PVC PIPE association

ASSESSING THE TRANSPARENCY & RELIABILITY OF ENVIRONMENTAL PRODUCT DECLARATIONS FOR UNDERGROUND PIPING

SUMMARY

Assessment of environmental claims for materials and products used in underground piping infrastructure can be a daunting task, since there are many widely varying methods that can provide contradictory results. The most logical way to ensure valid sustainability assessment is to use an internationally recognized, third-party certified method like an Environmental Product Declaration (EPD).

PVC PIPE: DATA RELEASED FOR PUBLIC REVIEW

PVC is the only piping material with a published EPD and Life Cycle Assessment (LCA) report. The *Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials* was published by Sustainable Solutions Corporation, a leading provider in the development of life cycle assessment. While LCAs are not required to be made publicly available, both the EPD and underlying LCA report for PVC water and sewer pipe have been released for public review.

STANDARDS, CERTIFICATIONS AND INDEPENDENT REVIEW

LCAs and EPDs are developed according to rigorous standards. The International Organization for Standardization (ISO) is recognized as one of the most reliable sources of industry standards. Three of its standards, ISO 14025, 14040 and 14044, describe the principles, framework and requirements for developing LCAs and EPDs. NSF International, an authority on testing and public health standards and certifications, provides independent verification to determine whether an EPD meets the requirements for the relevant LCA ISO standards and the applicable Product Category Rule (PCR).

Before the LCA is published, the PCR is independently reviewed by a three-person panel to ensure the PCR represents a specific product, category or product function, according to ISO standards. Without proper definitions for product categories, environmental impacts cannot be determined and compared. To specify the category of piping considered for analysis, the EPD for PVC sewer pipe used the PCR "Piping systems for use for sewage and storm water (under gravity) NPCR 19," which was developed by UL Environment (a program operator functioning under ISO 14025).[1]

DEFINITIONS

▶ ENVIRONMENTAL PRODUCT DECLARATION (EPD)

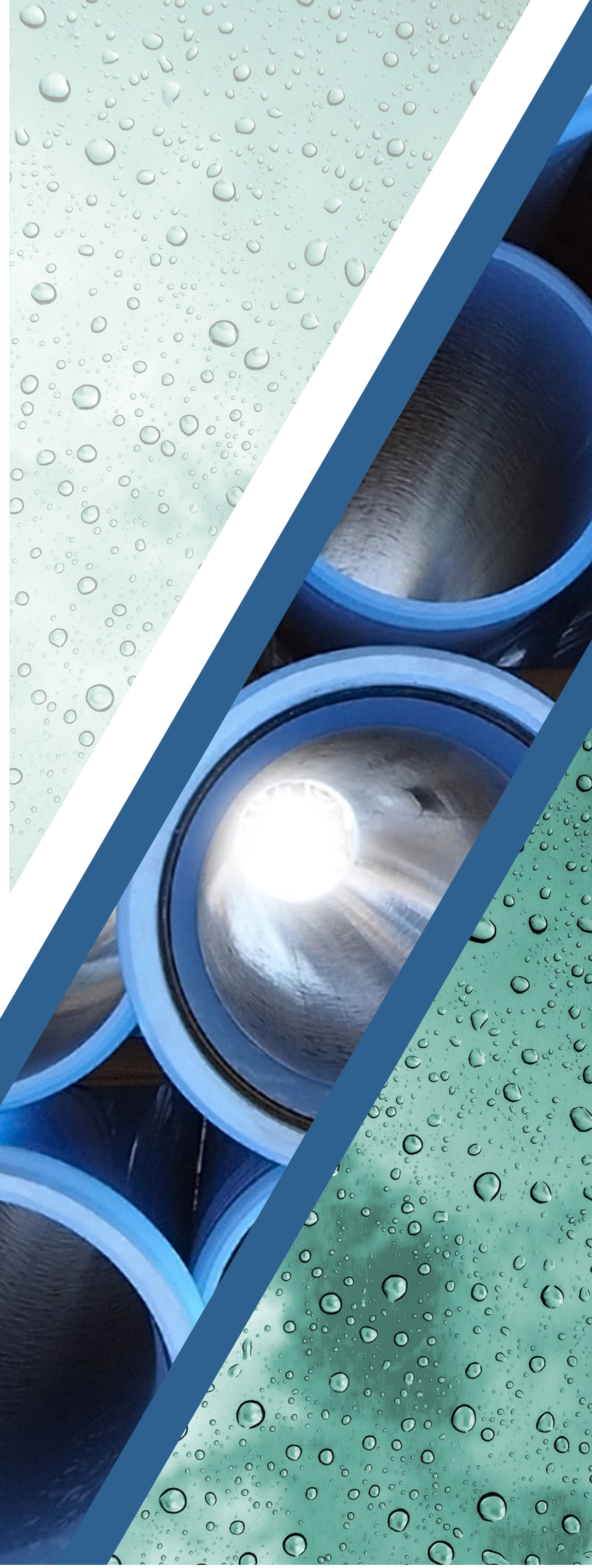
An EPD presents quantified environmental information about a product over its life cycle. The goals of an EPD are to provide verified information of environmental impacts, encourage improved environmental performance and enable purchasers to make educated decisions.

