INTEGRATED DESIGN, NOVEL TOOLING AND PROCEDURE OPTIMISATION FOR MICROWAVE PROCESSING OF COMPOSITES

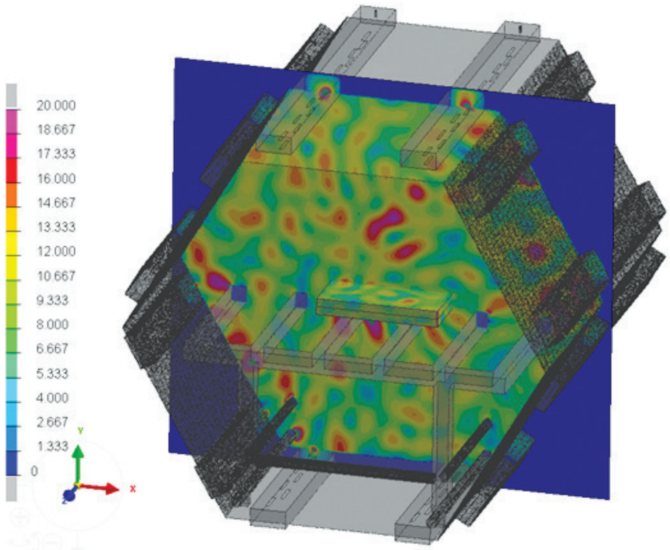
Introduction

Conversely, to the traditional heating methods that depend on surface heat transfer, microwave technology relies on volumetric heating. Thermal energy is transferred through electromagnetic fields to materials that can absorb it at specific frequencies. Volumetric heating enables better process temperature control and less overall energy use, which can results in shorter processing cycles. It also enables the processor to direct heating specifically towards the part to be processed, thus maximizing the energy efficiency of the process. These virtues of the MW technology have attracted interest in developing the method and adopting it for the production of thermoset as well as thermoplastic composite materials.

The SIMUTOOL project has been created with the objective of using a combination of established modelling and CAD / CAE software packages to create full modelling and process simulation software for the manufacture of composites through microwave (MW) heating.

Process Simulator

The three-and-a-half year project addresses the manufacturing issues that come from a lack of understanding of the basic physics of the MW heating process, including how carbon fibres interact with the microwave field. SIMUTOOL's software takes account of the MW oven, novel tool, and the interaction of microwaves with materials. A feedback control loop to the MW has also been developed, in conjunction with a virtual sensor, to control and help optimise the process. SIMUTOOL provides



an insight into the physical and chemical phenomena that occur during the process and allows industries to take full advantage of the MW heating of composites.

Tool for microwave processing

As well as creation of the SIMUTOOL simulation software, the project also saw the design of a ceramic matrix composite tool with an MW absorbing layer capable of maximising the energy-saving potential of microwave heating. The bulk of the tool will be transparent so that the heating is directed to the composite part rather than the whole tool.

Dielectric measurement system

In addition, the project is developing a dielectric measurement system, which takes measurement at MW frequency and elevated temperatures up to 400°C, which is then fed to the SIMUTOOL software. This system accommodates samples up to 45mm width or depth, which addresses the anisotropic nature

of composites. It can also take liquid samples where the dielectric measurements can be made throughout its cure cycle. Currently there is no such system available commercially.

knowledge management system (KMS) is being developed within the project, which bridges the gap between virtual and real production information. It will transfer knowledge and semantic models from simulation phase to production phase. The KMS uses co-simulation of process during production to assess

compliance to expected outcomes. Finally, it provides a knowledge base of optimal and critical scenarios for testing and training While the project will assess the economic impact of the developed technologies, it is believed that the MW production of composite parts will use 30% less energy than conventional processes.

TWI is working with seven other organisations from four different countries to bring MW heating of composites from Technology Readiness Level (TRL) 5 to TRL 6-7. The project is sponsored by the European Commission, under H2020-FoF-2015 (grant agreement number 680569) and is due for completion in February 2019.

The next steps

Future work includes the following:

- Optimisation and packaging of the process simulator
- Optimisation of the dielectric measurements system
- Intigration of the knowledge management system with simulation and production
- Simulation and production of Airbus and Faurecia demonstrators

Find out more

To find out more about our work on this project please visit http://www.simutool.com/, where you can also contact us for further details.

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Project consortium

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