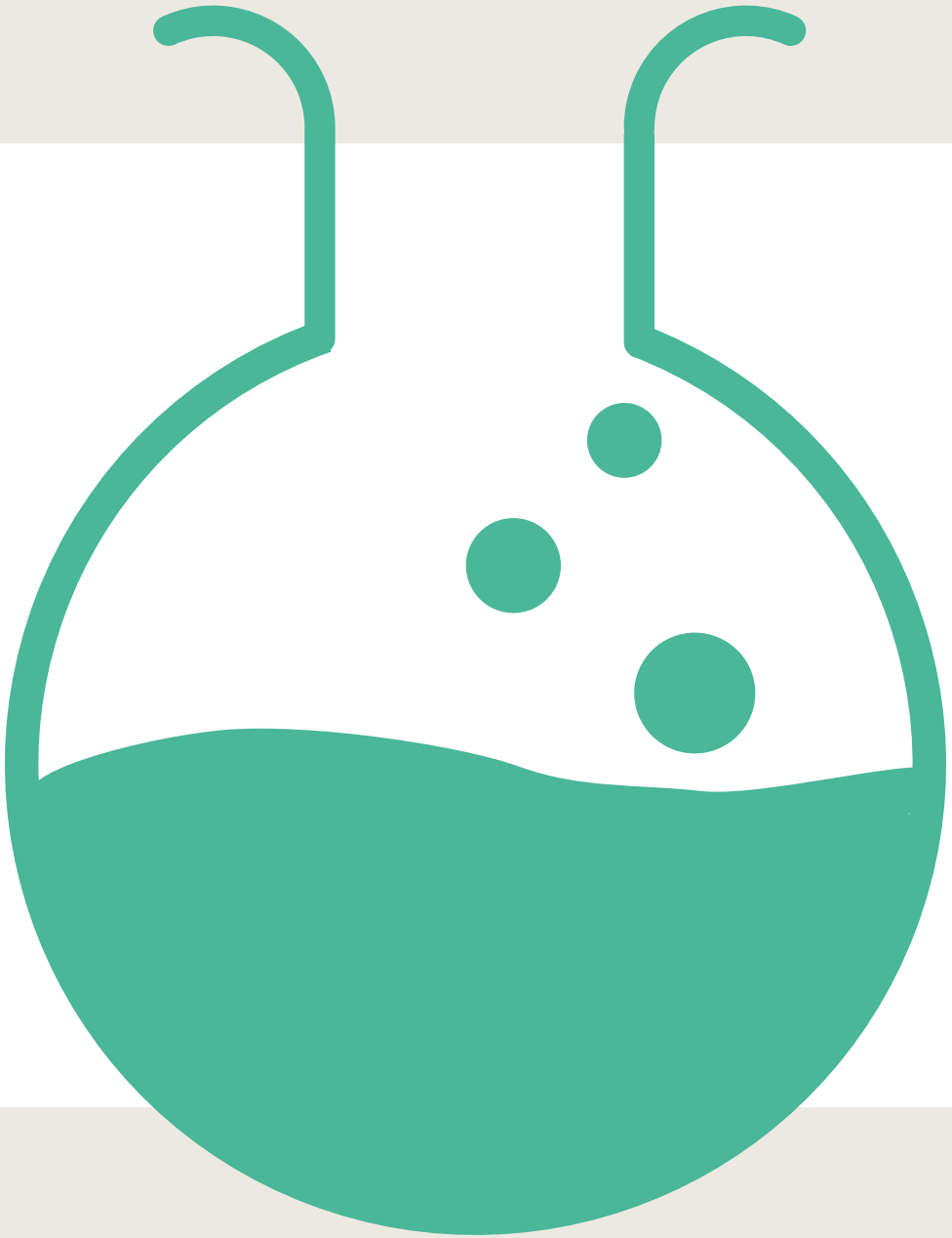
RDCR
Recycling.
Disassembly.
Circular materials.
Reuse.



Circular Materials

Alternative Carbon Fibre Precursors

Investigate the feasibility of using alternatives to polyacrylonitrile precursors to manufacture lower impact, high performance carbon fibres

Description

- This project will look to develop alternative precursors to polyacrylonitrile (PAN) for the manufacture of carbon fibre
- This could include the investigation of bio-derived precursors, such as lignin, or lower energy petrochemical alternatives
- It could also look to quantify the effects of the substitution

Background

- Due to their inherent properties (lightweight, durable), carbon fibre is often used to facilitate lower impact use phases, however their production is high energy
- A major contributor to this is the precursor (PAN)
- 90% of carbon fibres are manufactured from petroleum-derived PAN that is polymerised and carbonised

Objectives

- Identify alternatives to PAN, looking to both academia and industry for potential
- Produce, at lab scale initially, carbon fibres using an alternative precursor
- Test and quantify the fibres' performance

