Concrete in Practice

What, why & how?

NRMCA

CIP 46 - Environmental Product Declaration (EPD)

WHAT are EPDs

An EPD is an independently verified and registered document that communicates transparent information about the life-cycle environmental impact of products. EPDs are developed from an in-depth Life Cycle Assessment (LCA) of a material or product in accordance with a consensus-established Product Category Rule (PCR) document. PCRs are developed for specific product categories and EPDs generated based on different PCRs should not be compared to assess environmental impact. There are different PCRs established to develop EPDs for ready-mixed concrete, precast concrete, concrete pipe, masonry block, and other construction materials and building products. EPDs for upstream materials used in concrete – cementitious materials, aggregates, and admixtures are available and used as input data to develop EPDs of concrete mixtures.

Life Cycle Assessment (LCA) complying with standards in the ISO 14040 series and ISO 21930 are used to analyze and quantify environmental impacts of a product, system, or process. The LCA examines inputs of materials and energy and outputs of emissions and wastes of products from raw material extraction to end-of-life. Environmental impact assessment tools quantify the potential environmental impacts for several characterization factors. These typically include global warming potential (GWP), smog formation, ozone depletion, acidification, eutrophication, and other factors depending on the standard or entity requiring EPDs. The primary factor of interest for concrete more recently is the GWP, that is a collated value of various gaseous emissions that contribute to global temperature rise and expressed as CO_2-equivalent in kg for the declared unit volume of 1 m^3 (or yd^3).

Some important considerations for the PCR:

Consistency in PCR development lies at the heart of ensuring information in the EPD and its use is reliable. The transparency of process and uniformity of the PCR is essential for building trust and getting buy-in from stakeholders. The PCR should specify reporting of the performance characteristics of the product so users can make informed product comparisons. The LCA data collection and analysis methodology must be clearly defined in the PCR so that these are not subject to a practitioner's interpretation. The PCR defines the foreground process data that should be collected by the producer and the background process data that can be estimated from LCA databases or models. Background data sources should be defined such that every EPD is produced using consistent background datasets.

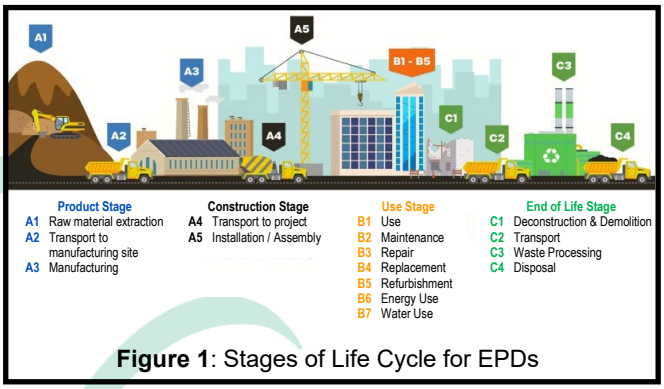

Figure 1: Stages of Life Cycle for EPDs

The current PCR for ready mixed concrete in North America is published by NSF International. A PCR is valid for 5 years at which point it is typically updated.

WHAT is the Scope of EPDs

There are four life-cycle stages related to a project – Manufacture of Products, Construction, Use, and End-of Life as shown in Figure 1. The scope of an EPD will be based on the included life-cycle stages as follows:

Cradle-to-Gate: Includes the impacts associated with Stages A1-A3. This is referred to as a Type III EPD representing life-cycle stages defined in European Standard EN 15804. Most PCRs for construction products, including concrete, are developed for this scope of EPD.

Cradle-to-Site: Includes the impacts of Cradle-To-Gate plus Stages A4-A5. The scope of this EPD covers impacts through the end of construction of a project.

Cradle-to-Grave: Includes the impacts of Cradle-to-Site, plus Use (B1-B7) and End of Life stages (C1-C4). The scope of this EPD would be applicable to designers to capture benefits of design and use of construction materials that result in reduced energy consumption and waste, longer service life with reduced maintenance and repair through the use stage; and aspects such as carbonation of crushed concrete in the end-of-life stage.

