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L O N D O N



20 – 23 OCTOBER 2015



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PUL-AERO

EC funded research project Framework 7 – Aeronautics

**ACP3-GA-2013-605613: High Quality Curved Aerospace
Composites using Pultrusion Manufacturing – 3 year project**

Dr. J.R. Hartley – Exel Composites UK

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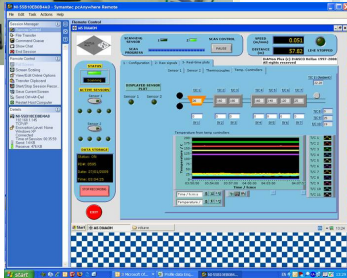
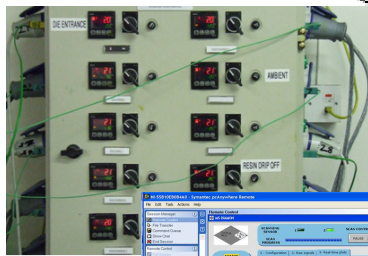
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Current Technology

Control the environment for the carbon fibre



Monitor the resin bath temperature

Control the die post former temperature and log

Control the tow / braid positions

Control and log the line speed

Label and number the parts





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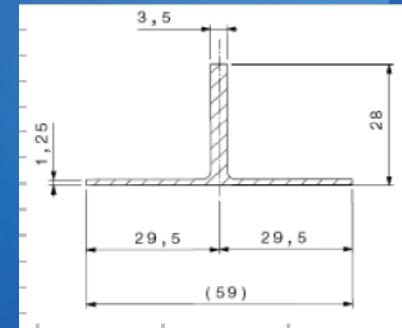
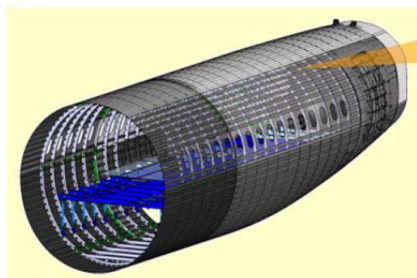
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PROJECT AIMS

Development of Carbon fibre stringers for Aircraft – Straight / Curved:

Outlook for Aircraft Applications





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PROJECT PARTNERS

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Work Package Objectives



WP 1 Process Design - Completed

WP1.1: Design of parts profiles: Profiles geometry and curvature characteristics of the final part

WP1.2: Selection of materials

The thermoset material and the reinforcements (fabrics and fibres) that will be used in the project will be selected.

WP1.3: Simulation specifications

The information required for the modelling and simulation of the pultrusion line will be confirmed.

WP1.4: Design of the cure process

The cure cycle of the thermoset material will define the temperature of the dies and the length of the dies in the first stage of the process (linear pultrusion) and the second stage of the process (post former dies).

WP1.5: Design of the pultrusion line

The resin recirculation system, the number of dies, their length and the positioning of the pullers, QA system and the post-former dies/tool will be the technical scope of this task.

WP1.6: Design of monitoring and QA systems

The requirements for application of process monitoring and QA systems.



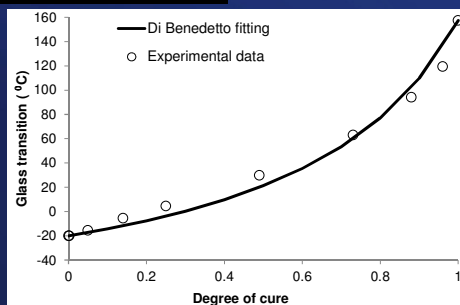
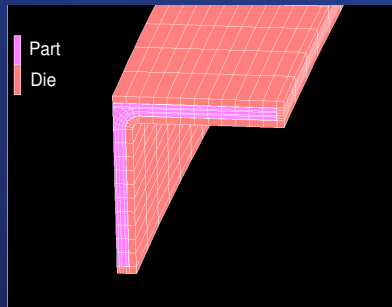
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Work Package Objectives

WP 2 Modelling and simulation - Completed

To develop the characterisation of the resin material(s) in order to design the pultrusion temperature profiles and stages according to the degree of cure of the resin and to build a simulation program for the pultrusion line that can be used in order to optimise the design of the line.



