POLYMER COMPOSITES WITH ABILITY OF VISUAL DAMAGE INDICATION

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Nowadays, the use of fibre-reinforced polymer composite materials (PCM) in such industries as shipbuilding, aviation, energy, construction is common and understandable. The use of PCM is explained by their unique mechanical properties and it is growing every year. At the same time, the application area of PCM also grows, thus making the question about structural health monitoring actual.

Unfortunately, internal damage of such material is not always visible. Non-destructive testing methods for fiber-reinforced composites with epoxy matrix are very costly and usually are related to the use complex equipment.

The aim of the study was to develop fibre-reinforced polymer composite with capability of visual indication of mechanical damages.

Visualization of damaged place is provided by colour changing in the place of applied load. Approach is undertaken by integrating microencapsulated leuco dye and dye developer into the glass fabric layer. The chemical reaction between microencapsulated leuco dye and dye developer is possible, if mechanical load brings to the burst of capsule shell, dye is released, and get into the contact with colour developer. Thus, the mark resembling a bruise of a human body is formed in the damaged place [1]. The following steps were made applying described approach.

Grass fibers and encapsulated components were selected for the composite manufacturing via the vacuum assisted resin transfer molding process. The worked out PCMs were tested on compression and tension to verify a capability of visual indication of mechanical damages. To decrease the threshold sensitivity of the damage visualization additional epoxy protective coatings with controlled thicknesses were used and tested. As a result, relation of threshold of visualization the load vs. protective epoxy coating thickness was estimated.

Presented damage visualization method can be successfully used for composites with big surfaces, it provides the reduction of inspection time and non-equipment permanent inspection.

Reference

1. Vidinejevs, S., Strekalova, O., Aniskevich, A., and Gaidukov, S. ‘Development of a composite with an inherent function of visualization of a mechanical action’, Mechanics of Composite Materials, 49, 77-84 (2013)