

WHEN PERFORMANCE COUNTS

PVC PIPE IS THE CHOICE

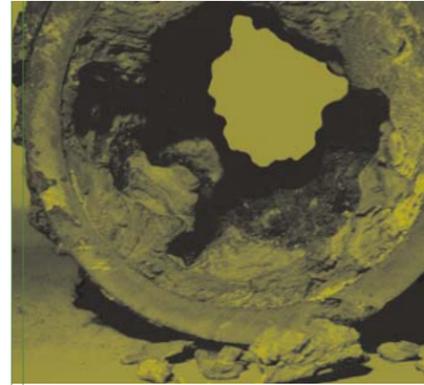
PVC PIPE | Superior Performance in Critical Systems

Of all the infrastructure systems on which our society and our economy depend – including our highways, airports, transit systems, waterways and harbors – probably no system is more important than our water delivery and wastewater handling infrastructure.

More than 264 million Americans rely on some 54,000 community drinking water systems to provide them with a dependable source of clean water.¹ Another 31 million Canadians count on their 5,400 public systems. As our first defense against water-borne disease, these systems significantly reduce sickness and related healthcare costs in our society.

Each year, our wastewater systems keep billions of tons of pollutants out of our rivers and lakes and away from our coastlines, keeping our water safe for fishing and swimming. Clean water supports a \$50 billion a year recreation industry, at least \$300 billion in coastal tourism and \$45 billion in commercial fishing.

And hundreds of billions of dollars a year in basic manufacturing depend on clean water. Access to clean rivers, lakes and coastlines attracts investment in local communities that in turn increases land value, creates jobs, expands the tax base and increases income and property taxes paid to local, state and the federal government.



700 WATER MAIN BREAKS
A DAY IN NORTH AMERICA

700



2.2 TRILLION GALLONS
OF WATER LOST ANNUALLY
IN U.S.

2.2



\$2.98 BILLION LOST
REVENUE TO U.S.
UTILITIES YEARLY

\$2.98

clean water



We might be able to live without airplanes, buses and highways, but we absolutely could not live without clean water. Nor would we want to live without effective wastewater handling systems.

SYSTEMS IN PERIL

Ironically, the reliability of these critically important systems is declining at an alarming rate.² Escalating deterioration of water and sewer systems due to corrosion threatens our ability to provide safe drinking water and essential sanitation services both today and in future generations. A recent article entitled “Corrosion, Not Age, is to Blame for Most Water Main Breaks,” estimated that, on average, 700 water main breaks occur each day in North America.³ This amounts to 250,000 breaks annually. This large and increasing rate of failure will create unprecedented financial burdens for water utilities and their customers.

In 1998, U.S. Congress enacted legislation authorizing a comprehensive study to calculate the impact of metallic corrosion on the U.S. economy. The two-year study determined that the direct costs of water and sewer system corrosion are \$36 billion annually.⁴ This figure does not include the indirect costs of the consequences resulting from corroded pipe failures. Those consequences can be catastrophic; in addition to service disruptions, breaks can cause street cave-ins and flooding. Businesses and traffic are often severely disrupted, sometimes for prolonged periods of time. Residents can be forced to evacuate their homes. Some pipe failures have prompted extended “boil water” notices, creating the real potential for a public health crisis.

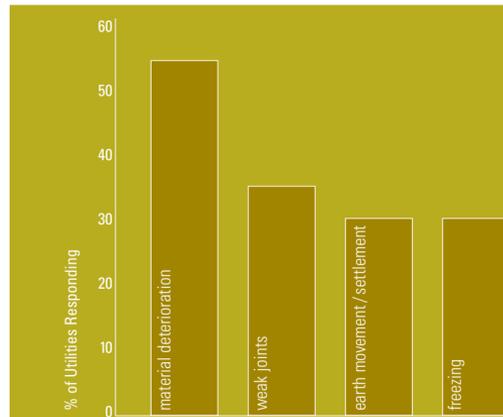
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A GROWING PROBLEM OF NATIONAL CONCERN

