Bern University
of Applied Sciences

Industrial Tannin extraction

Series of Life Cycle Assessments

System Description

In this project a future industrial extraction plant was developed, to produce tannin-based extracts (figure 1) out of spruce bark for a wide scope of applications in different industries.

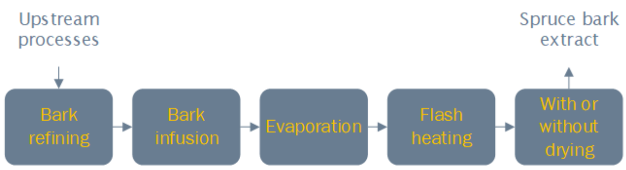

Figure 1: System diagram of the production process of spruce bark extract.

Goal

The goal of this LCA-study was to support the development of tannin business, by highlighting the environmental impacts and economical hotspots of a future industrial tannin-extraction plant.

Scope

A "cradle-to-gate" LCA was conducted, considering the raw material extraction and upstream supply chains (A1), going through the bark extract production/ packaging (A2+3) until the transport to the customer gate (A4).
The functional unit (FU) is the production of 1 kg bark extract, dry weight delivered to customer in Switzerland.
Two impact categories, Greenhouse gas emissions (Global warming Potential 20 years in kg CO_2-eq.) and Ecological Scarcity (in UBP, Version 2013 V1.08), 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.

Results

Five scenarios (S1-S5) were investigated, to describe different process settings such as different drying technologies, different energy sources and different processing temperatures. These scenarios led to various results, whereby the *"S4_update"*- Scenario, (Powder from hot water extraction at 90°C, with biomass as energy source, using a spray drier and a previous bark refining step) showed the lowest impacts regarding Greenhouse gas emissions and UBP (figure 2 and 3).

The Greenhouse gas emissions in S4_update is 1.13 k CO_2-eq. from which 55 % are due to steam production from biomass and 22 % are due to electricity production. Another 14 % results from the transport process to the customer.
Regarding the Ecological Scarcity, 3.77 UBP are to be assigned to Scenario S4_update. Additionally, 2.02 kg carbon are sequestered in the extract due to the tannin content.

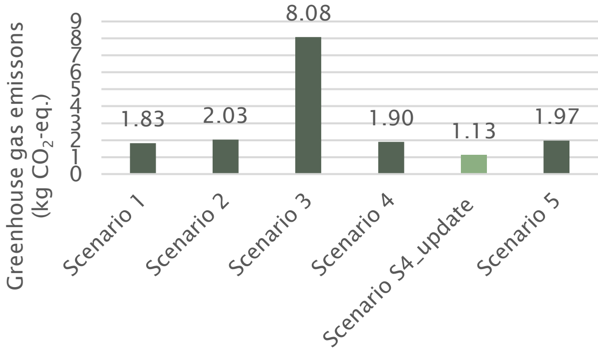

Figure 2: Greenhouse gas emissions in kg CO_2-eq. of different extraction scenarios

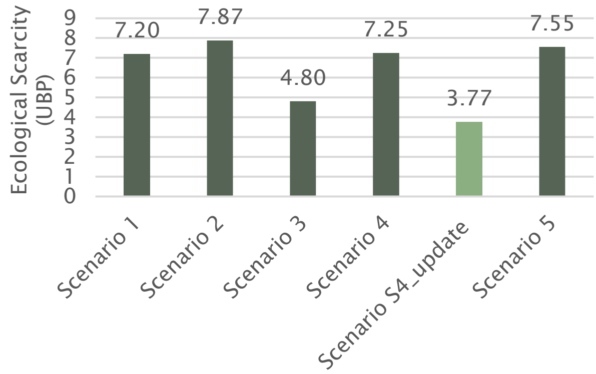

Figure 3: Ecological Scarcity in UBP of different extraction scenarios

Conclusions & Outlook

The Greenhouse gas emissions of producing 1 kg tannin extract is about 1.13 kg CO_2-eq. The emissions are largely caused (77 %) by the energy consumption (heat and electricity) in the production process. As an outlook the first key action for a better footprint would be to reduce the requested amount of steam and electricity consumption, to lower the overall impacts on all indicators Greenhouse gas emissions, Ecological Scarcity and cost. The project was carried out with the support of Innosuisse in collaboration with Schillinger Holz AG.

Contact

Institute for Building Materials and Biobased Products IBBM
Author: Hendrick Schardey, hendrick.schardey@bfh.ch
Project leader: Ingo Mayer, ingo.mayer@bfh.ch