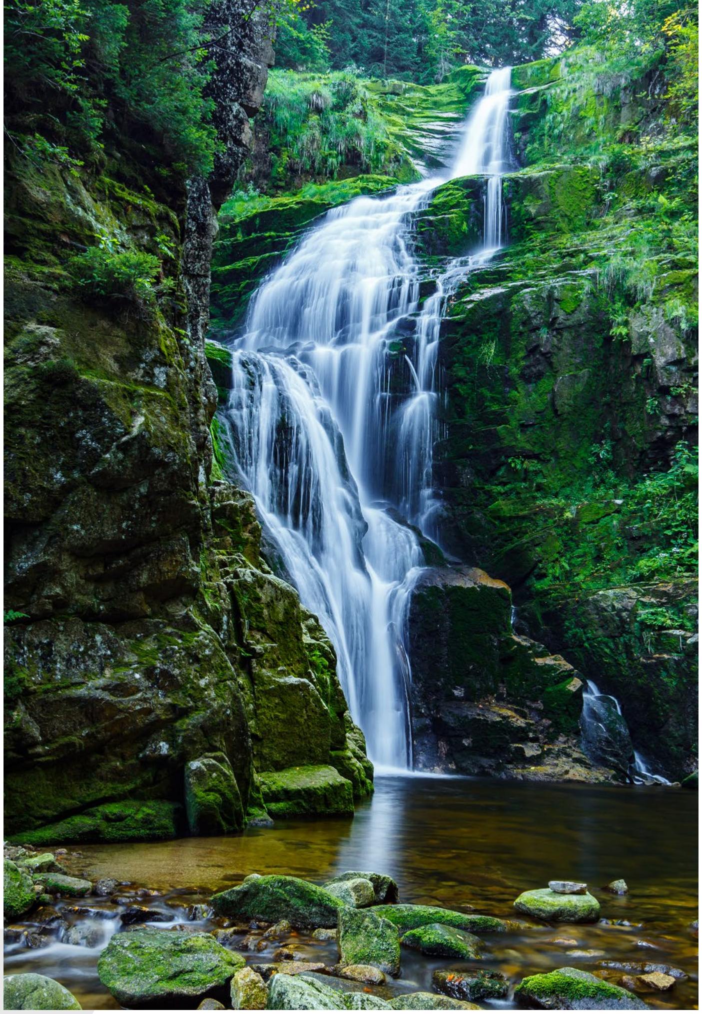
▶ LIFE CYCLE ASSESSMENT (LCA)

An LCA compiles and evaluates inputs, outputs and potential environmental impacts of a product throughout its life cycle. The LCA provides the basis for an EPD.

▶ PRODUCT CATEGORY RULE (PCR)

A PCR defines the requirements for performing an LCA to ensure consistency and comparability between EPDs within the same product category.





SMART CERTIFICATION: BASIC REQUIREMENTS NOT FULFILLED

Pipe materials like ductile iron and vitrified clay have both used the Sustainable Materials Rating Technology (SMaRT) Product Category Rule to certify the environmental impacts of their materials. Unfortunately, the basic requirements of the relevant ISO standards are not fulfilled, since SMaRT:

- Fails to enable comparability
- Does not represent a specific product category
- Excludes certain material types

Ironically, SMaRT requires that the products it certifies do not produce dioxins during manufacturing; however, dioxin emissions from the manufacturing of ductile iron pipe (which SMaRT has certified) can be almost six times as high as emissions from PVC resin production.[2]

