CIMComp
EPSRC
Future Composites Manufacturing Research Hub

Microwave (MW) heating through embedded slotted cables for composites manufacturing

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Aims / Objectives

Aim: Prove that uniform MW heating of composite during manufacturing can be achieved using a number of slotted coaxial cables embedded in tools

Objectives:

1. Simulate the energy output of the slotted coaxial cables and the absorbance of this energy by carbon fibres
2. Produce tools with embedded slotted coaxial cables,
3. Manufacture composite laminates using the new concept tools,
4. Quality assessment of the produced laminates
5. Efficiency assessment of the new tool compared to conventional heating methods

Methodology:

1. Drill holes in ceramic tool for the cables to be slotted
2. Measure temperature distribution in dry fabrics. Confirm uniform heating
3. Manufacture composite laminates and test their quality through DSC and DMA

Progress to date/Key findings:

- Use of slotted cables produces a temperature distribution of about ±10°C in dry carbon fibres
    - Use of MW absorbing coating reduces temperature distribution to ±5°C
- Simulation of energy transmission and absorbance shows that cable strips will perform better as they act as wider waveguides in the tool (energy is emitted to larger area)
    - Repeat of the tests using slotted strips

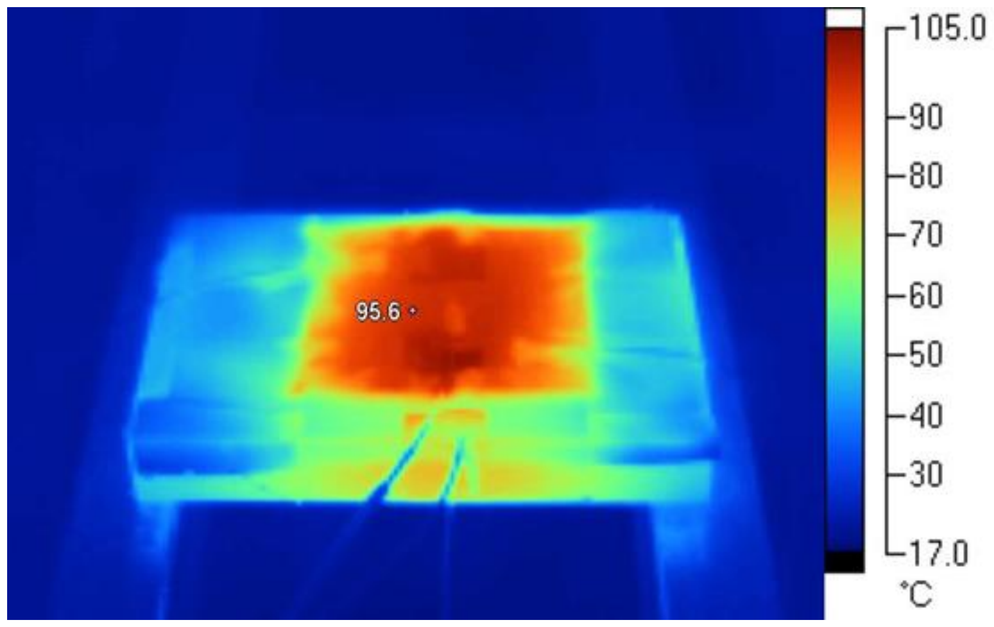

Figure 1. – Heating up of three layers of fibres using two slotted cables. The maximum temperature in the fibres is noted. $T_{max} - T_{min} = 19°C$

