PVC:

A Closer Look at Its Safe and Sustainable Journey

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INTRODUCTION

Polyvinyl Chloride (PVC)

Polyvinyl Chloride, or PVC, has been the material of choice to deliver clean, safe drinking water in North America and around the world for 70 years. PVC pipes are the preferred choice due to their corrosion resistance, lightweight composition and ability to maintain water quality[1].

Here are some of the key reasons why:

Low failure rate... PVC has proven itself a major improvement over many traditional piping materials. PVC pipes are built to last and have an extremely low failure rate compared to other pipe materials such as cast iron, ductile iron, concrete, and steel[2]. PVC also provides tighter joints and higher flow capacity.

...even when installed underground: Research has determined that buried PVC pipes can be operational for more than 100 years, making these systems highly cost-effective, efficient, and sustainable.

Ease of installation:

PVC pipes for water delivery are easy to install and significantly less expensive than ductile iron, making it an ideal choice for urban and rural communities. In fact, some researchers have described the ascent of PVC in modern infrastructure as a "Cinderella Story[3]."

Greater energy efficiency:

PVC pipes use less energy. Over a 100-year period, the total energy used is 2.4 times less than that of ductile iron when including manufacturing, transporting, installing, repairs, and replacement costs[4].

Greater strength = greater versatility:

PVC has excellent fire performance and higher strength, making it the predominant plastic piping material for underground water and sewer pipe, electrical conduit, building drain pipe (DWV), well casing and irrigation piping across North America.

Greater sustainability:

From production to the end of life, and accounting for maintenance and replacement needs, PVC has a lower overall carbon footprint than iron, steel, and copper.

THE SAFE CHOICE

Durable and Corrosion-Resistant

The robust and adaptable nature of PVC, also commonly known as vinyl, begins with its chemical structure. PVC is predominantly composed of carbon (C), hydrogen (H), and chlorine (Cl), which is derived from sodium chloride – ordinary salt.

Central to PVC's chemical stability is the strong and stable carbon-chlorine (C-Cl) bond that makes PVC highly resistant to chemical breakdown, whether from the external environment or from the substances it contains and transports.

Stringent North American codes and standards underline PVC's supremacy in terms of safety, reliability, and sustainability. With PVC being the newer material in displacing traditional concrete and metal piping, it is often held to higher standards.

Several notable product standards organizations throughout North America have helped PVC grow over the years by establishing credibility, trust and acceptance among engineers, contractors, designers, and builders.

For example, NSF, an international certification organization, establishes standards to which all water pipe materials, including PVC, must adhere. Its NSF 61 standard ensures pipes do not add harmful contaminants to drinking water. Extensive testing has proven that PVC pipe does not corrode internally or externally, even after decades of use, and does not require chemical additives to drinking water to inhibit corrosion.

PVC pipe isn't prone to scaling or tuberculation, a form of internal corrosion and biofilm contamination that can occur in other piping materials. Tuberculation creates a breeding ground for harmful bacteria such as Legionella and E. coli.

Corrosive soils affect 75% of water utilities. But PVC's durability makes it stand out in corrosive soils. Ductile iron pipe may last as little as 11-14 years in moderately corrosive soils, requiring several replacements over 100 years[5].

This is why PVC Sewer Pipe has become the predominant piping material used for sanitary sewers across North America for over 40 years. In addition to water-tight gasket joints and a smooth interior surface, PVC pipe does not allow the dangerous and unhealthy seepage of sewage from degraded pipes.

PVC not only prevents external corrosion but is also resistant to internal breakdown from sulfuric acid generated by sanitary sewage that can attack and deteriorate metal and concrete piping.

HISTORY OF PVC

Synthesized in 1872

PVC was synthesized in 1872 by a German chemist and was first used as a pipe to deliver drinking water in Europe in the 1930s. World War II saw PVC stepping in as an alternative to scarce rubber and metal, with the material primarily used for the benefit of its insulating properties.

In the post-war era, when North America underwent monumental urbanization, there was an acute need for reliable, cost-effective infrastructure. The versatility of PVC, spanning from water and sewer pipes to wiring conduits, made it an indispensable part of this urban development. Cities that previously struggled with corroding metal pipes and leaky conduits saw a transformation with PVC. Its rigidity, resistance to corrosion, and the fact it doesn't conduct electricity made it ideal for underground and above-ground applications. The first-generation PVC water pipes are still in use over 70 years after installation.