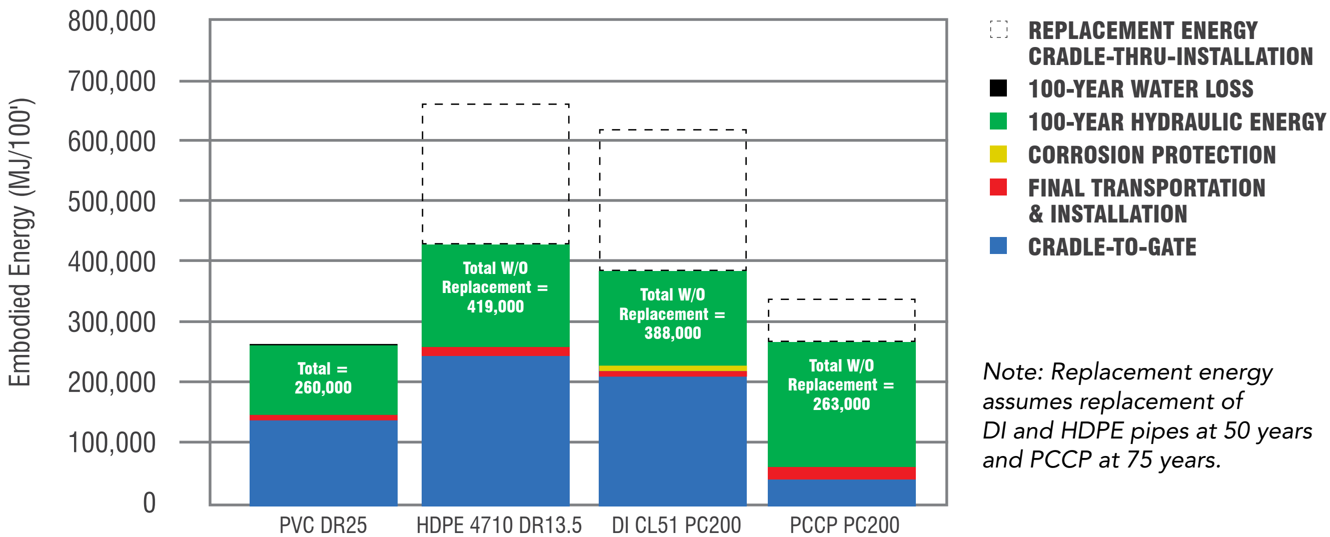
ENVIRONMENTAL IMPACTS

Having an EPD does not mean a product is better than alternatives; however, a third-party reviewed report of a life cycle analysis of comparative materials, written to applicable ISO standards, can provide a thorough and accurate comparison. The PVC piping EPD is based on the *Life Cycle Assessment of PVC Water and Sewer Pipe and Comparative Sustainability Analysis of Pipe Materials* report, developed by Sustainable Solutions Corporation and reviewed by three LCA and piping experts to ISO standards. The results of this study found that PVC piping systems have lower life cycle environmental impacts in most impact categories than alternative materials analyzed, including ductile iron (DI), high density polyethylene (HDPE), and prestressed concrete cylinder pipe (PCCP). PVC pipes consistently have reduced environmental impacts due to lower embodied energy and longer service lives than metallic pipes.[3]

Before a pipe's use stage, extraction and production of raw materials typically represent the most significant environmental impacts, specifically in the release of airborne emissions. PVC resin emissions have declined by 75% since 1987, even though resin production has increased by 76% in the same time period.[4] Dioxin emissions from PVC resin production also remain low, while the production of iron and concrete for other types of piping systems are significant sources of dioxins.[5] The cement industry is ranked as the third-largest emitter of greenhouse gases (GHGs) in the world. Additionally, it is important to critically examine recycling claims. DI pipe manufacturing, which uses metals from recycled automobiles, releases a host of additional chemicals such as lead, mercury, manganese, zinc, chromium compounds, trimethylamine, xylene, methanol and phenol compared to iron pipe made from virgin iron ore. The production of PVC pipe using virgin material is less energy intensive than DI pipe using recycled materials, resulting in fewer environmental impacts for water infrastructure projects. It is therefore critical to review using a life cycle data perspective, which may in fact indicate even greater impacts.

When examining embodied energy impacts, the cradle-to-gate stage (raw material supply, transport and manufacturing) of DI pipe production exceeds the embodied energy of the entire life cycle of the equivalent PVC pipe (Figure 1). Moreover, piping materials such as HDPE and PCCP also represent greater impacts, even when not accounting for replacement of failed piping systems.

