ATILH
ASSOCIATION TECHNIQUE DE L'INDUSTRIE DES LIANTS HYDRAULIQUES

DECRYPTAGE N°6

Building LCAs and Cement LCIs

LCA: Life Cycle Assessment - **LCI:** Life Cycle Inventory
Reference standards: NF EN 15804+A1, NF EN 15804/CN, NF EN 15978

Key Points

- **Environmental declarations for construction products intended for the building industry and sold directly to consumers have been mandatory since January 1, 2014 when an environmental communication on said product is expected.**
- **These declarations are called Environmental and Health Declaration Forms (EHDF, FDES in French). They provide information about the environmental impacts associated with a product's life cycle and serve as a basis for conducting environmental assessments on buildings.**
- **Auditing of EHDF by independent third parties has been mandatory since 1 July 2017.**
- **For intermediate products, these data can also come in the form of a Life Cycle Inventory (LCI) to contribute to the EHDF of the final product. Such is the case for common cements.**
- **In 2017, there were 8 LCIs for common cements, updated in accordance with regulations and standards in force.**

INTRODUCTION

All products and services can have both positive and negative environmental impacts. Every product requires raw materials and energy to be manufactured, packaged, transported, and used, and may end up as waste. Cutting down on and avoiding negative impacts first requires an assessment.

The voluntary assessment of the environmental impacts of the various stages (production, transport, implementation, recovery, processing) is carried out using a method known as Life Cycle Assessment (LCA). During this assessment it is necessary to take Life Cycle Inventories (LCI) to describe all of a product's inputs and outputs in elementary flows. LCA methods and research have undergone continuous development since the 1970s, and with the growing interest in environmental issues, these methods have been standardised, coming under regulatory frameworks at the international (ISO standards), French (NF standards) and later European (EN standards) levels. In France, these procedures are even becoming mandatory for construction products.

In Europe, LCAs have given way to Environmental Product Declarations (EPD), a communication format providing environmental profile information regarding a number of key indicators, such as:

- Climate change (kg CO_2)
- Atmospheric acidification (kg SO_2)
- Primary energy consumption (MJ)
- Generation of hazardous waste (kg)
- Eutrophication (aquatic ecosystem degradation, algal blooms, etc.)
- Etc.

Through such evaluations, LCAs have become a decision support tool for establishing action plans to reduce the environmental impacts of assessed products, as well as provide collective measurements to compare products with equivalent service rendered.

ENVIRONMENTAL DECLARATIONS

French regulations

Since 1 January 2014 (1) in France, an environmental declaration (notice disclosing environmental aspects) has been mandatory for producer-to-consumer marketing of products intended for the construction industry. Declarations must be compliant with standards NF EN 15804+A1 (2) and NF EN 15804/CN (3), applied over the entire life cycle, and are called Environmental and Health Declaration Form (EHDF, or FDES). These European format EPDs provide information about the product's entire life cycle, as well as additional health-related information and have been aggregated into the INIES database (www.inies.fr). They can be "individual", i.e. based on data gathered by a single industrial company on one of its products or product ranges, or it can be "collective", i.e. based on data gathered by a trade union or Industrial grouping, on a product considered as representative of all products or product ranges. FDES forms are used for conducting LCAs on buildings.

Since 1 July 2017 (4), FDES forms are required to be audited by an independent third-party accredited by the INIES auditing programme.

Changes in standards

In France, these environmental declaration procedures, initiated by the AIMCC (French association of construction product industries) in the 2000s, were first standardised for construction and building products by NF P01-010. Standardisation was subsequently broadened to the European level, with standards NF EN 15804 (product), NF EN 15978 (building), with references to international standards ISO 14040, ISO 14025, ISO 14044 (framework standards).

LIFE CYCLE INVENTORIES (LCI) OF CEMENTS

The first step in the environmental assessment of a product consists in drawing up a list of all the input and output flows (extracted material, fuels used, gases released into air, waste produced, etc.) in a production process. This list of flows is obtained from a data collection questionnaire and site audits. Once collection is completed, the questionnaire is compiled using LCA softwares (Simapro, Gabi, TEAM, OpenLCA) and databases (ELCD, Eco invent, Gabi, DEAM, etc.) to tabulate elementary flows.

Inventories can be taken during one or more stages of a product's life cycle. They are often presented in spreadsheet format, which enables analysis of flow lists as well as their translation into quantitative or qualitative indicators, For example, by compiling data on methane, nitrous oxide, carbon dioxide emissions as well as other greenhouse gases from the elementary flow list to extract a single "Global Warming" indicator expressed in kg of "CO_2 equivalent".