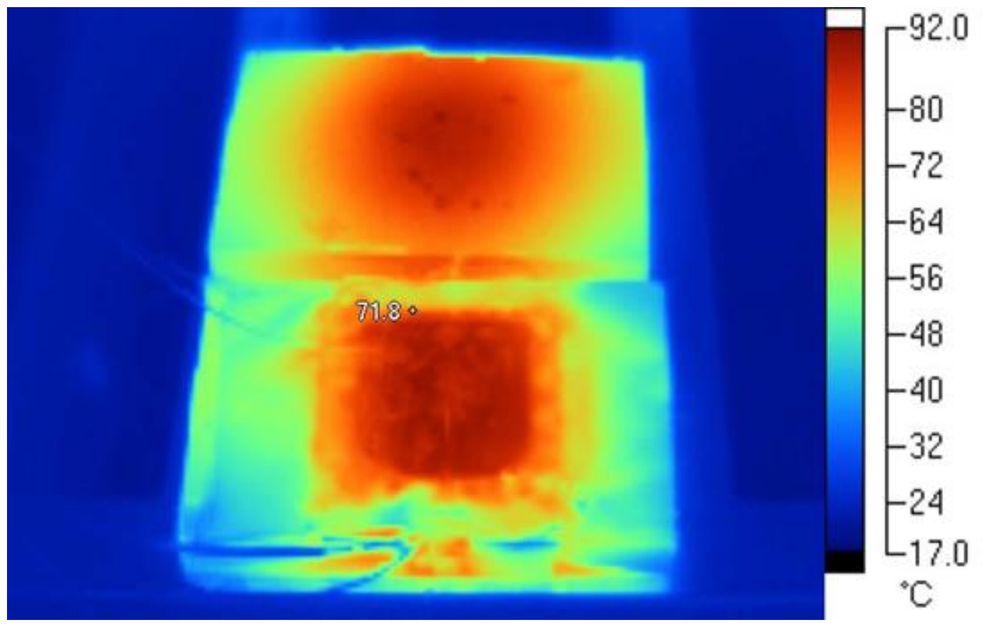

Figure 2. – Heating up of three layers of fibres using two slotted cables and a ceramic cover in order to keep fibres compacted. The maximum temperature in the fibres is noted. $T_{max} - T_{min} = 8°C$

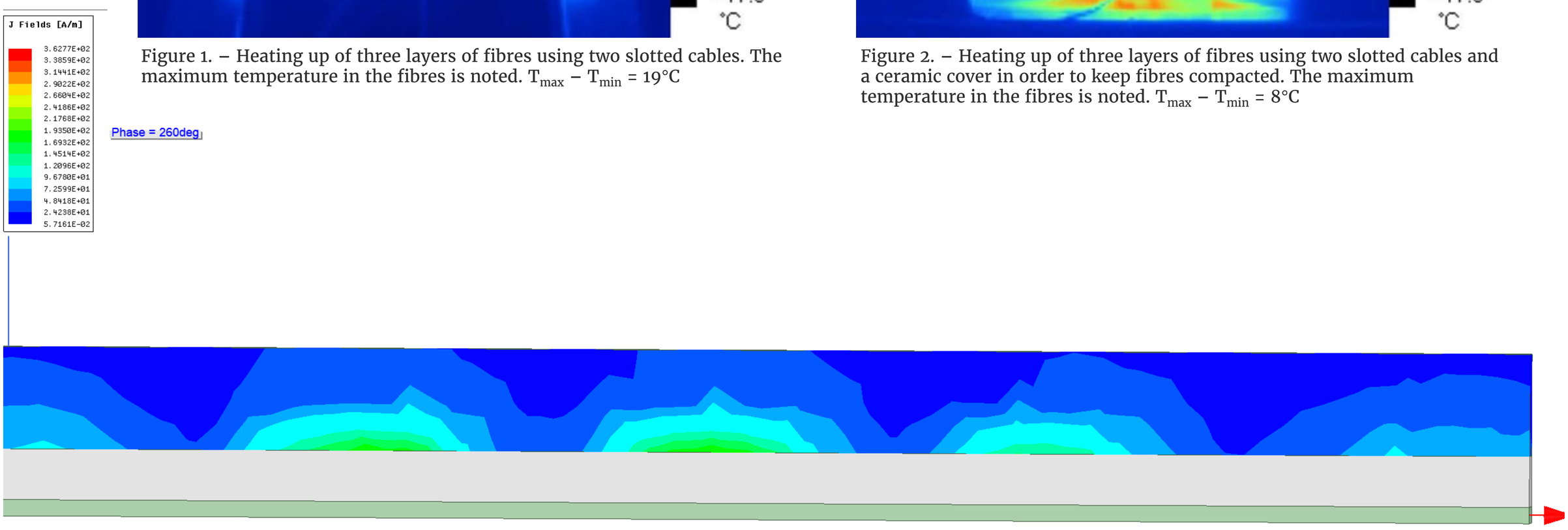

Figure 3. – Modelling results: the distribution of microwave-induced current in a composite with conductive reinforcement (unidirectional fibres). An array of microstrip monopoles (1mm width) radiates at 2.45 GHz (green area). A ceramic tool is denoted with beige.

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