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The challenge of circular economy in the concrete sector:

Life cycle thinking approaches to assess the environmental and economic impact of alternatives to conventional concrete

Introduction / Goals

Among the traditional construction materials, concrete is the most commonly used in modern construction. The use of traditional concrete leads to two main environmental problems (highlighted in figure 1)

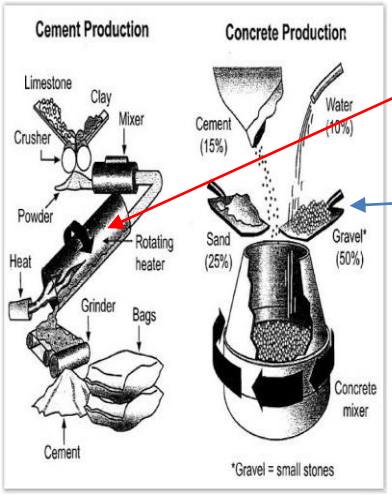

Figure 1

Problem 1 (cement production)
CO_2 emissions (calcination)
Use of fossil fuels/electricity
→ 8-10% of global anthropogenic CO_2 emission

Problem 2 (concrete production)
Natural resources consumption
→ 42% of global use of aggregates

Goal 1
To analyse the environmental impacts of metallurgic slags recycling, to produce an alternative to traditional cement

Goal 2
To assess the environmental and economic effects of construction and demolition waste recycling, to substitute natural aggregates in concrete production

Goal 3
To explore different methodological approaches in LCA, to investigate how different approaches may lead to different results.

Research Methodology

3 case studies:

- Activation of **stainless steel slag** as a substitute to traditional cement
- Activation of **zinc/lead production residues** to produce inorganic polymer
- Recycling of **construction and demolition waste** to produce new high-quality aggregates for new concrete

4 methodologies used:

(1) Attributional LCA; (2) Consequential LCA; (3) Dynamic LCA; (4) Life Cycle Costing

Results & Conclusions

Main conclusions of the study:

- Environmental hotspots of all processes
- Economic barriers to the production of recycled high-quality aggregates for concrete production
- Influence of market dynamics and time-related effect on the environmental analysis

Major publication

Di Maria, A., Eyckmans, J., & Van Acker, K. (2018). Downcycling versus recycling of construction and demolition waste: Combining LCA and LCC to support sustainable policy making. Waste Management. https://doi.org/10.1016/j.wasman.2018.01.028

Di Maria, A., & Van Acker, K. (2018). Turning Industrial Residues into Resources: An Environmental Impact Assessment of Goethite Valorization. Engineering. https://doi.org/10.1016/J.ENG.2018.05.008

Di Maria, A. Di, Salman, M., Dubois, M., & Acker, K. Van. (2018). Life cycle assessment to evaluate the environmental performance of new construction material from stainless steel slag. The International Journal of Life Cycle Assessment, 1–19. https://doi.org/10.1007/s11367-018-1440-1