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IMPACT ASSESSMENT OF STEEL CIRCULARITY SCENARIOS: CASE STUDY OF STEEL RADIATOR BASED ON LIFE CYCLE ASSESSMENT (LCA) METHODOLOGY

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Abstract – Steel is one of the most used materials in the industry and the building sector. Its production causes severe environmental impacts due to direct emissions within extraction and processing stages (e.g. CO, SO_x, NO_x, and PM_{2.5}), the intensive use of primary resources, contamination of wastewater, and significant amounts of hazardous and solid waste. In this context, the purpose of the current study is to perform a life cycle analysis (LCA) of four different types of steel used in the manufacturing of a steel-based radiator, namely: standard steel as a baseline scenario, steel with a recycling fraction of 40 % of scrap, steel with a recycling fraction of 60 % of scrap, fully recycled steel from scraps, and a hypothetical ‘Carbon-free’ steel production process. The baseline scenario relies on data from an existing company producing steel radiators. The LCA study is conducted within *SimaPro 9.4* software with data obtained from the *Ecoinvent 3.8* database and adjusted according to the defined scenarios and the functional unit of ‘1 kg of steel’. The environmental impact is assessed according to EN 15804 requirements for construction product sustainability. The results have shown that standard steel has the highest impact (176.87 μPt), followed by 40 % scrap steel (137.46 μPt), 60 % scrap steel (104.36 μPt), ‘carbon-free’ steel (76.14 μPt), and 100 % scrap steel (38.17 μPt). The climate change indicator is found to be one of the most sensitive for steel production. The selection of ‘carbon-free’ or 100 % scrap steel permits a decrease of impacts by 70 % and 84 %, respectively. The study concludes that the choice of steel is a fundamental point in reducing the environmental impact of construction products such as steel-made radiators within the whole life cycle perspective. Furthermore, the results obtained through the EN 15804 method, tailored explicitly for the Environmental Product Declaration (EPD), can be reused or taken as a starting point for further studies in the environmental labelling sector.

Keywords – Eco-design; LCA; resource use; steel

Different percentages of the recycled steel



Use of a carbon-free steel



Different eco-design scenarios considered in the study.