FLAME RETARDANCY OF EPOXY RESIN COMPOSITES REINFORCED WITH CNT-LOADED CARBON NANOFIBRE

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Introduction
The use of the parts made of composites of high mechanical loading capability, being suitable for replacing metallic structures, is rapidly increasing in the aircraft industry [1]. In the newest large airliners the fuselage, the wings and the empennage are also made of carbon fibre reinforced composites. For enhancing the thermal and electrical conductivity of these composites, CNTs can be incorporated into the matrix [2], or into the reinforcing fibres. The electrospinning method provides a simple and cost-effective method to produce ultra fine fibres even with the deposition of carbon nanotubes (CNTs) inside the nanofibres [3]. Considering the flammability of the composites, the incorporation of the carbon fibres has a reducing effect. By the addition of CNT to epoxy resins, improved thermal stability can be reached.

Sample preparation
For the flame retardancy measurements 12 samples were prepared by vacuum-bag method. The fabrics were impregnated with the resin and then cured at 80 °C for 8 hours. The CNTs were dispersed in the matrix using masterbatch mixing technology.

Materials
As matrix material, CL-13 glycidyl-based epoxy resin was used, cured with T-111 anhydrid-type hardener (IPOX Chemicals, Hungary).

Electrospinning
The method uses electrostatic forces to draw the fibres from the polymer solution. The electrostatic field between the two electrodes is provided by a high voltage power supply. Because of the applied field strength, a cone-shape, called Taylor cone is formed from the polymer droplet and a thin jet emerges from the tip of this cone. This jet elongates and solidifies as it travels to the collector. In case of a basic set up, a nanofibrous mat structure is formed on the collector electrode.

Conclusions
In this work CNT-loaded carbon nanofibre-carbon fibre reinforced hybrid epoxy resin composites were prepared and tested. The CNT-loaded nanofibres were produced via electrospinning, followed by stabilization and carbonization in order to prepare hybrid nano-reinforcing carbon fibres. The epoxy resin matrix also contained CNT. The application of the nanomaterial increases the thermal conductivity of the composites, however the effect of the nanofibres is negligible. In the cone calorimeter, when no carbon fibre reinforcement is applied, the CNT decreases the pHRR of the samples. In the hybrid composites, due to the increased heat conductivity, the samples burn easier, however no significant difference can be found. The LOI values increase with the incorporation of carbon fabrics, and also in UL-94 test only vertical burning can be observed.

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