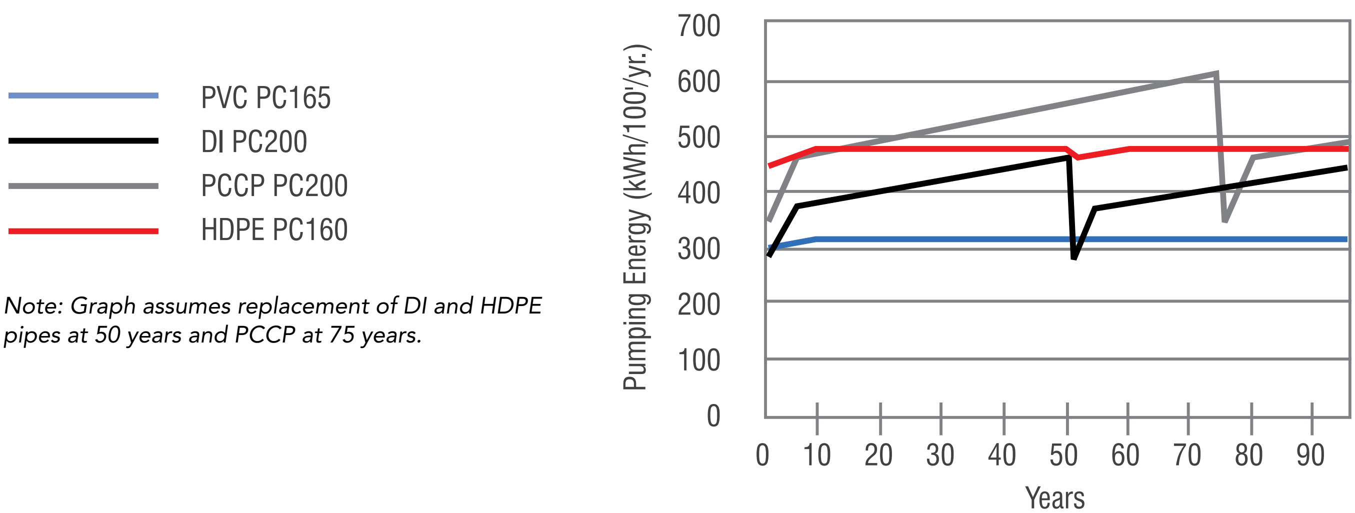
FIGURE 1. TOTAL 100-YEAR EMBODIED ENERGY COMPARISON FOR 24-INCH PVC DR25 EQUIVALENT PRESSURE PIPES



Note: Replacement energy assumes replacement of DI and HDPE pipes at 50 years and PCCP at 75 years.

The main source of environmental impacts in a pressure pipe system's life cycle is the use stage. Metallic pipes, such as ductile iron, are subject to degradation of the cement mortar lining over time, resulting in higher friction and lower pumping efficiency. PVC pipes are not subject to corrosion, so they maintain smooth interior pipe walls consistently through the service life. Smoother walls require less pumping energy than rough, corroded walls; the data referenced in the EPD and LCA demonstrate that PVC pipes provide an advantage during the pumping phase of the life cycle. Figure 2 illustrates that PVC pipes require less pumping energy than other types of pipes during the use stage.

