A Life Cycle based approach for the assessment of Circular Economy strategies for Composite Construction Materials

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Abstract

Composite materials play an important role in the construction industry with their diverse range of application. However, the end-of-life of composite materials are rarely focused and it is challenging due to their complex structure. In the long term, composite waste from construction industry can create a big problem as currently developed techniques for composite recycling are very limited. Considering the increased market share of composites in construction industry coupled with Europe's transition towards a circular economy, handling of composite waste requires a life cycle thinking. At this point, not only technical feasibility but also economic, environmental, legal and social aspects are essential in closing the loop of composite materials. Towards creating a circular economy around composite construction materials, eleven PhD students from RWTH Aachen University and Münster University of Applied Sciences with interdisciplinary background are working together with two industry partners with the aim of finding feasible solutions considering the whole life cycle of the selected composite construction materials.

Motivation

Construction industry accounts for:

- **36%** of total waste produced in EU [1]
- **55%** of total waste produced in DE [2]
- Raw material consumption → EU **47%** | DE **42%** [3] (non-metallic minerals)

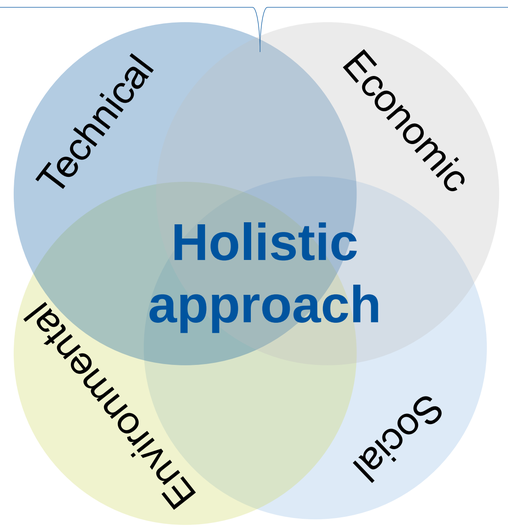
Composite materials in construction industry [4]

- higher strength
- lower weight
- less maintenance required
- longer service life

Forschungskolleg Verbund.NRW

11 PhDs
Interdisciplinary

Industry Partners
Transdisciplinary



Composite construction materials e.g.:

- Recycled concrete
- Textile concrete
- Carbon fiber reinforced concrete
- Gypsum board

Research Project at ANTS

Problem Statement:

- How can the circularity be measured?
  - LCA and LCC are alone insufficient
  - Quality of end-products are vital in recycling systems
- Construction and demolition waste (CDW) handling problem
  - mainly downcycling ($3/4$ in Germany [5])

Aim:

- Creating a methodology for circularity assessment considering 3 important aspects: environmental, economic and end-product quality through a case study on CDW recycling processes.
- From micro to macroscale, applying the methodology including a look in future and scenarios for assessing the optimization potential.

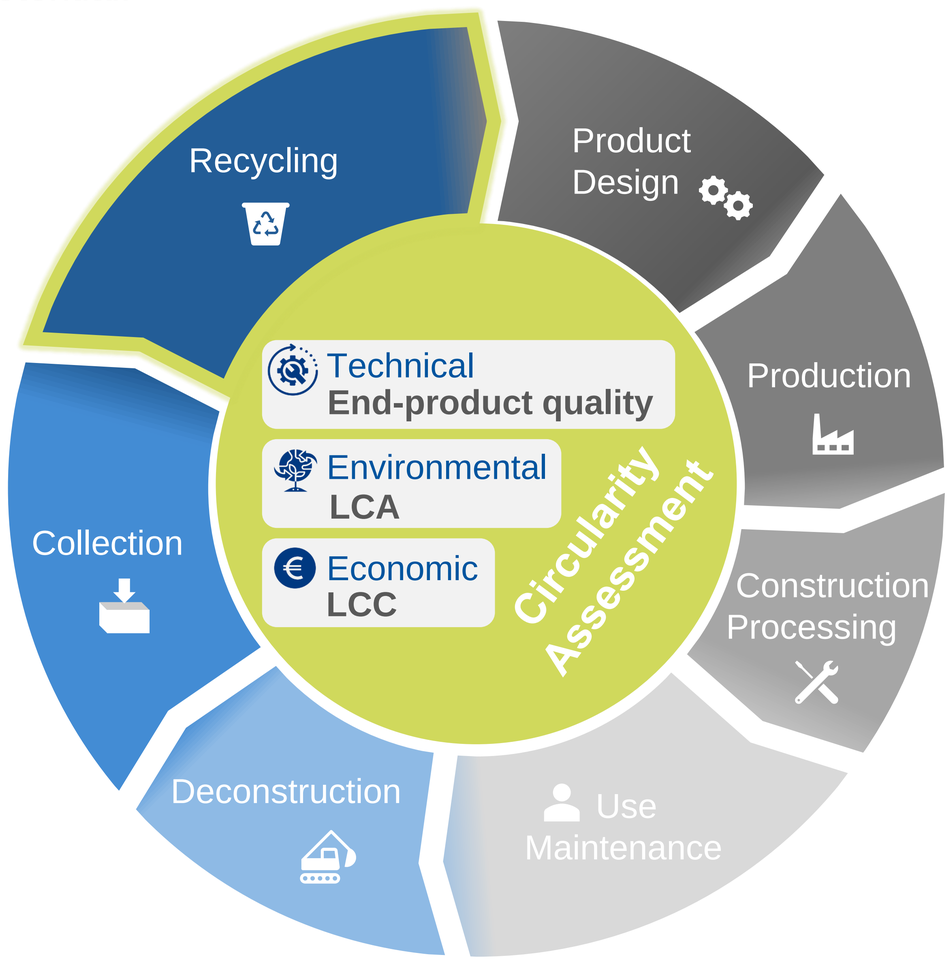


Figure 1. Research Project Scheme at ANTS

[1] Eurostat (2021): Waste Statistics of the year 2018. https://ec.europa.eu/eurostat/statistics explained/index.php?title=Waste statistics#Total_waste_generation
[2] Destatis (2021): Umweltstatistische Erhebungen, Abfallwirtschaft, Abfallbilanz 2018. https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Umwelt/Abfallwirtschaft/Tabellen/liste-abfallbilanzkurzuebersicht.html;jsessionid=53EC7FB55F5C0D6A8A21437A7A0A4A98.live722
[3] WU Vienna (2020): Material flows by material group, 1970-2013. Visualisation based upon the UN IRP Global Material Flows Database. Vienna University of Economics and Business. Online available at: materialflows.net/visualisation-centre
[4] Van Oudheusden, A. A. (2019): Recycling of composite materials. URL: https://repository.tudelft.nl/islandora/object/uuid:0749ed5c-7aeb-4275-abee-0f904a08ea4d/datastream/OBJ/download
[5] Volk, R.; Kern, C.; Schultmann, F. (2020): Secondary raw material markets in the C&D sector: Study on user acceptance in southwest Germany. 2196-7296. DOI: 10.5445/IR/1000105958

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