An optional Module D addresses supplementary information and is outside the system boundary. ISO 21930 states, *Module D information aims at transparency for the resulting potential environmental benefits from reused products, recycled materials, secondary fuels and/or recovered energy leaving a product system and being used in a subsequent product system.* Beneficial impacts, such as use of recycled aggregates in road construction can be reported in Module D.

WHAT are the Types of EPDs

EPDs typically report product-specific environmental impacts. Some PCRs provide instructions on how to perform averaging and develop a more general EPD. EPDs for concrete are typically categorized by compressive strength at a specific age.

Facility-specific EPD. Concrete mixtures are designed for different properties and use different upstream source materials and quantities. Each concrete plant (facility) produces several concrete mixtures. Each mixture produced at a concrete plant will have a different environmental profile and thereby will need a unique EPD for each mixture or family of mixtures produced at that specific plant. This type of EPD typically is most accurate and representative of each concrete mixture. Facility-specific EPDs would more commonly be used for project bidding and submittals.

Product-specific EPD. A producer could develop product-specific EPDs based on the weighted average production from multiple facilities using the PCR's averaging rules. This type of EPD could be used as a benchmark for that company.

Regional EPD or industry-wide EPD. For a more general assessment, an industry group can perform an LCA that describes the material production in a region or on an industry-wide level following the PCR. The LCA data are collected from industry participants to develop these EPDs. Regional or industry-wide EPDs can assist producers in evaluating their environmental performance compared to average regional or industry average impacts. These EPDs could be used as a data source for design decisions and to set project targets or limits.

WHY are EPDs Used

EPDs provide a standardized methodology for communicating a product's environmental impact associated with manufacturing a product to help guide decisions towards sustainable construction goals. EPDs are specified in green building standards (e.g. LEED) and codes (e.g. International Green Construction Code (IGCC)) to demonstrate environmental impact reduction. Because EPDs declare a product's GWP, they are used to measure progress in carbon footprint reduction initiatives like Architecture 2030 Challenge for Products and SE 2050 of the Structural Engineers Institute. EPDs have been the basis for documenting carbon footprint reduction for local, state and US Federal low-carbon procurement policies, such as the so-called Buy Clean regulations and will be increasingly required on public projects. These types of market-based and regulatory initiatives are driving an increased demand for EPDs for many product categories besides concrete and support whole project/building LCA.

HOW are EPDs Developed

There are four basic steps as defined in ISO 14025:

Step 1: A PCR is developed through a consensus process by a committee of impacted stakeholders and validated by an independent third-party for compliance with ISO 14025.

Step 2: The producer collects the relevant production parameters, referred to as foreground data, such as upstream materials, transportation distance and mode, fuel and energy consumption, and waste. Background data, such as electrical grid, are modeled using LCA databases. An LCA is developed to create a draft EPD, either in-house or using an LCA consultant. If data are developed for a location and its products, dynamic product-specific EPDs can be generated in real time as mix designs are developed or changed.

Step 3: The draft EPD is submitted to the Program Operator to verify conformance to the rules of its EPD program.

Step 4: An Independent Verifier reviews the LCA and draft EPD for conformance to the PCR, the rules of the Program Operator, and the applicable international standards. The Program Operator issues the EPD to the company.

The NRMCA is one of several Program Operators that facilitates the development of EPDs.

HOW are EPDs Used

- EPDs for concrete mixtures get credit for projects seeking LEED certification. Product-specific EPDs get more credit than an industry-wide EPD for participants.
- EPDs are used in whole building/project LCA to quantify the environmental impact of a construction project.
- Industry-wide EPDs establish national and average benchmarks for products. These may be used to set mixture or total limits for GWP on projects, or in local and national policies. Tools such as EC3 use these to establish conservative baselines in a product category; and additionally establish *typical* and *achievable* estimates for product categories from EPDs in their database.
- EPDs are used to evaluate GWP reduction of products from a specific producer or in a region.
- EPDs are being collected by public agencies to establish project targets in the future.

References

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