

Debondable Epoxies for a Circular Economy: a Microbusiness-Academia Partnership in Action

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Introduction:

Epoxy adhesives are essential across many industrial sectors, valued for their strength, durability, and versatility. However, these same qualities make disassembly and material recovery extremely difficult at end-of-life – a major barrier to circular economy practices.

Structural Adhesives Ltd, a UK microbusiness specialising in industrial adhesives technologies, partnered with the **University of Leicester** through a **Knowledge Transfer Partnership (KTP)** to address this challenge. The KTP provides long-term research capacity, laboratory access and specialist expertise needed to explore debond-on-demand epoxy adhesives – a technology with potential to maintain strong in-service performance while allowing clean, controlled separation during recycling or repair.

Our approach:

Many existing debondable adhesive technologies rely on complex chemistries or bespoke fillers that limit cost-effectiveness, scale-up or mechanical performance.^{1,2} In this KTP project, we instead pursued a simple, thermally-triggered debonding mechanism using commercially available products and in-house formulation knowledge.

Our approach aimed to create a practical, drop-in solution suitable for:

- Semi-structural bonding
- Potting and encapsulants
- Coatings

The formulations were developed to behave as strong, stable epoxies under normal conditions, but debond cleanly and predictably when heated above a designated activation temperature.

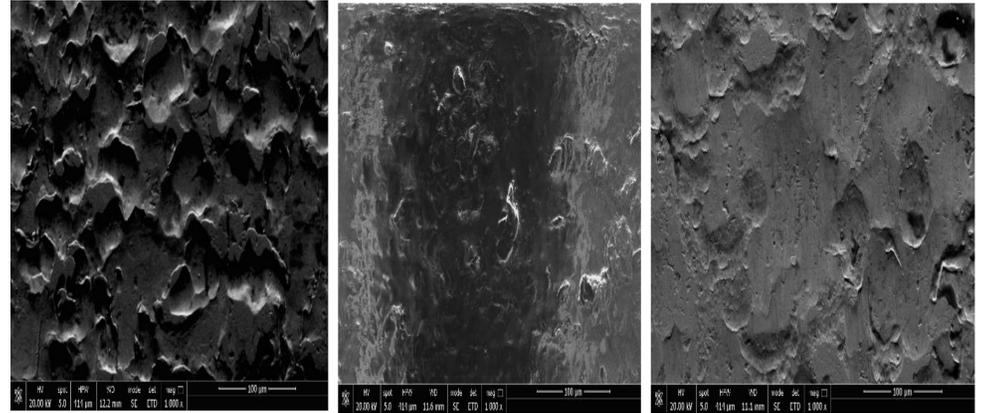
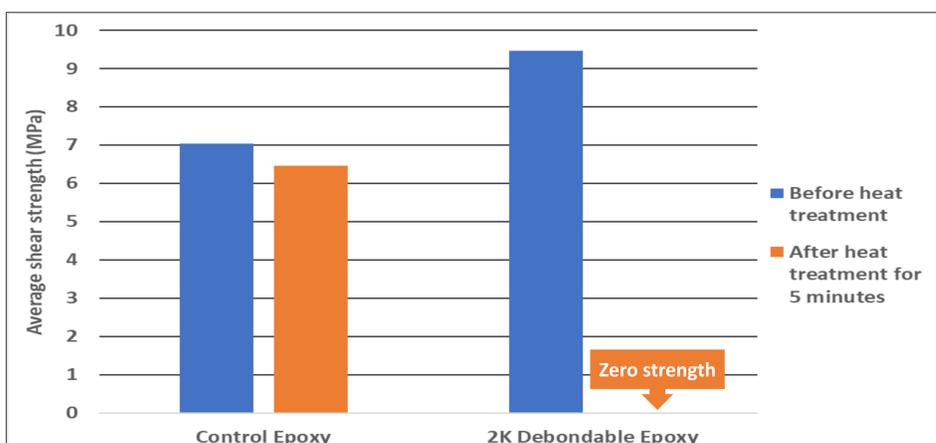


Watch the
debonding process
on video!

Experimental findings:

Through iterative formulation screening and thermo-mechanical testing enabled by the KTP:

- ✓ 40% enhanced shear strength when compared to traditional 2K epoxy
- ✓ Complete debonding achieved at specific temperatures
- ✓ High stability of formulation, with no debonding below specified temperatures
- ✓ Multiple epoxy formulations trialled with consistent success



L-R; SEM-EDX Images of steel surface before coating, when coated and after coating removal.

Average surface carbon content before coating (wt %)	Average surface carbon content when coated (wt %)	Average surface carbon content after debonding (wt%)
15.18 ± 5.44	75.12 ± 3.92	9.68 ± 4.52

Circular economy and commercial impact:

This technology supports circular economy goals by enabling:

- ✓ **Improved recycling**
 - Reduces carbon contamination during material recovery
 - Supports rework and maintenance
- ✓ **Industrial relevance**
 - Drop-in solution for existing adhesive lines
 - Viable across industries such as electronics, composites etc.
 - Scalable with current production equipment
 - Solid waste generation with no off-gassing during debonding
- ✓ **Commercialisation pathway**
 - Ongoing scale-up through KTP programme
 - Novel market identification and assessment
 - Engagement with OEMs and manufacturers for trials

Role of the KTP programme:

- An embedded full-time researcher focused on innovation from project inception
- Access to laboratory capability and advanced characterisation techniques
- Accelerated formulation screening and validation
- Clear, agreed pathway from concept to product
- Derisked R&D
- Access to network of collaborative partners
- Knowledge transfer between industry and academia

Conclusions and next steps

This KTP enabled the development of a **simple, scalable debondable epoxy system** using commercially available solutions. Formulations show improved shear strength and reliable thermally-activated debonding – a combination essential for circular economy integration. The partnership significantly accelerated innovation within a microbusiness setting, reducing technical risk and creating a clear pathway toward commercial adoption.

Next steps include scale-up manufacturing, sector-specific testing and engagement with industry partners to validate real-world performance.

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