In the case of "intermediate" products such as cement, lime and aggregates, which lose their physical identity during their transformation, it is difficult to complete FDES forms for the entire life cycle (with end-of-life scenario, implementation, etc.) given the multiplicity of possible uses and mixing with other products. The collection of elementary flows from cement production to factory output is presented in table form, referred to as Life Cycle Inventory (LCI). These data can sometimes be translated into indicators also inaccurately referred to as LCIs or Environmental Information Modules (EIM). These LCIs or EIMs are used to develop FDES forms over a full life cycle for concrete end-products. The relationship between LCIs, FDES forms and product or building LCAs is outlined in Figure 1.

History

ATILH has taken Life Cycle Inventories (LCI) and drawn up Environmental Information Modules (EIM) for common cements on several occasions:

- First in 2001, then in 2005 and 2009, according to standard NF P01-010 (5), a former French standard governing environmental declarations.
- Then in 2011, with a first independent third-party verification.
- In 2014, following the replacement of standard NF P01-010 by standard NF EN 15804, these data were recalculated.
- Then again in 2016, with the publication of the national supplement NF EN15804/CN.
- Finally, in 2017, they were again updated and verified by an independent third-party.

Collective Declarations

Data on common cement take the form of collective declarations covering all common cements produced by ATILH members. Declarations are based on the weighted average of representative data from different manufacturers and products. In this respect, the declarations must comply with the requirements of Annex L of standard NF EN 15804/CN and enable:

- Representativeness of the reported results related to the manufacturers, products and/or commercial references;
- Identification of "sensitive parameters" that most influence a specific set of environmental impact indicators;
- A precise description of the products;
- Where necessary, a consistent calculation of the variability of life cycle impact assessment (LCIA) results, relative to input/output data variability.

2017 Declarations

The latest LCIs for common cements, published in 2017, were based on data collection for the year 2014. All 26 common clinker and cement production sites filled the collection questionnaire, thus ensuring the representativeness of common cements produced in France. Data compilation enabled the drafting of declarations (see Table 1), available on the *Infociments* website (www.infociments.fr).

The cements studied are "grey" cements, included in the 2017 LCI, and in accordance with standard NF EN 197-1:2011 (6). Their compositions are weighted average compositions, according to the tonnages supplied by each producing plant. Cement types cover all the designations specified in Table 1 and include all the current and short-term strength classes of standard NF EN 197-1. Data are expressed per tonne of cement.
Data collected on site were supplemented with data from the Ecoinvent v3.1 database and calculations were performed using professional SIMAPRO 8.0.5 software.

Designation	Designation of cements (includes all strength classes and sub-classes)
CEM I	CEM I
CEM II/A-S	CEM II/A-S
CEM II/A-L or LL	CEM II/A-L or LL CEM II/A-M (LL-S) CEM II/A-M (LL-V)
CEM II/B-L or LL	CEM II/B-L or LL
CEM II/B-M	CEM II/B-M (S-LL) CEM II/B-M (L-S-V) CEM II/B-M (S-L) CEM II/B-M (L-S) CEM II/B-M (LL-S) CEM II/B-M (V-L) CEM II/B-M (L-V) CEM II/B-M (LL-V) CEM II/B-M (V-LL) CEM II/B-M (LL-S-V)
CEM III/A	CEM III/A
CEM III/B	CEM III/B
CEM V/A-(S-V)	CEM V/A (S-V)

Table 1 - Common cement types covered by 2017 LCI.

The indicators

These declarations cover different flows and indicators, including:

- Impact indicators (global warming, soil and water acidification, eutrophication, photochemical ozone formation, ozone layer depletion, depletion of abiotic resources, air pollution, water pollution);
- Material and energy consumption indicators (renewable/non-renewable primary energy use, renewable/non-renewable primary energy used in production of reusable/non-reusable process/material, renewable/non-renewable secondary fuel use, water consumption);
- Output indicators (components for reuse, materials for recycling, materials for energy recovery, hazardous/non-hazardous/radioactive waste).

Third-party verification

Pursuant to the decree of 31 August 2015 (4), environmental declarations were verified in March 2017 by an independent third-party, according to the INIES verification programme.
This verification certifies that:

- All requirements of FDES Programme, NF EN 15804+A1 and NF EN 15804/CN (applicable to the EPDs of intermediate construction products) are met;
- Environmental and health data and information contained in the abovementioned EPD are plausible for the product which is the subject of the EPD.

