SIMULATION, DETECTION AND REPAIR OF DEFECTS IN POLYMERIC COMPOSITE MATERIALS.

Fact Sheet

Project Information

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Coordinated by
Agusta SpA
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Objective

Major objectives of this proposed research will be:
-To define how the more important defects contribute to a decrease in strength.
-Enhance NDT accuracy and reliability confidence and optimise data evaluation in order to define a cross?correlation between their results and residual mechanical

characteristics.
-To define the application ranges of repair procedures in terms of cost-effectiveness and residual life as a function of the type of damage.
Key limiting factors to introduce large monolithic composites have been identified as high costs and high weight respectively in relation to the high rejection rate and design oversize due to the influence of in manufacturing defects which have not been satisfactorily determined, high sensitivity of composites to in service damages and lack of defined application ranges of suitable repair techniques, especially when in field intervention is needed.
Studies have shown that a better understanding of the influence of defects and the definition of related repair procedures will lower the amount of manufacturing scrap and allow the weight of the parts to be reduced. Major objectives of this proposed research, therefore, have been to define how the more important defects contribute to a decrease in strength, enhance nondestructive testing (NDT) accuracy and reliability confidence and optimise data evaluation in order to define a cross correlation between their results and residual mechanical characteristics and define the application ranges of repair procedures in terms of cost effectiveness and residual life as a function of the type of damage.

Porosity, resin content variation, delamination in solid laminates and impact damage both on solid laminates and on sandwiches have been evaluated. Porosity was measured on the basis of interlaminar shear strength and was compared to void content. Resin content was assessed on the basis of flexural strength, and compared to the resin to fibre ratio, measured by the nitric acid digestion method. Delamination was measured on the basis of compression strength. Impact damage was inflicted by means of a hemispherical impactor. Damage caused by a 3 J impact was deemed tolerable; a 30 J impact caused perforation and therefore rejection of the sample component. Between those limits the damage was assessed as repairable.

Use of an ultrasonic wave was found to be the best nondestructive method to detect porosity or resin content defects. Delamination, however, was not consistently detected.

The main conclusions were as follows:
there was no difference in behaviour of the materials (ie solid laminates or sandwich structures);
a more realistic method is required to simulate delamination;
a standardized procedure is required for the evaluation of voids by means of image analysis;
a promising tool for the detection of areas with a variation in resin content has been demonstrated;
an improved procedure has been developed for compression testing of thin laminates with delaminations or impact damage and also a tool to suppress global buckling;
repair methods have been developed for applications to real structures.

Polymeric compounds are used more and more in many industrial sectors because of their high mechanical efficiency (low density and anisotropy), high fatigue behaviour and lack of corrosion effects. The trend in polymeric composites manufacturing is to develop larger integrated parts. Key limiting factors to introduce such large monolithic composites have been identified as:
-High costs and high weight respectively in relation to the high rejection rate and design "oversize" due to the influence of in-manufacturing defects which have not been satisfactorily determined.
-High sensitivity of composites to in-service damages.
-Lack of defined application ranges of suitable repair techniques, especially when in-field intervention is needed.

Studies have shown that a better understanding of the influence of defects and the definition of related repair procedures will lower the amount of manufacturing scrap and allow the weight of the parts to be reduced.

Fields of science (EuroSciVoc)

engineering and technology > materials engineering > **composites**

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