The U.S. Environmental Protection Agency, in its 2002 *Clean Water and Drinking Water Infrastructure Gap Analysis*, estimates that the funding gap in water infrastructure investment is \$534 billion over the next 20 years.¹ The Water Infrastructure Network – a broad-based coalition of elected officials, drinking water and wastewater service providers, environmental and health administrators, engineers and environmentalists – estimates that the U.S. will need \$23 billion per year over the next 20 years to meet the national and public health priorities in the Clean Water Act and Safe Drinking Water Act.⁷

Quite simply, the piping materials that have served as the backbone of our water infrastructure systems since the 1800s – first cast iron, then ductile iron – are deteriorating. Their prevalence has created a situation that will get worse before it gets better because the thinner iron pipes made after World War II have shorter useful lives.⁸ In testimony on behalf of the National League of Cities before a subcommittee of the Senate Environment and Public Works Committee (March 2001), Bruce Tobey, then-mayor of Gloucester, Massachusetts, stated that a primary reason for the escalation in water main breaks is “the simultaneous expiration of the useful life of water infrastructure installed at different times.” He elaborated by saying, “... the newer the infrastructure, the more likely it is to be deteriorating. Different materials, with increasingly shorter useful lives, leave us in the position where 100 years’ worth of infrastructure is being exhausted all at once.”

COMMON CAUSES OF main breaks⁹



The conditions water and wastewater pipe will have to face in the future won't be any different than they are now. Our growing population will place even more strain on systems that are already on the verge of collapse due to the corrosion problem, which is why other materials have quickly taken over these markets.

Since 1977, the pipe market in total has almost doubled. Eighty percent of that growth has gone to plastic, and the leading material among those plastics is PVC – polyvinyl chloride, or vinyl. **PVC is the leading plastic pipe resin in global use, accounting for more than two-thirds of plastic pipe demand by weight. Its durability, strength and low cost have allowed it to make significant inroads against other pipe materials.**¹⁰

(c) George M. Gutierrez/ *The New York Times*
A water main break in New York City flooded streets, businesses and apartments and required building occupants to evacuate.



continued from cover

Some 2.2 trillion gallons of water are lost annually in the United States alone, primarily as a result of premature pipe corrosion leaks and breaks.⁵ This amount of lost water would satisfy the drinking water needs of every man, woman and child on earth for a year. The lost revenue to water utilities is estimated to total \$2.98 billion per year.⁴

A recent survey of several thousand drinking water and wastewater utilities found that 29 percent of the drinking water utilities and 41 percent of the wastewater utilities were not generating enough revenue from user rates and other local sources to cover their full cost of service.⁶ Roughly a third of the utilities deferred maintenance because of insufficient funding, had 20 percent or more of their pipelines nearing the end of their useful life, and lacked basic plans for managing their capital assets.

pipe failure



\$1 million in damage was done in Hull, Quebec, when 29-year-old pipe corroded and failed long before it should have.

WHY PVC?

A leading reason for PVC's dramatic market growth is its superior durability. In a 1994 survey sponsored by the American Water Works Association Research Foundation, 162 responding utilities gave PVC pipe a life expectancy rating of 4.1 on a scale of 1 to 5, which was unsurpassed by any other pipe material.¹¹ A two-year study conducted by the National Research Council of Canada found that, for each 100 kilometers of water distribution pipe laid, PVC had only 0.7 breaks per year compared with 35.9 breaks for cast iron and 9.5 breaks for ductile iron.¹² When each pipe failure costs thousands of dollars to repair, the drain on municipalities and taxpayers quickly adds up, not to mention the costs associated with business disruptions and disease outbreaks.

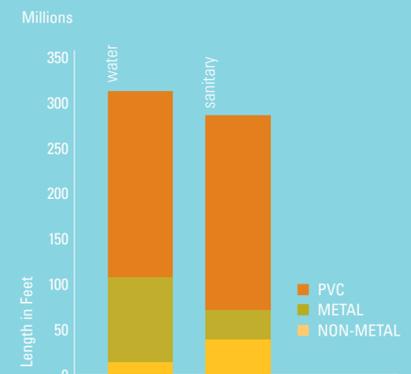
Communities around the world are choosing PVC because it's solving problems, but it's also helping governments achieve very clear-cut and tangible additional benefits over the product's life cycle.

