CASE STUDY

Dismantlable Joints
A Technology Pull-Through Project

The Dismantlable Joints project is part of the NCC's Technology Pull-through (TPT) Programme and is in collaboration with Oxford Brookes University (OBU). The project aimed to validate and increase the Technology Readiness Level (TRL) of OBU's academic work on adhesive disbonding technologies.

Replacing mechanical fixtures with bonded joints can reduce assembly time and decrease structure weight, however modifications and disassembly of these components are complex due to the irreversible nature and high strength of the structural adhesives used. The ability to facilitate disbonding with localised and controlled triggering systems could enable innovation in rework and repositioning as well as increase the ease of disassembly of multi-material parts.

Two additives, Thermal Expandable Microspheres (TEMs) and Expandable Graphite (EG), were investigated. These can be included with any off-the-shelf adhesive and do not significantly change adhesive application. Two off-the-shelf adhesives (3M's EC9323 and Permabond's ET536) were used in combination with these additives, NCC then tested and compared their bond strength and usability, and OBU evaluated their durability.

One major advantage of this technology is that there is no need for a complete system redesign to get the same disbonding effect, meaning that any future uptake should require very little variation in use.

Project partner

OXFORD BROOKES UNIVERSITY

Previous OBU work was limited to small-scale lab investigation in a pre-competitive space. The Dismantlable Joints project accelerated the development of the technology and proved it in a medium-size demonstrator, for which OBU created and tested a bespoke induction coil. The nature of the TPT project is such that it also remains pre-competitive, however the interest generated from NCC members and customers allowed industry requirements to be taken into consideration throughout. This was particularly well showcased in the demonstrator, when a battery box geometry from Williams Advanced Engineering was used.

The bond strength investigation showed a slight reduction with the inclusion of either non-activated additives. However, the volume of additive included in the adhesive has not yet been fully-optimised and it is predicted, with good reason, that any negative effects would likely be improved with further development. The usability investigation concluded that the EG had the least effect on both the starting viscosity and pot life when combined with either adhesive. The durability investigation did not show any significant difference in performance between adhesives that did or did not include additives.

All heat sources investigated (oven, infrared lamp, induction coil, and heat gun) were able to impart enough energy on the additives to stimulate activation, though joints using adhesives that included TEMs required an additional input of force to enable separation.

The potential benefits of successful deployment of this technology into industry include potential innovation in rework for repair, repositioning, modifications, as well as the ability to disassemble structures and multi-materials at end of life. This could, in turn, positively impact the ease of effective recycling, ultimately reducing the application's impact on the environment. Effective reuse or recycling routes for end of life composites may result in further exploitation of the technology due to enhanced end of life options and therefore a greater ability to meet any legislative requirements surrounding decommissioning or waste management.

For more information on the NCC's Technology Pull-Through Programme, visit www.nncuk.com.