White Paper

HOW HDPE IS READY TO MEET THE CHALLENGES OF AGING WATER MANAGEMENT INFRASTRUCTURES ACROSS NORTH AMERICA





SOLENO
MASTERING WATER SUSTAINABLY

Think HDPE Can't Reinvent Large Diameter Water Management Systems?

Think Again.

While High-Density Polyethylene (HDPE) structured wall pipes are not new to the infrastructure industry of today, the material is not widely adopted for large diameter applications, despite certain distinct advantages over other materials. But as infrastructure systems around the world age, the need for sustainable and cost-effective solutions is becoming increasingly critical. The push to advance versatile, durable, economical and ecological solutions that address modern water management systems has yielded major advancements in non-traditional pipe materials like HDPE. HDPE pipes, particularly customizable options like KUSTOMFLO, are emerging as leaders in flexibility, sustainability, longer lifespan and long-term cost-effectiveness, making them an ideal choice for numerous large diameter applications, from stormwater management to sanitary sewage systems.



HDPE:

Over 60 Years of Innovations in Water Management

In the 1960s and 1970s, thermoplastics were a growing presence in numerous industrial sectors. In its earliest inceptions, HDPE piping was a solid-wall construction, effective but not optimized for performance. Structured wall pipes evolved to improve strength-to-weight ratios, and comprehensive guidelines to ensure rigorous and consistent performance standards evolved in tandem. Over the next 20 years, more complex and efficient structured wall pipes were produced, optimized in stiffness and wall strength to withstand the demanding conditions required for large diameter systems. Integrated electrofusion technology was developed, merging the ease of socket/spigot joining with the major benefits of HDPE weldability.



Tailor-Made Production:

A Game Changer

With today's technology, KUSTOMFLO pipes can be produced with customized wall thickness, stiffness and diameters to meet the precise and specific needs of any client, site or project. KUSTOMFLO is made with world-renowned KRAH technology, which is the product of an adaptive process that allows the optimization of the pipe profile to meet the specific needs of any project or applicable standard.

Why Customization Matters

Managing the criteria for HDPE pipe design involves balancing various factors such as material strength, flexibility and cost. The customizable nature of HDPE allows for fine-tuning these parameters to match the project's specific needs. Simply put, complete customization is the driving force behind a variety of cost metrics and other benefits:



1 Made-to-measure production eliminates the need for overdesign.

The standard practice of overdesigning to meet performance criteria means excess or wasted materials across a water management system. Tailoring the wall thickness, stiffness and diameter of not only the system, but for each individual section within the system, reduces the material costs for the entire design. In short, HDPE allows you to use (and pay for) just what you need. If the past was overdesign, the future is the right design.

2 Standard catalog options can't always address complex needs.

Major infrastructure projects can be exceptionally complex, with varying specifications and a broad range of site-specific criteria. Standard catalog table options may not be able to adequately address unique requirements, making custom solutions for all or part of a project essential. KUSTOMFLO offers both complete customization and catalog options to meet the needs of virtually any water management scenario.

3 Customization means never encountering a standard you can't meet.

As regulations and standards evolve, technology that delivers flexible and seamless production customization is key. KUSTOMFLO mandrels can be easily modified to meet regulatory specifications without changing or adding production equipment, making critical design changes to meet safety and performance standards faster, easier and more cost-efficient.

How KUSTOMFLO Stacks Up To Industry Heavy Hitters

In a world where reinforced concrete (RCP) is often still king, HDPE is gaining traction but slowly and unevenly. The market for major large diameter infrastructure projects is comparatively small, so hands-on experience working with HDPE water management systems like KUSTOMFLO is less common than with legacy materials like RCP, or even concrete alternatives like fibreglass.

But the many advantages of HDPE make it a necessary option for consideration. From reduced costs to increased durability, sustainability and even environmental impact, KUSTOMFLO pipes stand up to the closest scrutiny:

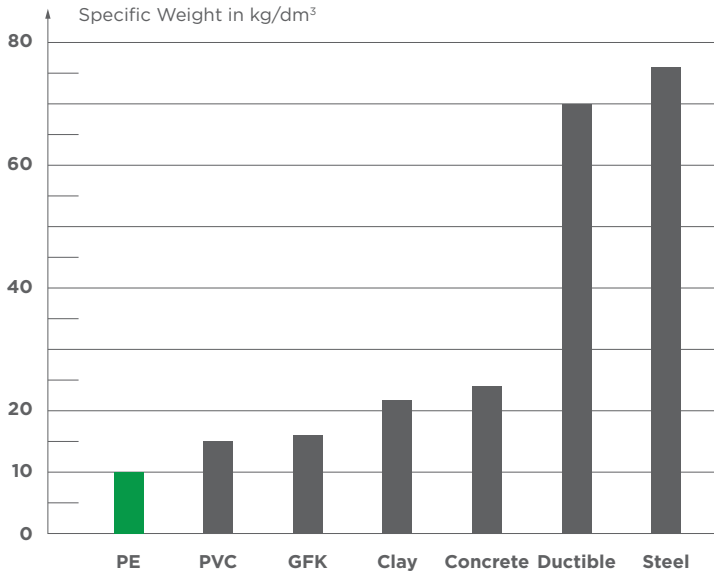


1 Standards and Reliability

KUSTOMFLO HDPE pipes are designed to meet international standards such as BNQ 1809-300 in Canada and ASTM F894 in the United States. The ability to adjust design parameters like wall thickness and stiffness allows for precise control over performance characteristics, which means HDPE pipes can be manufactured to meet or exceed virtually any specific regulatory requirements without changing molds.