First, they're saving money. Because it's less prone to breaks and other failures, the cost to repair and maintain a PVC water or sanitary system is far less than with other materials. The city of Calgary, Alberta, is notable both for the depth of its commitment to PVC as a material for water and sewer mains, and the low failure rate it has experienced.

Calgary's PVC pipe break rate in the early 1990s – about 0.2 failures per year per 100 kilometers – was roughly one quarter of the average for 10 other Canadian cities, and less than 1 percent of the break rate for poly-wrapped ductile iron pipe in the same environment. Calgary's effectively all-PVC installation of new mains for the past 25 years, plus some 525 kilometers of metallic main replaced with PVC since 1981, has yielded an inventory of almost 2,000 kilometers of C900 PVC pipe, but less than four breaks per year. A similar length of mostly iron and ductile iron distribution mains sustains over 400 repairs per year, held down to that rate by cathodic protection programs and 12 kilometers of replacement per year. The associated capital and operating budget is more than 300 times higher than it is for a like amount of PVC pipe.¹³

PVC pipes also are saving water and sewer utilities substantial amounts by reducing water loss. Gasket joints provided with PVC water and sewer pipes are manufactured and tested to perform without any leakage. The zero-leakage PVC joints are enabling sewer utilities to dramatically reduce wet weather flows and the unnecessary associated treatment costs. Similarly, water utilities have reported much lower unaccounted-for water rates where systems are comprised of PVC pipes. Typically, PVC water systems have unaccounted-for water rates of below 3 percent, none of which is attributed to leaks in the pipe or pipe joints.

PVC far surpasses any other material used in piping applications. Its dominance is clearly evident in the water distribution market, where it accounts for 66 percent of the market, and in sanitary sewer pipe applications, where it has even higher market share – 75 percent of all material installed.



BURIED PIPE MARKETS U.S. and Canada

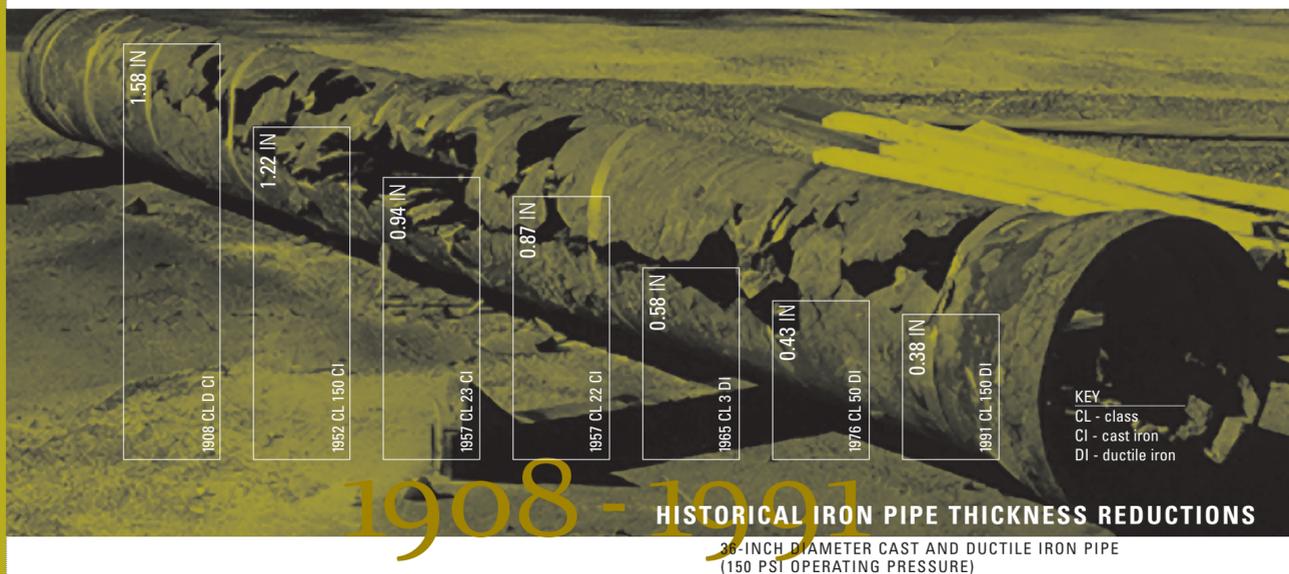
SOURCE: Uni-Bell PVC Pipe Association, November 2000