Formulation
Development

Constitutive
models
Characterisation

Process simulation





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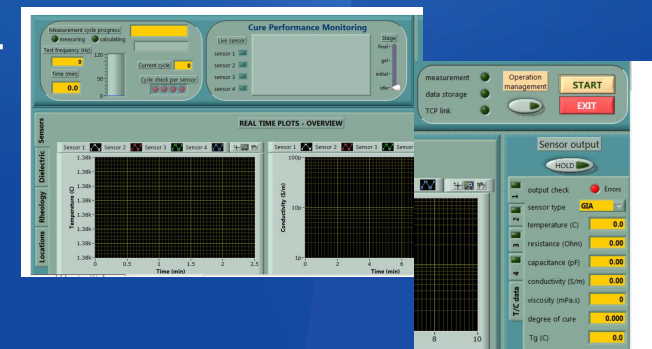
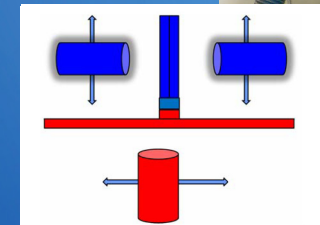
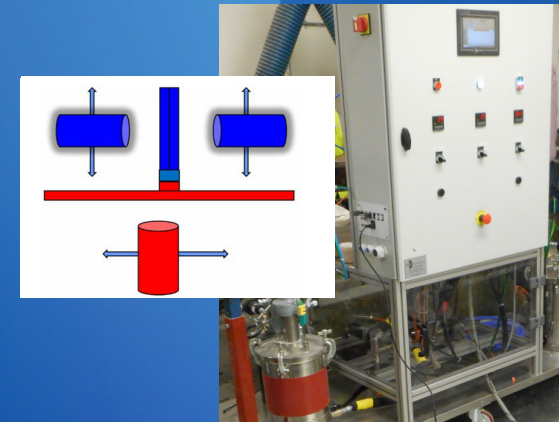
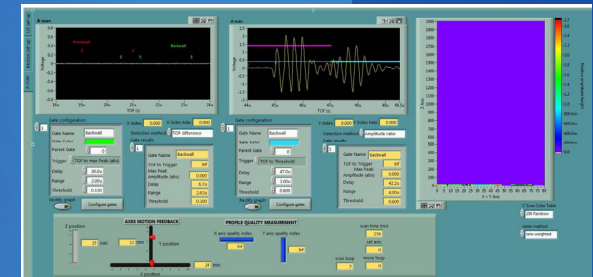


Work Package Objectives

WP 3 Pultrusion line implementation – Completed

The main objective of WP3 is the build-up of the pultrusion line according to the process design specified in WP1. For the achievement of this objective, the technical work is divided into 3 phases:

1. Sub-systems setup: included manufacturing of the dies and other parts for the line (WP3.1), the resin recirculation system (WP3.2) and the process monitoring and QA system (WP3.3)
2. Setting up of the line (WP3.4): includes integration of the sub-systems, the line pulling system and controls
3. Pultrusion line operation and production of preliminary parts (WP3.5): the line first runs for fine tuning and testing of the sub-systems





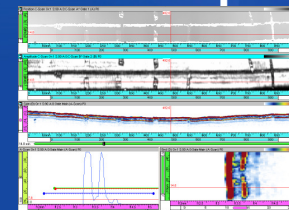
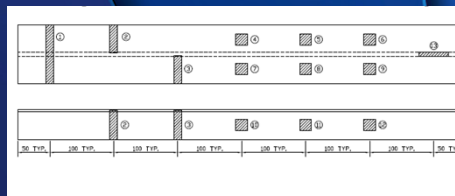
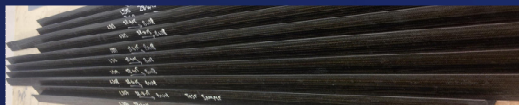
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Work Package Objectives

WP 4 Process Monitoring Assessment – Currently in Progress

WP4 has three objectives:

1. Utilise the data obtained by WP3 and analyse the line monitoring controls at the resin bath and the pultrusion line.
2. Perform QA tests on the parts produced in order to verify that the quality of the parts is within the specifications set in WP1
3. Provide a complete report for the operation of the line. The report will list the main results and include actions for optimising the production process





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Work Package Objectives

WP5 – Pultrusion Line Operation & Assessment – To be started

The main objective of WP5 is the successful operation of the pultrusion line and the production of curved profiles according the specifications set in WP1.

The line will run production material over a period of 4 months.

The mechanical performance of the produced profiles will be measured. Full On – Line ‘cure monitoring and NDT testing’ will be implemented. Finally, the cost for the production of profiles (estimated as cost per meter of produced profile) will be assessed.

WP 6 Exploitation and Dissemination - Progressing

Exploitation and the envisaged IPR developed is under consideration (Patents), dissemination has started -





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Thank you for your attention

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