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Design: Studio ***201***
Published:
NOVEMBER 2018
Publication director:
Anne Bernard-Gely
Managing editor:
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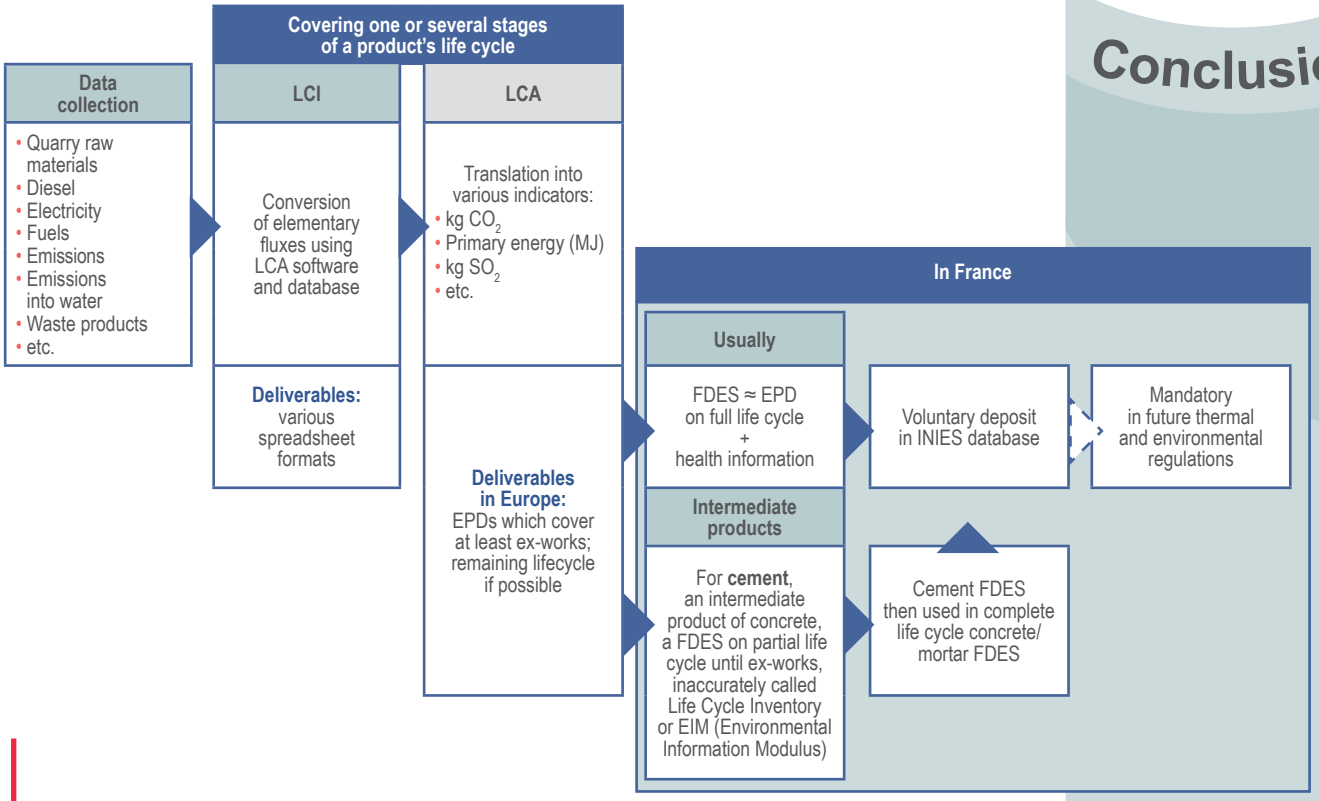

FIGURE 1 - LCI development process and its use in product and building Life Cycle Assessment

Conclusion

- **FDES-format environmental declarations for construction products were made mandatory in France on 1 January 2014. For common cements, the data, updated and verified in 2017, are also referred to as LCIs or EIMs and cover the life cycle of one tonne of cement until it leaves the plant. The data are then used to draft concrete FDES forms over an entire life cycle, covering implementation, use and end of life.**
- **Using these data on cement then concrete, in combination with the FDES forms for different products and materials making up a structure, or a building or construction work, LCA can then be carried out. The assessor must add up the various elements that form the structure being studied and also take into account the operational phase of the structure (water consumption, energy consumption, etc.). Building LCAs will eventually become mandatory, particularly in the context of upcoming French thermal building regulations, set to become thermal and environmental regulations.**

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