Communities also are reducing their liability. La Mesa, California, estimates that 40 percent of the liability claims filed against the city in recent years have been linked to sewer backups – a sum that adds up to about \$1.3 million. Recently, a judge ordered the City of St. Louis to pay St. Louis Community College more than \$8.2 million to repair damage caused by a large water main break.

Municipalities also are finding that PVC can be a benefit in pipe rehabilitation. A new ANSI/NSF 61-certified PVC water line renewal system is making the traditional dig-and-replace method obsolete. PVC liners can be inserted through existing lines, with minimal excavation, then pumped through with hot water to make the liners expand and mold to the old lines' interiors.

One of the most dramatic illustrations of the advantage PVC pipe has over other pipe materials was demonstrated in 1994 during the catastrophic 6.7 magnitude Northridge earthquake in California. The Valencia Water Company's system was dewatered in 30 minutes, and main line and service line breaks were in the hundreds. Yet none of the main lines made of PVC – about half of the total 270-mile system – failed, although the earthquake was generally felt to have had some of the strongest ground motions ever recorded by instruments in a major North American urban area.¹⁴

But perhaps even more important, managers who have chosen PVC are leaving a legacy of good stewardship for future generations. By increasing the useful life of new infrastructure, a utility will eventually relieve future managers, water system ratepayers and even the federal government from the burden of constant system repair and replacement. By selecting a product with a predicted life exceeding 200 years¹⁵, the replacement crisis systems currently face every 20 to 30 years will be a thing of the past.



1908 - 1991 HISTORICAL IRON PIPE THICKNESS REDUCTIONS

36-INCH DIAMETER CAST AND DUCTILE IRON PIPE
(150 PSI OPERATING PRESSURE)

After years of exposure to corrosive burial conditions, iron pipes are literally falling apart, and at a faster rate than in the past due to significant reductions in pipe wall thickness.

PVC | The Choice When Performance Counts



PVC offers a host of properties that have made it the dominant water and sewer utility pipe material:

Corrosion Resistance / Durability

PVC is invulnerable to underground external corrosion as well as internal pipe corrosion. This eliminates the need to specify corrosion protection methods that have become standard procedure for metal piping. With PVC, long-term durability is not compromised when encasement bags are punctured or torn, or when thin coatings or linings are damaged. System design and installation are simplified with a single wall, durable pipe material. For sanitary sewers, PVC pipe is resistant to virtually all the chemicals found in domestic and industrial wastewater. In addition, PVC pipe is highly resistant to erosion or abrasion wear.

Strength

When properly designed and installed, PVC pipes can handle external loads up to 75,000 kg/m² (about 40 meters of ground cover) and are available with internal pressure ratings up to 2,100 kPa (305 psi). PVC pipes also are able to bend or flex without breaking, making them better suited to handle ground movements caused by unstable, shifting soils and earthquakes.

Water Quality

PVC water pipe delivers water as clean and pure as it receives. It imparts no taste or odor to the water it transports, isn't a source of lead or other chemical contaminants associated with metal pipe, and does not react with even the most aggressive water. PVC's smooth, non-biodegradable interior wall surface makes it more resistant to biofilm build-up – a potential source of water contamination and disease, including *E. coli*.

Superior Flow

PVC's resistance to internal corrosion also eliminates tuberculation – the build-up of corrosion by-products that can reduce hydraulic capacity and increase pumping costs. PVC pipe's smoother internal wall surface minimizes fluid friction and flow resistance. The need for cleaning and maintenance are reduced, thereby lowering operating costs.

Superior Strength-to-Weight Ratio

Fewer pounds of material are required to manufacture a foot of PVC pipe versus a foot of metal or concrete pipe. That weight advantage is quite significant. Not only does it make PVC more economical on a per-foot basis, it also conserves resources, lowers shipping costs, simplifies and reduces the time needed for installation, and decreases the number and severity of injuries for installation crews. Collectively, these advantages result in lower installed costs.



