

Semester Thesis / Bachelor Thesis / (*Master Thesis*)

Life Cycle Assessment of Directly Reusing LPBF Waste Powder in Plasma-Based DED

Background

Additive manufacturing processes such as Laser Powder Bed Fusion (LPBF) require high-quality metal powders with strict specifications regarding particle size, morphology and contamination. During LPBF processing, powder can become unsuitable for further use in the same process, although it may still be valuable as feedstock for other additive manufacturing routes. Plasma-based Directed Energy Deposition (DED) can process a broader range of powder sizes and material conditions, making it a promising route for the direct reuse of LPBF waste powder.

Aim

The aim of this thesis is to evaluate the environmental potential of using LPBF waste powder directly as feedstock for plasma-based DED. Depending on the thesis level, the work can range from a focused case study to a more detailed comparative Life Cycle Assessment. The study should compare different material-use scenarios, identify environmental hotspots and assess under which conditions direct reuse is beneficial compared to conventional feedstock routes.

Tasks

- Literature review on LCA in additive manufacturing and aluminium recycling
- Definition of goal, scope, functional unit and system boundaries
- Development of process chains for different scenarios, e.g. virgin powder, direct reuse of LPBF waste powder, reprocessing / re-atomisation, or conventional recycling
- Collection of inventory data for powder production, conditioning, DED processing, electricity and shielding gas consumption
- Modelling of selected scenarios in SimaPro
- Comparison of environmental indicators, especially CO₂-equivalent emissions and energy demand
- Sensitivity analysis for key assumptions such as powder allocation, deposition efficiency, electricity mix and required powder preparation

- Discussion of environmental hotspots and recommendations for future data collection

Your profile

- Interest in sustainability, additive manufacturing and circular material use
- Basic understanding of Life Cycle Assessment or willingness to learn
- Experience with SimaPro or similar LCA software is beneficial but not required
- Structured working style and interest in comparing technical process chains
- Basic knowledge of materials engineering or manufacturing processes is a plus

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