Bern University
of Applied Sciences

# Electrically conductive particle board

Series of Life Cycle Assessments

## System Description

In this project an electrically conductive particle board for the furniture industry was developed. On the one hand this board differs from standard particle board in the selection of raw materials, where 0.5 % to 5 % of the panel volume is replaced by carbon fibers on the other hand in the production process, where an additional mixing process of carbon fibers and wood fibers in water is necessary (raw material mixing). Other processes (blending with resin, mat forming, panel pressing and cooling) do not differ from standard particle board production (figure 1).

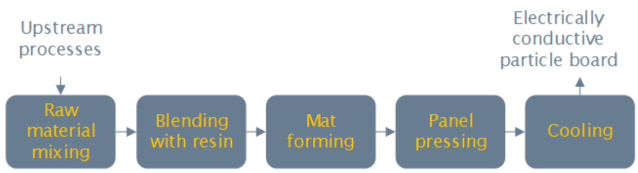


Figure 1: System diagram of the production process of electrically conductive particle boards.

## Goal

The goal of this LCA-study was to calculate the ecological impact of the additional carbon fibers and process for this conductive particle board. The environmental impact was compared to a standard furniture solution, where the LED lights are connected with a copper-cable to the power supply.

## Scope

A cradle to gate LCA was conducted, considering the raw material extraction (A1), transport processes (A2) and production of panels (A3).
The functional unit is the production of 1 $m^2$ of board, with a thickness of 16 mm and a 1 m long conductive system with the capability to supply a LED-lamp.
Two impact categories, Global Warming Potential 100 years and Ecological Scarcity, were calculated within this study. The LCA was done in accordance with the standard EN ISO 14044 using the Life Cycle Assessment Software Simapro (9.2.0.2, multiuser), in link with the database Ecoinvent 3.6.

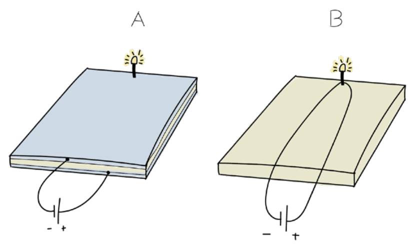


Figure 2: Developed particle board with carbon fibers in the surface layer (A) and an alternative system, where the electricity is transported by a copper-cable (B)

## Results

Three different Scenarios were calculated to compare different solutions. The new developed panel with carbon fiber has an increased Global Warming Potential compared to a conventional particle board. With 5 % carbon fiber content, the Global Warming Potential is higher than an alternative system with a copper cable. In all the scenarios, the highest $CO_2$ eq. emissions occur during the raw material production (Figure 3).

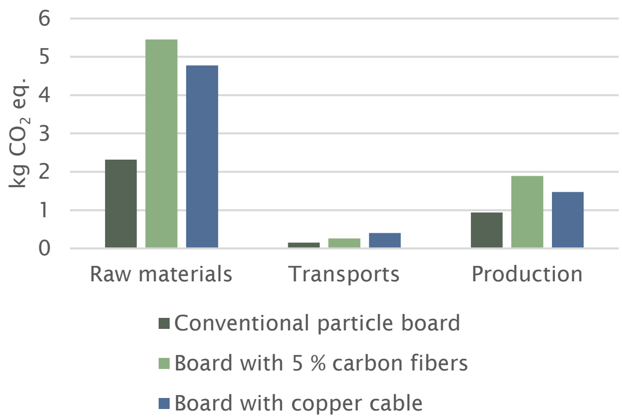


Figure 3: Global Warming Potential (GWP) for a conventional particle board, the new developed board with carbon fibers and a conventional particle board with a copper cable.

By reducing the carbon fiber content in the panel from 5 % to 0.9 %, the GWP can be reduced by 2.6 kg CO2 eq.

When evaluating Ecological Scarcity, the values for the «heavy metals in the air», «Main air pollutants and PM» and «Global Warming» are the highest. Specially the value for heavy metals in the air stands out with over 100'000 UBP for the scenario with a copper cable. With the raw material extraction of copper, also water is highly contaminated with heavy metals.

## Conclusions & Outlook

Adding carbon fibers to a particle board leads to a significant increase of GWP. From this perspective, carbon fiber content should be minimized as far as possible. Compared to an alternative system with a copper-cable, the new developed electrically conductive particle board has a comparable GWP. The drying process of wet particles is energy intense. Increasing moisture of the raw materials by mixing carbon fibers with wood particles in water is therefore not ideal. If technical possible, a dry mixing process should be applied in an industrial application.

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