For more information about the superior performance PVC pipe provides in critical water systems in North America:

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When the University of California surveyed 404 utilities for the AWWA Research Foundation, PVC water pipe earned both the **highest satisfaction rating among all the materials included and ranked best for the lowest repair rate.**¹⁷

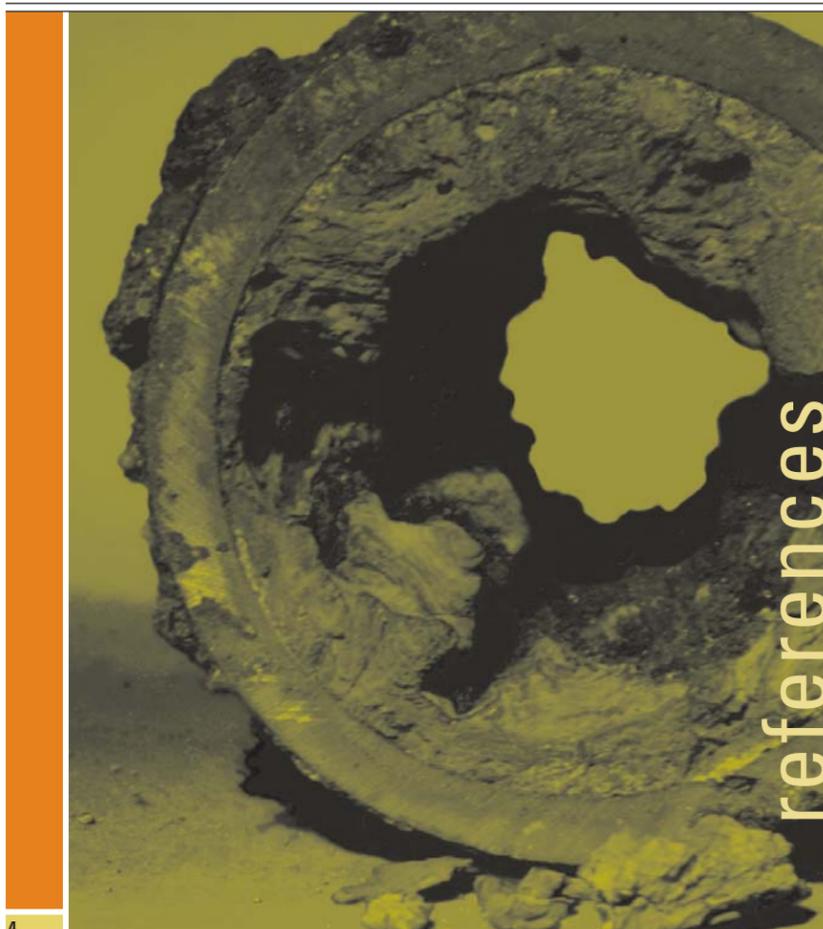
Watertight Joints

PVC pipes for most water distribution applications and sanitary sewers are designed with deep insertion, gasketed joints that are engineered not to leak.¹⁶ When PVC pipes are used for water distribution, this prevents the loss of valuable clean drinking water. When used for sewers, fewer leaks mean less chance of groundwater contamination and much better end-of-line treatment. Watertight joints significantly reduce infiltration that can overload treatment facilities and disrupt their proper operation. A lower volume of water to treat substantially reduces operating costs. Watertight joints also reduce the likelihood that embedment soil will be washed away, potentially weakening the pipe or nearby structures such as paved roadways. Because gasketed, push-together PVC pipe joints are simple and easy to assemble, they can be tested and placed in service quickly.

Crack Resistant Flexibility

PVC pipes also have an ability to bend or flex when subjected to excessive loads. As a result, they develop fewer cracks and breaks – another source of leaks and a major entry point for tree roots and surrounding embedment soil, two costly reasons why sewer systems get blocked and need extra maintenance. Water leaking into sewer pipes through cracks and breaks also can increase the volume of wastewater that treatment facilities must process. That, too, can drive up operating costs significantly.

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