Critical evaluation of circular economy open loop principle

LIRIDE

Research team

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Context

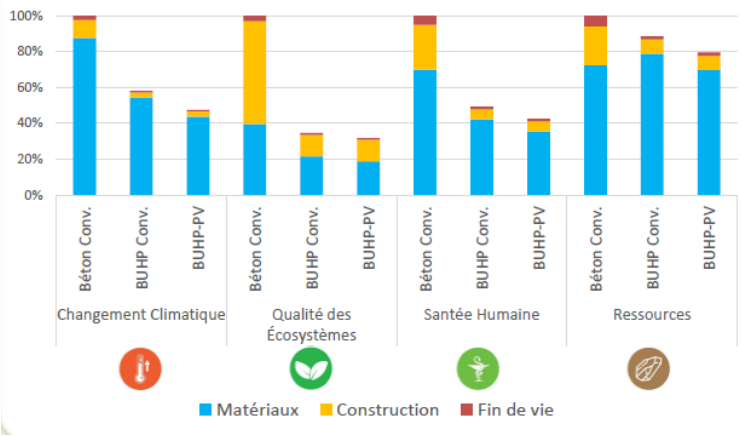
How can we make better use of resources? This is the question that the circular economy concept attempts to answer.
A situation illustrating the complexity of this question is the management of end-of-life glass in Quebec. Although it is a potentially infinitely recyclable resource, glass from Quebec's selective collection is difficult to recycle. Indeed, the quality of the glass stream is too low to be reused via traditional channels.
In 2015, despite more than 150,000 tonnes of glass recovered in Quebec by sorting centres from selective collection, only 23,000 tonnes were resold, resulting in sorting centres collapsing under waste glass, unable to find viable economic outlets for this material.

Goal

The main objective of this research project was to evaluate the environmental impact of the open-loop circular economy principle, using Life Cycle Assessment methodology, in the case of the use of recycled glass powder in concrete as a cementitious additive.

Methods and results

The study consists of a comparative LCA of innovative concrete formulations including glass powder as a cementitious addition with more conventional concrete formulations. The study focuses on two concrete case studies, a concrete sidewalk slab and an ultra high performance concrete pedestrian bridge.
The LCA of these scenarios was carried out by modelling them using SimaPro 8 software, the ecoinvent 3.2 database and the Impact 2002 + impact analysis method.



Comparative results of the environmental impact of a conventional concrete (Conv. C.), an ultra high performance concrete (UHPC) and an ultra high performance concrete with glass powder (UHPGC) in the case of a pedestrian bridge.

Applications

This study demonstrated the environmental benefits of using glass powder as a cementitious additive compared to more conventional concretes. Mainly due to the reduction of the cement content, as well as the gain in durability that glass powder confers.
Those results will enable industrialists and public entities to direct their efforts in the choice of supplementary cementing materials in order to reduce the environmental impact of concrete production.

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