The intervening decades also have seen great progress in the design, construction and sustainability of PVC pipe:

- A significant portion of drain, waste and vent (DWV) piping systems today in North America use PVC. Success in displacing cast iron and copper DWV systems can be attributed to a familiar list of benefits, such as ease of installation, corrosion resistance, durability and longevity.
- PVC's low flame propagation and limited smoke generation permit its use in several critical areas of commercial buildings, such as high-rise construction.
- PVC pipe is also now widely used for water wells, septic systems, rainwater harvesting, subsurface irrigation, greywater reuse, and gas-fired appliance venting. Once again, these applications were traditionally served by metal or clay pipe, but the many performance benefits of PVC drove the transition.

Outside of piping, PVC is now ubiquitous in everything from medical devices to protecting wires, cables, and fiber optics to automobile components to window frames. Continuous innovation, especially in making PVC stronger and more flexible, lightweight, and UV-resistant, has unlocked many new applications.

PVC AND SUSTAINABILITY

Climate Change

The growing use of PVC pipe is an important tool in fighting climate change. Making the right choice of materials is more than just a technical decision—it reflects a commitment to future generations.

PVC has an overall lower carbon footprint than other pipe materials, such as iron, cement, and clay, based on total life-cycle energy usage[6]. How? —

Lower gas emissions:

The production of PVC creates about 45 percent less greenhouse gas emissions than reinforced concrete and 35 percent less than ductile iron.[7]

Less energy to transport:

Lightweight PVC pipes require much less energy to transport than other materials while providing unmatched longevity.

Less energy to pump:

PVC pipe systems also require less energy to pump water, resulting in savings in cost, energy usage and carbon production. For example, it takes up to 54 percent more energy to pump water through an 8-inch ductile iron (DI) pipe than it does through an 8-inch PVC pipe during the life of the piping system[8].

Less waste in manufacturing:

Also, PVC pipe in North America may be produced using reground PVC scrap, significantly reducing waste from the manufacturing process. PVC can be recycled repeatedly, although its 100-year durability means most of what has been installed has yet to enter the recycling stream.

Eco-friendly production:

Phthalates were once extensively used as plasticizers to impart flexibility to PVC. However, when concerns arose about their potential environmental and health impacts, the industry embarked on a rigorous journey of innovation.

Modern PVC formulations have incorporated alternatives like bio-based plasticizers and other eco-friendly compounds, which offer the required flexibility without compromising environmental safety[9]. The vast majority of PVC piping systems in North America now use rigid PVC, also known as unplasticized PVC (uPVC), which does not use any plasticizers.

SAVING MILLIONS

Safeguarding Water Supplies

It's estimated that each day, the U.S. loses six billion gallons of treated water – enough to fill more than 9,000 swimming pools[10]. Some cities lose at least half their treated water before it reaches residents' taps[11]. This waste carries a huge financial and environmental cost.

For example –

- Atlanta's water system lost almost one-third of the 35 billion gallons it supplied to residents in 2021, costing taxpayers nearly $3 million.
- A study of the water system in Topeka, Kansas, found that, as of 2018, failing iron pipes accounted for more than 85% of water main breaks. Just 4.5% were associated with PVC piping, which makes up 25% of the system.

In total, iron pipes (cast and ductile) failed 18 times more frequently than PVC pipes. In contrast, PVC pipe has the lowest overall failure rate compared with five other commonly used piping materials, according to a comprehensive North American study by Utah State University's Buried Structures Laboratory in 2023.

This is why demand for PVC pipe is growing exponentially. More communities are turning to PVC to safeguard their water supplies. The market was valued at $6.3 billion in 2021 and is projected to reach $12.1 billion by 2031[12].

Pleasanton, CA, for example, found PVC pipe to be 70% less expensive than metal pipes. Officials there noted that PVC pipe doesn't require corrosion protection (unlike ductile iron pipe), its installation requires less labor, and PVC pipe failures are "extremely rare," which helps keep operation and maintenance costs low[13].

MISLEADING CLAIMS

Fact-based Scrutiny

Some proponents of other pipe materials have made a series of claims about PVC that don't stand up to fact-based scrutiny.

PVC DOES NOT LEACH HARMFUL VINYL CHLORIDE INTO DRINKING WATER. NSF has conducted more than 10 million water quality control tests that have shown the safety of PVC pipe. Certification to the rigorous standard NSF/ANSI 61 confirms the safety of PVC for conveying drinking water.

PVC PIPE IS NOT A SIGNIFICANT SOURCE OF DIOXINS. In fact, PVC represents less than 0.2% of all U.S. dioxin releases, compared with heavy equipment (approximately 2%), industrial wood burning (approximately 3%), and diesel trucks (approximately 5%[14]). The largest contributors of dioxins are unregulated sources, such as forest fires, volcanoes, and the common burning of wood.

