aeronautical benchmark materials. The aim of this study was to examine the mechanical property changes caused by the application of epoxidized soybean oil as renewable component in natural fiber reinforced epoxy resin composites.

Materials and methods

As composite matrix materials epoxidized soybean oil (ESO) (Drapex 39, Galata Chemicals, Lampertheim, Germany) from renewable sources was combined with a glycerol based epoxy component (ipox MR 3012, ipox chemicals, Budapest, Hungary), which is currently synthesized on mineral oil basis, but could be possibly synthesized from plant-based glycerol as well. In this study 0:100, 20:80, 40:60, 60:40, 80:20 and 100:0 of ESO - ipox MR 3012 mass mixing ratios were investigated. As curing agent an aliphatic amine, triethylene-tetramine (TETA) (ipox EH 2291, ipox chemicals, Budapest, Hungary) and an aromatic one, 4,4'-diaminodiphenylmethane (DDM) (Sigma-Aldrich) were used. Based on mechanical properties and worldwide production, jute fibers were chosen

as natural reinforcement[2]. Woven jute fabric with 309 g/m^2 surface mass provided by Műszaki Konfekció Kft. Szeged, Hungary was used. Based on earlier studies[3] the fibers were preliminary treated with alkali solutions.
The effect of mixing synthetic and renewable epoxy resin components on the mechanical and morphological properties of jute fabric reinforced composite materials was investigated by Differential Scanning Calorimetry (DSC) and Differential Mechanical Analysis (DMA).

Results and discussion

Based on the tensile and bending test results, by changing the mixing ratio of the synthetic and renewable epoxy resin components, the glass transition temperature and the mechanical properties could be customized according to the requirements of different aeronautical applications as aircraft interior panels or body fairing. The fiber treatment was necessary to optimize the mechanical properties of the composites.

Conclusions

In this study bio-based and partially bio-based thermoset matrix composite materials were investigated in different compositions with jute fabric reinforcement. Optimal mixing ratios of the synthetic and renewable epoxy resin components have been selected based on the DSC and DMA results for further investigations. The effect of fiber treatment on the mechanical properties of the prepared composites has also been characterized.

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