Life Cycle Assessment of Fibreboard made of Coconut Husk and Tannin-based Adhesive

Degree programme: Master of Science in Wood Technology | Specialisation: Management of Processes and Innovation
Thesis advisors: Prof. Dr. Frédéric Pichelin, Dr. Matthias Meier

Cocoboard, a medium density fibreboard (MDF) made from coconut husk fibres and tannin adhesive, underwent a comparative life cycle assessment, highlighting raw materials and transportation as main contributors of Global Warming Potential. Proposed improvements including alternative tannin supplier and transport method, led to significant reductions of 41% and 11% respectively, enhancing the environmental performance of Cocoboard compared to conventional MDF.

Objectives:

The key objectives of this study were threefold. Firstly, to conduct a comprehensive comparison of the environmental impacts of Cocoboard and conventional MDF throughout their respective life cycles, including raw material supply, transportation to the factory, and the manufacturing processes. Secondly, the study aimed to identify the primary sources of environmental impacts for both Cocoboard and conventional MDF, shedding light on the key contributors to their ecological footprints. Lastly, based on the identified hotspots and significant contributors, the study proposed improvement scenarios within LCA model of Cocoboard to enhance its environmental performance, offering potential pathways for sustainable sourcing, transportation, and manufacturing.

Methodology

The study employed a life cycle assessment (LCA) following EN 15804 and ISO 14040 guidelines to evaluate the environmental performance of Cocoboard in comparison to conventional MDF. Key impact categories, such as Global Warming Potential (GWP) and Cumulative Energy Demand (CED), were assessed across the product life cycle stages including raw material supply and production, transportation of raw materials to the factory, and the manufacturing process of the fibreboards. Existing LCA data for conventional MDF served as a foundation, which was then adapted to represent a state-of-the-art, sustainable MDF production process in Europe. Additionally, an LCA model closely resembling the production process of Cocoboard was developed based on an existing retrofitting industrial production process demonstrated in Europe. To account for the unique characteristics of Cocoboard, additional inventory data for its raw materials, including coconut husk fibres and tannin adhesive, were incorporated, relying on existing supply chain activities.

Results

The LCA analysis found that raw material stage was the main environmental contributor for Cocoboard and conventional MDF. Cocoboard's GWP was 372.31 kg CO_2 eq and CED was 4,597.42 MJ, while GWP of conventional was 316.45 kg CO_2 eq and CED was 6,061.33 MJ. Cocoboard's transportation stage had significant impacts, contributing 27% of GWP and 19% of CED due to raw material transport. Optimizing transportation routes is vital for the sustainability of Cocoboard. Improvement scenarios, alternative tannin supplier and transport method, achieved substantial reductions in environmental impacts, including 41% GWP and 32% CED reduction. Future research should explore the complete life cycle of Cocoboard, including end-of-life applications, to maximize its environmental footprint. Localizing production near raw material sources could enhance environmental footprint and promote regional economic development.

Daniel Egidio Dinizo
079 527 20 15
dinizode@gmail.com

Figure 1: Cocoboard: a medium density fibreboard made of coconut husk and tannin-based adhesive