FIGURE 2. ANNUAL PUMPING ENERGY COMPARISON FOR 24-INCH PIPES



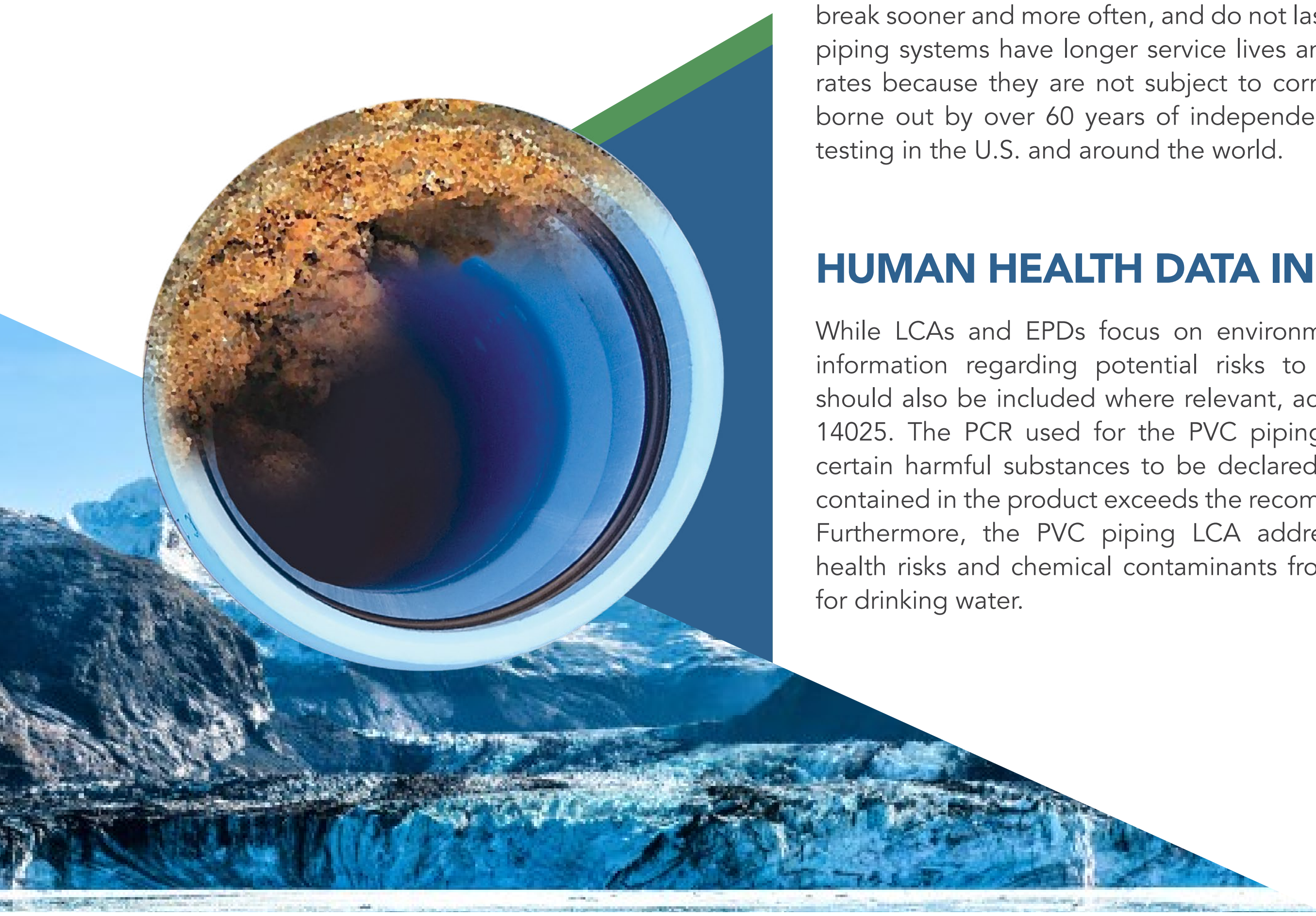
Note: Graph assumes replacement of DI and HDPE pipes at 50 years and PCCP at 75 years.

Differences in data sources, methodologies, system boundaries and assumptions make a perfect comparison difficult without EPDs for each product, but accurate comparisons can still be achieved. Field experience, research studies and other LCAs corroborate the claims made in the PVC piping LCA.

UNDERSTANDING SERVICE LIFE

The PVC piping EPD provides empirical environmental impacts of different types of pipe. In order to facilitate comparison of environmental impacts during the use phase, the service life of each piping system type must be defined. For PVC water and sewer pipes, service life is confirmed to be in excess of 100 years based on extensive research, decades of field experience, industry and Water Research Foundation (WRF) studies, dig-up field samples and historical data. Sources for many of these studies are included in the PVC piping LCA report. The PCR developed by UL Environment also defines the reference service life for PVC pipe to be 100 years.