Total dioxin emissions from PVC have been in decline for decades and by more than 50 per cent since 2009 alone. In addition, the overall total releases of dioxin in the United States have declined 90% between the years 1987 and 2000, while the growth of PVC usage during that time was substantial. That fact alone helps to confirm the absence of a link between the two. *(https://assessments.epa.gov/dioxin/document/&deid=159286)*

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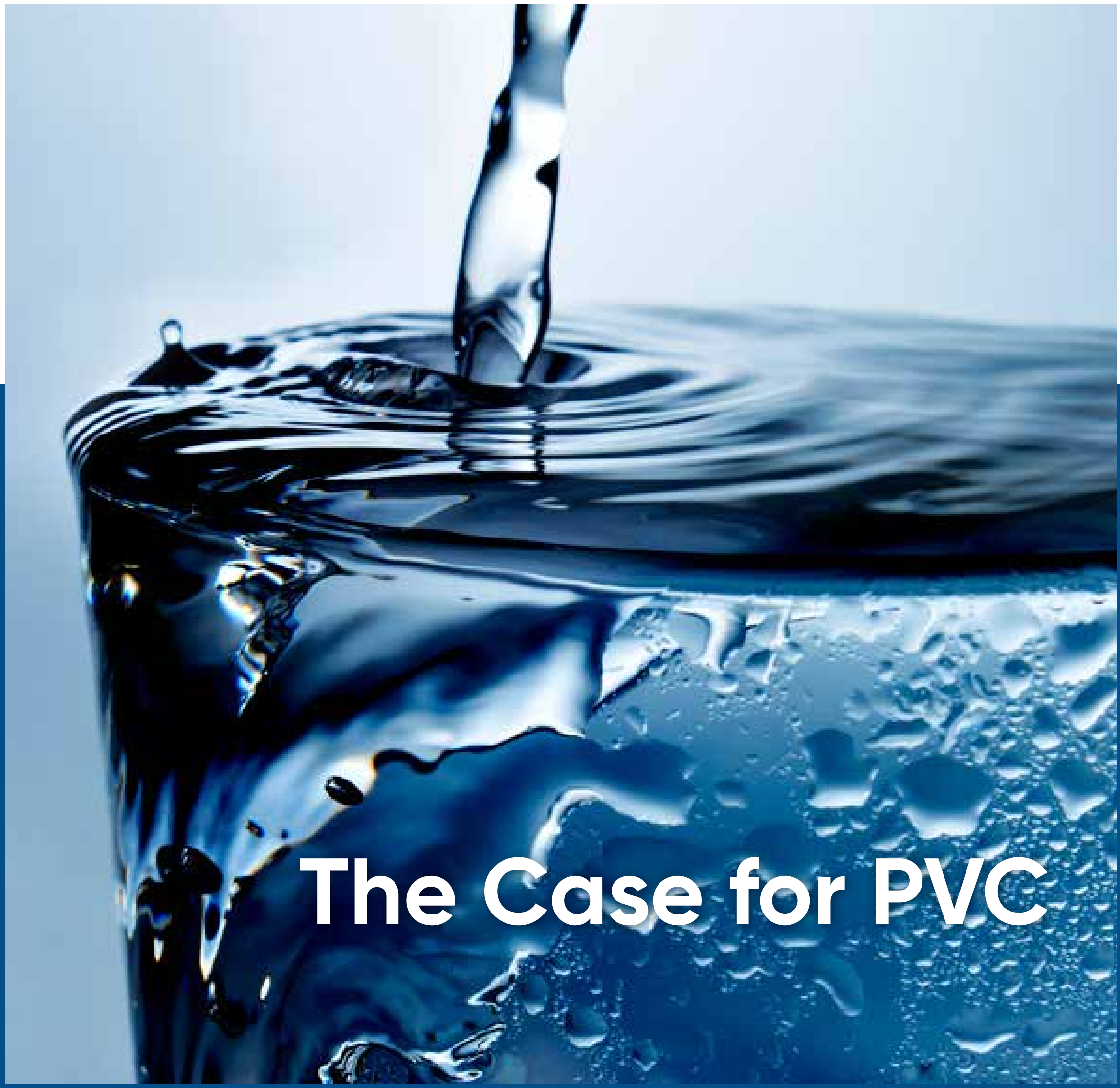
CONCLUSION

PVC offers unsurpassed performance and value among municipal water and numerous other piping options. Decades of science and experience make it clear that PVC pipe is reliable, safe, affordable with many positive sustainable features.

Effective, affordable, safe and sustainable PVC piping



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