Benefits

- High performance, lower impact carbon fibre
- Lower energy solutions could be lower cost
- Bio-based solutions could sequester carbon during use
- Bring carbon fibre manufacture back to UK

Smart Composite Materials

Investigate and develop smart composite materials with multi-functionality to increase usability

Description

- This project will look to investigate and implement smart multi-functional composite materials
- This could include self-healing materials, smart sensors, and shape memory composites amongst others
- It could also look to develop new applications for multi-functional materials, and to deployment feasibility

Background

- Industry's desire for multi-functional or smart materials is increasing
- At current, materials are predominantly designed and selected for their mechanical performance with little emphasis on secondary material functions
- Their inherent tailorability means they could be designed for multi-functionality

Objectives

- Review the current technology landscape of smart composite materials
- Down-select a multi-functional material for further development
- Develop and demonstrate the technology

Benefits

- Self healing or smart sensing materials could support component life extension, saving cost
- Shape memory composites could facilitate disassembly or reuse

Reversible Resins

Develop cost effective and scalable manufacturing processes for reversible resins that facilitate easier end of life

Description

- This project will look to identify, develop, and demonstrate reversible resin chemistries that facilitate easier end of life
- This could include resin chemistries that return to their monomer building blocks
- Or 'unzippable' thermoset resins whose crosslinks can be reversed, amongst other technologies

Background

- Whilst thermoplastics can be ground, melted, or reformed, thermosets are not easily reversed once cured
- Current composite reclamation technologies are additional processes, and don't look to the inherent characteristics of the materials
- They are also predominantly focused on reclaiming the higher value fibres

Objectives

- Evaluate the current technology landscape for reversible resins
- Develop, optimise, and potentially scale up a reversible method for a selected resin, and test the output

Benefits

- A matrix chemistry that can be reversed could facilitate reclamation of both polymer resin and fibre without degradation of either
- This could help the composite industry to reduce waste and meet legislation targets

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Supply Chain for Bio-based Composites

Support the development of the supply chain for high performance, low cost, sustainably sourced feedstock for bio-based composites

Description

- This project will look into developing the supply chain for bio-based composites
- This could include validation of the mechanical performance of the materials to increase consumer confidence
- It may also look to define what 'sustainably sourced' means, and how certification can be introduced to ensure a sustainable supply chain

Background

- At current, the majority of composite materials are derived from petrochemicals
- These feedstock are highly energy intensive to produce
- Replacing these with bio could reduce a composite's overall impact as they sequester carbon during use
- Although commercialisation exists, it is limited by the immaturity of the supply chain

Objectives

- Define what makes a material 'sustainably sourced'
- Identify potential supply chain routes for feedstock and intermediates
- Validate mechanical performance/impact

Benefits

- Enhanced supply chain – validated bio-based materials that are more readily available and therefore at a lower cost
- Potentially lower impact alternative materials for use in composites

Validation of Circular Materials

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Investigate, compare, and report the key parameters that quantify the performance of a range of circular materials

Description

- This project will look to quantify the performance of a range of circular materials, increasing user confidence
- Parameters quantified could include mechanical performance, environmental impact, costs, and processing parameters
- Materials tested may include bio-based resins, natural fibres, recyclate etc.

Background

- Industry is becoming increasingly interested in alternatives to traditional, virgin, petroleum-derived materials
- However, uptake is stunted by a lack of understanding of, and confidence in, these materials and their physical and mechanical properties
- Environmental impacts and costs are not always known

Objectives

- Quantify the performance of a range of circular materials for use in composites
- Devise and populate a database to store this information
- Increase awareness of alternative materials

Benefits

- Validated data sets for circular materials, facilitating better-informed decision making
- Increase in the uptake of these materials due to greater user confidence
- Well-linked supply chain -> lower cost

Circularity of Thermoplastic Composites

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Identify methods to create thermoplastics (materials and processes) that are more cohesive with the principles of a circular economy

Description

- This project will look to determine ways in which thermoplastics can be made more circular
- This could include derivation of new processing methods or reclamation technologies
- It could also look in to feedstock derivation, such as recyclate or bio
- Self-reinforcing thermoplastics may also be considered

Background

- Thermoplastic composites are commonly regarded as 'more sustainable' than thermosets due to their ability to be melted and reformed
- Current recycling methods involve grinding, resulting in short, unaligned fibres. This could be considered to be downcycling
- Most thermoplastics are derived from petroleum

Objectives

- Develop innovative techniques for processing or reprocessing thermoplastics whilst retaining value
- Assess feedstock and material derivation
- Validate and demonstrate the technology

Benefits

- Retaining the performance of thermoplastics during reclamation gives second uses higher value
- Reduced waste to landfill, saving costs
- Development of the UK supply chain