It is evident that the life cycle provided by the UL Environment PCR is based on quantitative data rather than qualitative perceptions. This distinction is critical for precisely assessing the durability, performance and longevity of pipe networks. This stands in contrast to studies like AWWA's 2012 *Buried No Longer* report, which is qualitative in nature (i.e., subjective). The critical problem with the study is that it provides estimated service lives of different pipe materials based only on perceptions of service life rather than on quantitative data — this weakness in methodology severely reduces the value of the report.[6] Additionally, the report provides a confusing number of lifetime estimates for the same piping materials. Some materials are assessed based on "ideal" installation and soil conditions, while others are not. This enables competitive pipe materials to choose a favorable life expectancy for their product and then compare it to the least favorable estimate given for other materials — making accurate comparisons between materials impossible. Although the AWWA report admits that "predicting the actual life expectancy of any pipe is outside the scope of this study," these flawed perceptions are often used to claim that pipe materials such as ductile iron have service lives exceeding 100 years, while suggesting PVC pipe lasts only 50 years (even though longevity estimates provided for DI pipe are as low as 50 years in the report). This non-scientific method is of limited value for asset management, pipe replacement planning, life cycle cost projections and pipe service life estimates.



While older metallic pipes could last 50 to 75 years, studies have shown that iron pipes manufactured during the mid-1900s last 25 to 50 years, and that DI pipes with the thinnest walls (representing the majority of metallic pipes sold today) in moderately corrosive soils have a life expectancy of only 11 to 14 years.[7] The corrosive soils that cause these failures affect 75% of all U.S. water utilities.[8] A common misconception about service life is that iron pipes today perform as well as cast iron pipes installed over 100 years ago. However, modern DI pipe's far thinner walls are more susceptible to pits or holes from corrosion, break sooner and more often, and do not last as long.[9] PVC piping systems have longer service lives and lower failure rates because they are not subject to corrosion, which is borne out by over 60 years of independent dig-ups and testing in the U.S. and around the world.

HUMAN HEALTH DATA IN EPDs

While LCAs and EPDs focus on environmental impacts, information regarding potential risks to human health should also be included where relevant, according to ISO 14025. The PCR used for the PVC piping LCA requires certain harmful substances to be declared if the amount contained in the product exceeds the recommended limits. Furthermore, the PVC piping LCA addresses potential health risks and chemical contaminants from piping used for drinking water.

LEACHING OF VCM NOT AN ISSUE FOR PVC WATER PIPES

Regarding vinyl chloride leaching, an EPA study has found no instances of vinyl chloride monomer (VCM) leaching from gasketed PVC pipes manufactured in North America for water transmission and distribution in sizes 4 to 60 inches.[10] All PVC pipe, fittings and materials are tested at least twice per year for residual VCM. For PVC pipe to be certified, residual VCM measured in chemical-extractant testing of the pipe must be below 0.2 parts per billion. This value is one-tenth the allowable level set by the EPA. In effect, certification to NSF Standard 61 is much more stringent than EPA requirements since it applies a safety factor of 10:1. Not only does PVC pipe meet the requirements set by the EPA and by NSF Standard 61, but it consistently tests "Non-Detect" for VCM per the Agency for Toxic Substances and Disease Registry.

The EPD for PVC pipe, certified by NSF International, also confirms the safety of PVC water pipe. The EPD states: "No known chemicals are released into the water system. No known toxicity effects occur in the use of the product."[11] The subject of VCM leaching from PVC water pipe is raised periodically by competitive materials. This is an unfounded allegation, since VCM migration is not an issue for PVC pipes.

For DI pipe, NSF/ANSI has certified the lining of cement-mortar lined DI pipe for health effects, but not the pipe wall itself. This means that health risks may arise as a result of any factor that can cause linings to fail and expose the metallic pipe. Lead, rust and corrosion are examples of health risks that occur in metallic pipes but not in PVC pipes.

HOW TO KNOW IF AN EPD IS ACCURATE

A reliable EPD must:

- Follow relevant ISO standards
- Be critically reviewed by an independent third-party
- Be verified by a program operator (such as NSF international)

All EPDs are reviewed for accuracy of data, conformance with ISO standards and the quality of supporting information, as well as precision, completeness, consistency, reproducibility and sources. The PVC pipe PCR, LCA and EPD all have been reviewed and verified by independent parties.

Not all certifications require the same level of accuracy and transparency that ISO-compliant LCAs and EPDs have. As a result, competing claims must be assessed technically and analytically. Documents should be written in conformance with internationally recognized standards, certified for adherence to those standards and critically reviewed by experts. These documents should be clear and specific regarding the performance, function of the products, material types, locations analyzed and should disclose the methodology used for evaluating impacts. In evaluating the individual life cycle phases of a product, all relevant information should be presented, whether the information implies a benefit or detriment. In contrast, characteristics of an unreliable document are: unsupported claims, lack of specificity in product performance or function and an absence of reviewed sources.

REFERENCES

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