Recommendations for Routes to Sustainable Exploitation of CFRP Materials

Review of Life Cycle Assessments of Carbon Fibre Reinforced Materials

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Agenda

• Literature review
• Results: Comparing results for climate impact from different studies
• Results: Transitioning from PAN to lignin as precursor for carbon fibres in CFRP
• Results: Energy savings from reusing carbon fibres
• Conclusion and future work
Literature review

- 33 LCAs of CFRP was found
  - Only one study (Das, 2011) assessed lignin based carbon fibres
    - The literature review was expanded to also include LCA of lignin (10)
Literature review
Results: Light weighting climate impact

- For light weighting a longer use phase is beneficial from a life cycle perspective
- The manufacturing of CFRP has a large share in the total life cycle environmental impact
• **Results: Materials and manufacturing climate impact**

  - Most obvious way to decrease the environmental impact of CFRP is to decrease the amount of carbon fibre in matrix
    - might not be possible due to structural requirements
  - Two other concepts of reducing the environmental impacts of CFRP manufacturing:
    - Use a bio-based raw material for the carbon fibre production (for example lignin)
    - Use recycled carbon fibres rather than primary carbon fibres
• Results: Materials and manufacturing – Replacing PAN with lignin

Depending on the allocation method, replacing PAN with lignin as a precursor could decrease the climate impact.
Results: Demonstrated gains from recycling

Shifting to using recycled carbon fibres shows a large potential to decrease the climate impact.

What would happen if we recycled lignin based carbon fibres?

(Includes only 2 PAN-CFRP studies)
Conclusions

• Three main aspects need to be considered to decrease the environmental impact of CFRPs
  • Decrease amount of carbon fibre in matrix
  • Prolong the life time of the product (mileage in light weighting)
  • Decrease the environmental impact of the production for the CF by for example shifting to a bio based precursor
  • Look into recycling opportunities to reuse carbon fibres/CFRP
Future work

• Life Cycle Assessment of lignin based carbon fibres
  • Comparing different lignin and polymer blends
• Carbon fibre=> CFRP=> in applications
  • Addressing challenges in going assessments in early stages of material development
• By this review we have mined the literature from whatever we can learn for or own LCA. Three methodological challenges are:
  • Allocation of lignin: Waste or a by-product?
  • Allocation when including recycling of CFRP
  • Comparing a fossil-based material to a bio-based material
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