Asphalt Sustainability

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Material EPDs - What they tell us and what they do not

Our industry is starting to see "Buy Clean" legislation at the federal[1,2] level and some state governments[3,4] are now regulating public procurement. These legislations require the reporting of Environmental Product Declarations (EPDs) on certain materials used in pavement and building construction, rehabilitation and maintenance projects.

The objective is to quantify the potential environmental impacts in particular the carbon footprint of the construction material and in some cases establish a threshold for these impacts. The thresholds could be lowered in successive cycles to bring down the carbon footprint of the selected materials.

These legislative efforts are well-intended. As the late Peter Drucker, a widely known expert on the topic of effective management, wrote, "If you can't measure it, you can't manage it." Accurately quantifying potential environmental impacts in a consistent manner is a necessary first step in trying to manage those impacts over time.

It is especially important to understand the scope of the information that material EPDs provide and the information they do not.

Scope of material EPDs

The legislative requirements cited involve the reporting of "cradle-to-gate" material EPDs. The term cradle-to-gate represents the boundary condition of the life cycle assessment (LCA) upon which the EPD is based. Cradle-to-gate starts with "upstream" activities that include raw material extraction, transportation of those raw materials to a manufacturing/production plant, all the plant processes used in producing the material and ends at the gate where the material leaves the plant. The employment of the material in either the maintenance, rehabilitation, construction or use phases ("downstream" per se) is not included in cradle-to-gate material EPDs.

One necessary element of a material LCA or EPD is the "declared unit" of that material. For example, the declared unit used in Asphalt Institute's published LCA study in 2019 on four asphalt binders[5] is one kilogram of asphalt binder, with the gate being the end of the terminal operations. Similarly, the declared unit used in NAPA's cradle-to-gate LCA and the corresponding EPD tool on asphalt mixtures[6] is one short ton of asphalt mixture, with the gate referring to end of the asphalt plant operations.

A cradle-to-gate LCA (and subsequent EPD) typically does not reflect the expected performance of that material. To include performance, the boundary conditions would need to be expanded to include cradle-to-gate plus options with a "functional unit" that represents pavement performance. Sometimes this is referred to as a cradle-to-grave LCA, implying the inclusion of the life of a pavement system. This type of analysis is significantly more complex and deserving of a separate future article.

A disconnect between Buy Clean policies and ISO standards

The International Organization for Standardization (ISO) standards 14025[7] and 21930[8] define the core rules for developing EPDs. These standards are clear that the comparison of construction products (e.g., materials) should be at the "construction works" level (e.g., pavements, buildings) which includes the performance of that material in its final product form. Specifically, ISO 21930 Section 5.5 Comparison of EPDs states:

"Comparison of construction products using an EPD shall be carried out in the context of the construction works. Consequently, comparison of the environmental performance of construction products using the EPD shall consider all the relevant information modules over the full life cycle of the

products within the construction works. Such a comparison requires scenarios in the construction works context."

Section 5.5 goes on to discuss in more detail that the comparison of product EPDs "shall have the same functional performance" and be "based on the same functional unit."

There seems to be a fundamental discrepancy between the ISO standards that the "Buy Clean" policies cite and the intent of these policies regarding the comparability of materials. The scope of cradle-to-gate and the definition of "declared unit" for material EPDs are not sufficient to compare EPDs. The performance of a material should be considered from the perspective of its final product form such as the pavement system.

Using LCCA to explain material EPDs

Those of you reading carefully may be thinking the title of this section has a typo. Surely, Buncher meant to write "LCA" (Life Cycle Assessment) versus "LCCA" (Life Cycle Cost Analysis) because this is an article on environmental sustainability, right? Well, it is an article on environmental sustainability, and people in our industry often mistakenly intermix these two terms or at least the word that the "A" represents. But I did mean to write LCCA. So, where am I going with this analogy - you might be asking.

As pavement engineers, we generally have a good understanding of LCCA because it is used routinely in our profession, while LCA is relatively new. While they are quite different, there are parallels between LCCA and LCA that can help us understand the limited scope of cradle-to-gate material EPDs.

LCCA is the analysis method used routinely by transportation agencies to objectively select the most cost-effective alternative within a defined window of a pavement's existence. LCCA considers all the expected costs such as initial construction, rehabilitation and maintenance activities for a defined analysis period. Next, the analysis brings all these costs back to a total net present value (NPV) to compare alternative scenarios. Agencies often use LCCA as part of their pavement type selection process by comparing different equivalent designs, such as a rigid concrete pavement to a flexible asphalt pavement. The alternative with the lowest initial cost may not be the same as the alternative with the lowest total NPV (synonymous with the lowest life cycle cost). The cost and time interval (expected performance) of treatments beyond year zero play a key factor in determining life cycle cost.

Those familiar with LCCA know that many assumptions go into an LCCA, including expected performance between treatment intervals. They also know the quality of those assumptions drives the quality of the LCCA. This is one reason why tools such as FHWA's RealCost[9] allow for probabilistic analysis accounting for uncertainties associated with those assumptions.

There are many excellent resources (reports, bests practices, software tools, etc.) to learn more about LCCA[9] but since I am assuming most readers are familiar with LCCA basics, I'll stop there.

Now, what can we learn about the implementation of EPDs from a basic understanding of LCCA?

Cradle-to-gate material LCAs (and corresponding EPDs) are analogous to the material costs that are one of the many inputs required to estimate initial agency costs in LCCA. They quantify the potential environmental impact (e.g., carbon footprint or global warming potential) in producing a construction material, but do not quantify the impacts of using that material over the life of a pavement. While cradle-to-gate material EPD information is important, just as initial agency cost is in LCCA, it is important to recognize the limited scope material EPDs represent.

Wrap-up

ISO Standards 14025 and 21930 form the foundational basis for developing and using EPDs. Since the Buy Clean policies are specifying EPDs as the required communication medium for potential environmental impacts, the development and use of EPDs should adhere to these ISO standards. Quantifying the potential environmental impacts and establishing benchmarks should be done at the pavement level by accounting for the performance of the material in the context of its final product (the pavement). Whether it is LCCA or LCA, the numerous assumptions will have a major impact on the analysis and results.

Policies on the use of EPDs should reflect a fundamental understanding of "what material EPDs tell us, and what they do not."

References:

1. Federal Buy Clean Initiative. https://www.sustainability.gov/buyclean/

2. General Services Administration. https://www.gsa.gov

3. State of California, 2017. Buy Clean California Act. Sacramento: Department of General Services, Procurement Division.

4. State of Colorado, 2021. Measures To Limit the Global Warming Potential for Certain Materials Used in Public Projects. General Assembly of the State of Colorado.

5. https://www.asphaltinstitute.org/engineering/sustainability/life-cycle-assessment-of-asphalt-binder/

6. https://www.asphaltpavement.org/uploads/documents/EPD_Program/NAPA_Product_Category_Rules_%20final.pdf

7. ISO 14025, Environmental labels, and declarations — Type III environmental declarations — Principles and procedures, 2020.

8. ISO 21930, Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services, 2017.

9. RealCost. FHWA Life Cycle Cost Analysis Software. https://www.fhwa.dot.gov/pavement/lcca/lccasoft/