Bern University
of Applied Sciences

Ground screw foundations

Series of Life Cycle Assessments

System Description

Krinner Switzerland is mounting screw foundations in various projects. The ground screws are produced in Germany. For the mounting on the construction site, Krinner Switzerland offers various installation options. Depending on the project the ground screws are mounted with an excavator, a crawler or a hand machine. At the end of the service life, the ground screws are removed with the same techniques. Depending on the service life and the material quality the screws are feed to the metal recycling stream or directly reused in other projects (figure 1).

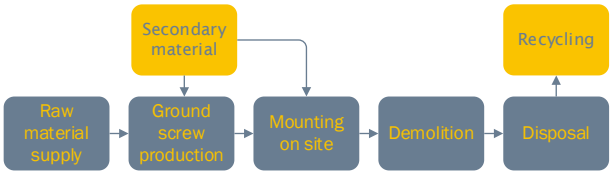

Figure 1: System diagram of a ground screw life with circular economy measures in the material and product supply and after the disposal phase (module D)

Goal

The goal of this study was to compare the greenhouse gas emissions of ground screws with concrete foundations based on three realized construction projects by Krinner Switzerland. The results should serve Krinner as an assessment of the current situation and show clear measures for reducing the greenhouse gas emissions of the ground screws.

Scope

A cradle to gate LCA with options, the modules C1-C4 and module D was conducted (EN 15804:2012+A2:2019). Beside the obligatory modules (A1-A3, C1-C4 and D) additionally the transport to the construction site (A4) and the construction (A5) were calculated. The LCA was conducted on the basis of three exemplary projects: a Wooden Walkway with a service life of 15 years, a Tiny House for 50 years and a Temporary School for 1.5 years. The functional unit is defined in the three projects by the amount of point foundations with the load requirements.
As an impact category, Greenhouse gas emissions (Global Warming Potential 100 years, IPCC 2021) were calculated within this study. The LCA was done in accordance with the standard EN ISO 14044 using the Life Cycle Assessment Software Simapro 9.5.0.1 with the database ecoinvent 3.9.1.

Figure 2: Ground screw out of steel and zinc coating (Krinner Switzerland)

Results

Which of the two foundation types has lower greenhouse gas emissions depends on the quantity of raw materials and varies between the three analyzed projects. The results show that the life phase of raw material supply (A1) has the greatest influence followed by the productions phase (A3). The results from the Tiny House serve here as an example, representing the outcome of all three projects (Figure 3).

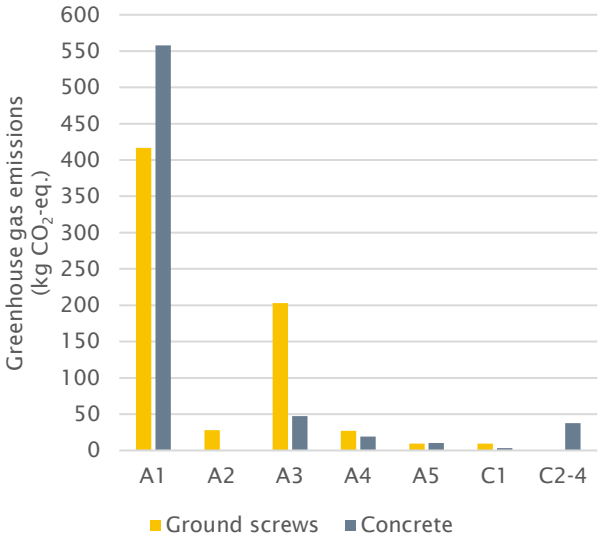

Figure 3: Greenhouse gas emissions in CO_2-eq. for a ground screw and concrete foundation of a Tiny House. (A1: Raw material supply, A2: Transport, A3: Production, A4: Transport, A5: Construction, C1: Demolition, C2-4: Other disposal phases)

The results in module D showing greater potential to recycle ground screws compared with concrete. Because secondary steel is substantially reducing greenhouse gas emissions of new foundations compared with secondary concrete.

Conclusions & Outlook

This study shows a high potential to reduce greenhouse gas emissions with circular economy methods. Mainly the reuse of used ground screws and the use of secondary steel to produce new screws can reduce greenhouse gas emissions effectively.

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