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SUSTAINABILITY OF REINFORCED CONCRETE SPECIMENS: A LIFE CYCLE ASSESSMENT STUDY

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Introduction: Since nowadays reinforced concrete is the material mostly used in the sector of civil construction, such as in buildings, bridges and roads, it seems necessary not only to make studies about its behaviour when using different types and quantities of materials, but also to investigate how these choices can affect its environmental impact. Here, the idea is to compare environmental performances by using different scenarios and LCA methodology has been adopted to this purpose. The different scenarios follow several criteria, as changing the plants where the cement is produced and also changing the type of cement used always guaranteeing the same resistance to compression, so their life time will be the same for all of them.
Materials and Methods: The analysis follows the methodology defined by ISO 14040 and 14044 and it is performed using SimaPro 8.2 software adopting a cradle-to-gate perspective, i.e., from the materials production to the reinforced concrete specimens production at laboratory scale. A large number of impact categories was investigated by assessing the impact with ReCiPe 2008 method. Both different cements and different materials production plants were compared.
Results: The more significant changes are reported for the categories of climate change, ozone depletion, terrestrial acidification, photochemical oxidant formation and metal depletion.
Among the considered cements, the most impacting is CEM I 42.5 R while the least one is a Pozzolanic cement (CEM IV/A 42.5 R).
When changing the plants and keeping constant the type of cement, the plant which has more transport impacts is Augusta, which is the one that requires more road transportation, nevertheless Siniscola needs transportation by ferry. On the other hand, the one that has less transport impacts is Vernasca, which is the closer to Milano, where the reinforced concrete specimens are produced.
Discussion: The materials production phase is the most critical among the overall impacts. The manufacture of Portland cement consumes a great deal of energy and results in high embodied energy and carbon dioxide emissions from clinker calcination. This study shows evidences that concrete has become less energy intensive, by utilising higher levels of pozzolanic materials such as fly ash.
Furthermore, the transport impacts can play a significant role when distance is long and road transportation is used.