

Measurement of the T_g , as providing information on the degree of cure, through a range of methods

Objectives

The aim of the project is to propose internationally accepted test methods, traceability and methodologies for the evaluation of the cure state of fibre reinforced composites. It is envisaged that this work will support new or revised international standards.

Background

The measurement of T_g - the glass transition temperature, which is a materials property but reported as a temperature value, can be determined through a wide range of measurement techniques, including:-

- Differential Scanning Calorimetry
- Thermo Mechanical Analysis
- Dynamic Mechanical Analysis

The value of T_g is often used in materials qualification and specification requirements, as T_g is related to service temperature capability. A Standard Qualification Plan was developed at NPL for aerospace pre-impregnated composite materials where DMA is the stated method.

The techniques mentioned are all used as secondary measures of degree of

cure. However, as different methods are used, the lack of precision in some cases causes confusion and dispute when data from alternative methods do not agree (e.g. polymer chemists involved in synthesising new materials favour DSC, while engineers as end users favour DMA).

In addition, some of these techniques are meant for off-line, rather than on-line measurements and a change from initial development of an epoxy resin to a final product manufacture of a carbon fibre/epoxy aerospace component forces a change in the monitoring methods for checking cure. This is a vital measurement to ensure that future performance of the component or material is as required.

Standardization Needs

Standards exist for the thermal analysis techniques (DSC, TMA, DMA etc). No standards are available for T_g by other techniques (e.g. ultrasonics, dielectrics).

Work Programme

- Initial expressions of interest will be obtained and measurement capability of participants assessed.

Call for Participation

- Fully/partially cured material will be circulated to all participants. Glass-transition temperature to be determined by a range of techniques, as above.
- A temperature reference specimen will be supplied for evaluating the DMA equipment (Indium embedded in a carbon-fibre/PEEK resin specimen).
- Results will be analysed using statistical methods (e.G. ISO 5725)



Deliverables and Dissemination

Recommendations / guidance sheet as to the method and procedures to obtain valid measurements of the cure state, leading to their international standardization. The initial

dissemination will be through the VAMAS web-site, international conferences and international standards committees. Later work will lead to a VAMAS/ISO TTA document and recommendations for standardization.

Funding

Participation is based on in-kind contributions from the partners. Materials for the interlaboratory comparison will be manufactured and supplied by NPL.

Duration

12 months following start-up

Status

Approval for startup. Interlaboratory trial to be initiated.

For more information on participation, please contact:

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