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Environmental performance of wastes incorporation in concrete mixtures

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INTRODUCTION

- The building sector contributes to **39%** of annual global CO_2 emissions
- Concrete production is estimated in **12 billion ton**/year

Resource efficiency & circular economy models

EU Commission set a decrease of 90% of CO_2 until 2050

Reformulation of building materials and products

Wastes as secondary construction materials to replace cement → channel by-products back into the value chain

GOAL

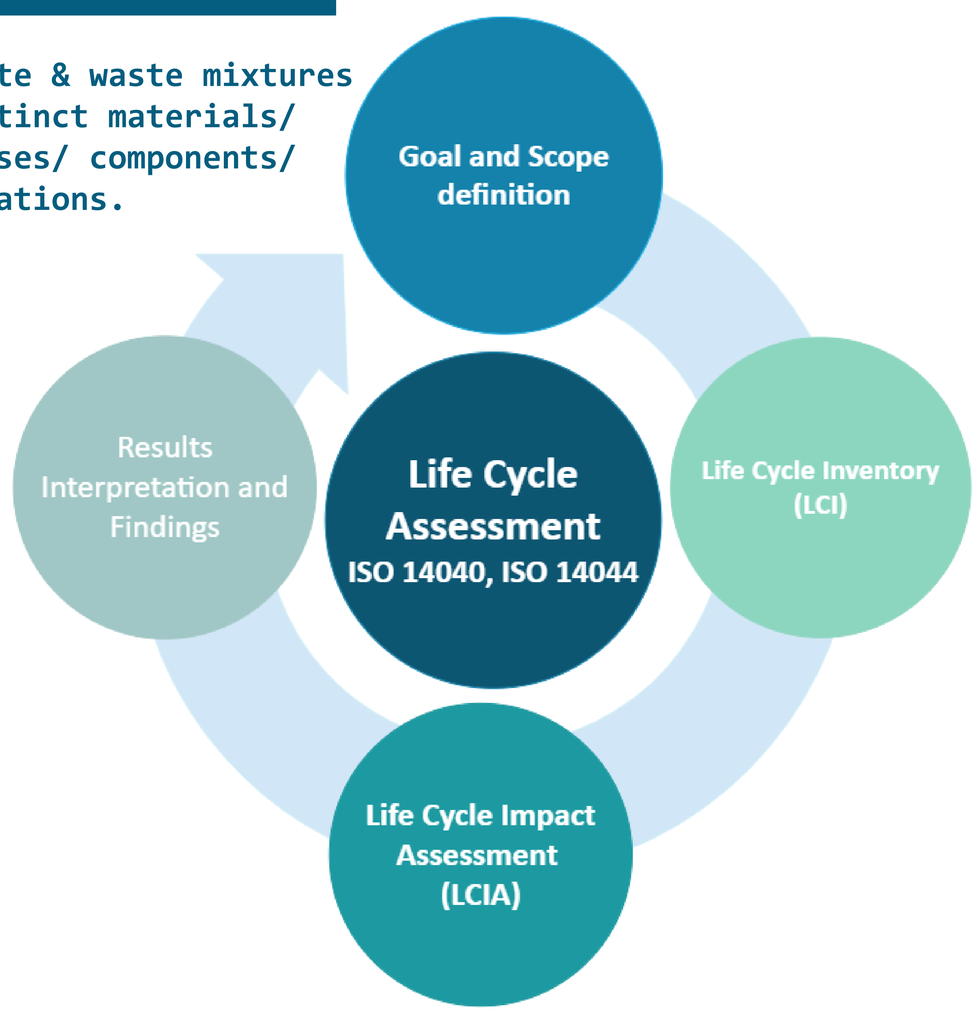
From an **LCA perspective**, synthesize the existing knowledge of waste incorporation in concrete mixes.

Potential **Benefits**

Current **Challenges**

METHODOLOGY

Concrete & waste mixtures in distinct materials/ processes/ components/ applications.



RESULTS & DISCUSSION

Trends identified in LCA studies found in the literature:

Foamed concrete mixtures

Granite waste to replace fine sand showed a reduction of the impacts on: ADP (16%), GWP (32%), AP (13%), EP (58%), and OP (21%).

Concrete Mixtures

Increasing costs in 25%.
Emissions of CO2, NOx, CO and SO2 can be reduced by 10%, 38%, 2.5% and 43%, respectively.

Concrete Mixtures

Mixtures with recycled coarse aggregates showed an improved environmental performance than natural coarse aggregates

Pavement Materials

Plastic aggregate content maintains mechanical properties and alleviates GWP.

Roller Compacted Concrete Pavement

Incorporating 15% of ceramic waste aggregate and 8% of coal waste powder mitigate greenhouses gases by 10%, reducing GWP by 9%.

Alkali-activated Concrete

Alkali-activated concretes instead of OPC concrete reduces GWP in 64% - 70%, AP in 23% - 35%, and TEP in 53% - 60%.

Source: https://cen.acs.org/materials/inorganic-chemistry/Alternative-materials-shrink-concretes-giant/98/i45

CONCLUSIONS

Environmental assessments, oriented to waste incorporation in concrete, can support further developments and promote circular economy models while providing a reliable strategy to compare materials and products. These findings are valuable for stakeholders to evaluate the cost-effectiveness of alternative green concrete materials in their construction projects.

Note: ADP – Abiotic Depletion, AP - Acidification, EP - Eutrophication, OP – Photochemical Oxidation, GWP – Global Warming, TEP – Terrestrial Eutrophication

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