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1.3.3. CARBON FOOTPRINT STUDY IN CONSTRUCTION IN SPAIN

OERCO2

ONLINE EDUCATIONAL RESOURCE FOR INNOVATIVE STUDY OF CONSTRUCTION MATERIALS LIFE CYCLE

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Consortium members: Universidad de Sevilla (US), Asociación Empresarial de Investigación Centro Tecnológico del Mármol, Piedra y Materiales (CTM), CertiMaC Soc. Cons. a r. L. (CertiMaC), Centro Tecnologico da Ceramica e do Vidro (CTCV), Universitatea Transilvania din Brasov (UTBV), Asociatia Romania Green Building Council (RoGBC).

1. Introduction

The carbon footprint study is focused in investigations related to construction industry, in which this indicator has been evaluated in the construction phase, using ACV methodologies and equivalents.

2. Related research

From the civil work sector, we emphasize these two inquiries:

Fernández-Sánchez y Rodríguez-López (2010) assessed various indicators of sustainability in construction projects, explicitly applying to roads. With an innovative methodology concluded that the most important indicators in these types of projects are, sorted by relevance: power consumption, waste management, ecological footprint, carbon footprint (CO_2 emissions), health and safety.

Another survey of Barandica et al. (2013) allowed, through an innovative management system, reduce CO_2 emissions in highway projects. Four types of highway projects were assessed in construction phase with ACV methodology. According to the authors, the initial effort to reduce CO_2 emissions should be focussed in two points: earth movements and improvement in efficiency of machinery. Secondly, the choice of materials and restoration of environmental systems.

It is too important in civil work, although the same applies to other type of constructions, environmental impact assessments. Thus, for example, CEMEX Company has developed an indicator (CO_2 footprint) to evaluate carbon footprint in their products. According to CEMEX, the objectives of this indicator are the following:

- Quantifying the gas emissions in CO_2 equivalents of their products, in order to support emission reduction targets.
- Performing a benchmark between different installations of the company to promote a continuous improvement in carbon footprint reduction.
- Communicating their carbon footprint products to the stakeholders. This information allows to customers obtain a specific footprint of CEMEX products that will be used in their projects.

The carbon footprint evaluated by the company count the amount of CO_2 equivalent directly and indirectly emitted during the entire building process, to door of the CEMEX factory (approach "cradle to gate"). All the production steps are considered, from the raw materials generation as of natural resources and their transport, through manufacturing and packaging (if it's necessary), to the moment when the product leaves the CEMEX factory.

The methodology developed by CEMEX is based on the norm ISO 14040:2006 "Life cycle assessment" and the standard PAS 2050:2008 "Specification for the assessment of the life cycle greenhouse gas emissions of goods and services", such as versions "draft" of ISO 14067 "Carbon Footprint of products" and the protocol WBCSD/GHG "Product Life Cycle Accounting and Reporting Standard".

On the sustainable materials level, there are studies related to CO_2 emissions too. Martínez-Alonso y Berdasco (2015) assessed the carbon footprint in wood products in the north of Spain. Wood analysed was structural use and non-structural. The methodology used to determine the carbon footprint was PAS 2050 "Specification for the assessment of the life cycle greenhouse gas emissions of goods and services", applying cradle to gate analysis. Sensitivity studies were made to consider the influence of the transport from de origin and sawmills efficiency. The study determined that for 1 m^3 of wooden products, the total of CO_2 emissions were in the range of 100 to 400 kg CO_2 equivalent.

In addition, Giesekam et al. (2016) publication is important, because it analyse the situation of the construction field from the point of view of the awareness in the use of sustainable materials. For that purpose, various actors specialized in sustainable materials (technics, promotors, factories, managers, etc.) were analysed the advantages and disadvantages of the use of these materials by surveys and interviews.

The objective of the study was to understand the economic, technique, practice and culture barriers that prevented professionals select low carbon materials.

Finally, we focus in studies related to CO_2 emissions in the phase of building construction. We are going to analyse three surveys:

First, Mercader et al. (2010) raise the generation of a quantification model of CO_2 emissions produced during the implementation of the usual constructive model like residential blocks intended for social housing derived of the manufacturing process of the material resources using in their implementation. Identification and quantification of the construction materials consumed, allowed knowing the environmental impact produced by the defined typology, through one of the most important indicators of environmental impact associated to weight per m^2 of construction, like CO_2 emissions deriving from the process of manufacture of the construction materials using in their execution. The practical implementation to a set of ten construction projects located in Seville, provided conclusive data about the quantification of CO_2 emissions produced during the execution, identifying the greatest environmental impact.

González y García Navarro (2006) were pioneers in Spain in evaluation of construction materials from the point of view of CO_2 emissions. This assessment was verified through the study of three houses with low environmental impact. According to the authors, the CO_2 emissions in construction phase could be reduced to a 30%, with careful selection of low environmental impact materials. The purpose of the study was to quantify CO_2 avoided emissions with the method presented in the selection phase, in other words, in the project design. The three houses evaluated were compared with a standard house without low environmental impact materials. These three houses were built according to low impact criteria, and they used alternative sources of energy.

Finally, Ortiz et al. (2009) assessed a Catalonia house following the life cycle management methodology. The life cycle management can be applied to all set of construction process, enabling the improvement of sustainability indicators and building's loads during their life cycle. To illustrate, a study was implemented in a typical Mediterranean house in Catalonia, using the methodology, and which estimated life is about 50 years, and projected according to CTE. The objective of the investigation is to use sustainability indicators in the design, use and maintenance phases. The conclusion was that the use could involve to 90% of the CO_2 emissions associates to all life cycle of the building.

Thus, the use phase was considered the most critical for the needs of heating, cooling, ventilation, illumination, electrical appliances and cooking.

Additionally, it was concluded that the appropriate combination of the improvement in the behaviour of the materials, change consumption patterns and application of specific legislation conditions of buildings to build would further improve.

3. References

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