BIOMIMETIC FIBER REINFORCED COMPOSITE WITH DAMAGE VISUALIZATION CAPABILITY

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Keywords: Damage visualization, Microcapsules, Epoxy polymer matrix, Fiber reinforced composite

ABSTRACT

Fiber reinforced composites (FRC) with epoxy matrix are widely used for applications in different construction components and structures due to their better specific strength and stiffness. Due to brittleness and inability of plastic deformation, damages caused by critical loadings often manifest itself internally within the material as matrix cracks and delaminating. The ability to 'see' and become aware of internal damage in composite materials in wide branches is critical.

The aim of the study was to develop fiber reinforced epoxy composite with damage indication ability. A top surface of enhanced FRC changes color upon composite itself undergoes different (quasi-static, impact, et.al). The FRC sample operation after this loading is unsafe due to possible sample's damage. The embedded biomimetic function provides damage visibility like a 'bruise' in the human body.

In the issue of this study:

1. Samples of glass fabric epoxy composite with biomimetic top surface are worked out. The acquired feature of the composite arises due to using microencapsulated leuco day and activator in the top surface;
2. A reproducible laboratory manufacturing method of the composites with controlled threshold level of the impact visualization is designed;
3. The indentation tests with spherical indenter demonstrate relation of threshold level of the impact visualization vs. 'bruisable' material parameters;
4. A series of quasi-static three-point bending tests allowed determining critical loadings for FRC samples. Digital image analysis of composite top surface after loadings performed evaluation of an intensity and threshold of the colored response. The correlation between colored response magnitude and sublimit and critical loadings is revealed.

The method of the production of the biomimetic FRC gives benefit where visual inspection of composite elements of large surface areas is required during limited lead-time, but undetected damaged areas in the construction bring disaster failure. Examples are obvious: plane elements, lifeboats, wind turbine blades, industrial helmets and so on.