2 Lighter for Easier Transportation and Installation

HDPE is approximately 20x lighter than a concrete pipe of the same diameter.[1] The weight difference has several cost-saving benefits in favour of HDPE, from lower transportation costs to lower installation costs. Lighter large diameter pipes allow for the complete optimization of transportation by increasing shipment capacity (nesting pipes), which reduces the cost and number of trucks needed for the project. Handling lighter pipes also reduces work risks, doesn't require specialized equipment and calls for less manpower during installation, all factors in reducing installation costs.



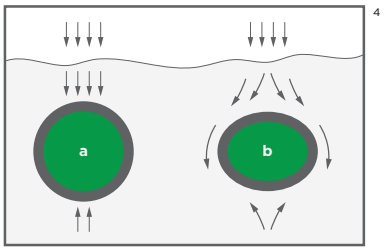
[1] Krah Group. Structured Wall Pipes System. Online. Applications (krah.net). Issue 2019-10-10

3 Longer Lifespan and Less Maintenance

KUSTOMFLO pipes have a lifespan that can exceed 100 years.[2] RCP has an average lifespan of 50 to 100 years, but corrosion and degradation can begin in as few as 10 years, which means that invasive repairs to concrete pipe infrastructures are generally required every 15-20 years. While the clear advantage goes to HDPE in terms of longevity, it is also worth noting that KUSTOMFLO pipes won't require the same maintenance or repairs over their 100-year lifetime.

4 Flexibility and Durability

While concrete can corrode, erode, crack and abrade, both over its lifespan and during installation, KUSTOMFLO HDPE pipes resist corrosion, abrasion, de-icing salts, vibration, impact and freeze-thaw cycles of -28.9°C to 87.8°C (-20°F to 190°F). They are more flexible than PVC and concrete without compromising strength or performance, and the additional flexibility carries many advantages. Rigid materials with a zero-bend radius simply can't contend with even slight twists or turns without additional fittings during installation, adding costs and potential points of weakness. HDPE is flexible enough to provide some direction change, a huge perk during installation in uneven terrain, and also a significant advantage in areas with seismic activity. In essence, HDPE products like KUSTOMFLO can deflect without cracking, working with backfill materials by transferring pressure to the surrounding soil. The structural behaviour of HDPE has been proven to remain effective up to 20% deformation, with that degree of deflection causing negligible changes to a pipe's flow capacity and having no impact on its structural integrity. The result? HDPE pipes can handle the live loads, dead loads, surcharge loads and construction loads that apply to underground infrastructures.

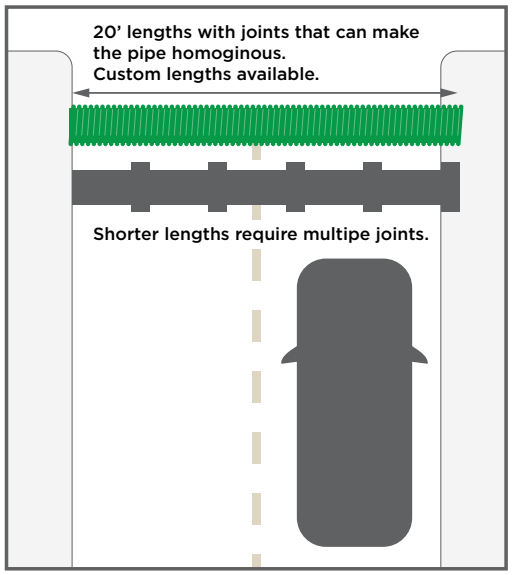


[4]

Deflection of flexible pipes compared to flexural resistant pipes.

5 Leakage[3] and Joints

Concrete pipes are typically joined using flexible rubber gaskets or mortar joints. While these joints provide sufficient integrity for some applications, they are more prone to leakage compared to welded or fused joints used in other pipe materials. In the industry, concrete pipes have an expected and allowed leakage rate of around 10-20%. HDPE pipes like KUSTOMFLO target a 0% leak rate and a 100% watertight system when properly installed in accordance with regulations, better preserving the surrounding ground soil to reduce the risk of sinkholes and eliminate the possibility of contamination. Inversely, the zero leakage and higher flow rates inherent to HDPE make it better for hydraulic capacity and water conservation, a particular challenge for dry regions contending with water insecurity. It also addresses growing global concerns over water management in the context of climate change and an increase in sewer overflows. Finally, HDPE pipes can be longer and more efficient, requiring fewer joints than concrete. In a comparable infrastructure, HDPE pipe systems have approximately 40-60% fewer joints than a concrete network of the same size. Fewer joints and longer pipes decrease the likelihood of leaks, improving watertightness and reducing costs all at once.



[4]

[2] M. Pluimer, "Establishing 100-year Service Life for Corrugated HDPE Drainage Pipe," in Pipelines 2006: Service to the Owner, 2006, pp. 1–8.

[3] K. Q. Nguyen, K. Mohamed, P. Cousin, M. Robert, and B. Benmokrane, "Stress Crack Resistance of Recycled and Virgin HDPE Corrugated Pipe for Transportation Infrastructure Applications," Art. no. 5488, May 2021, Accessed: Dec. 07, 2021. [Online]. Available: https://login.easychair.org/publications/preprint/BK2.

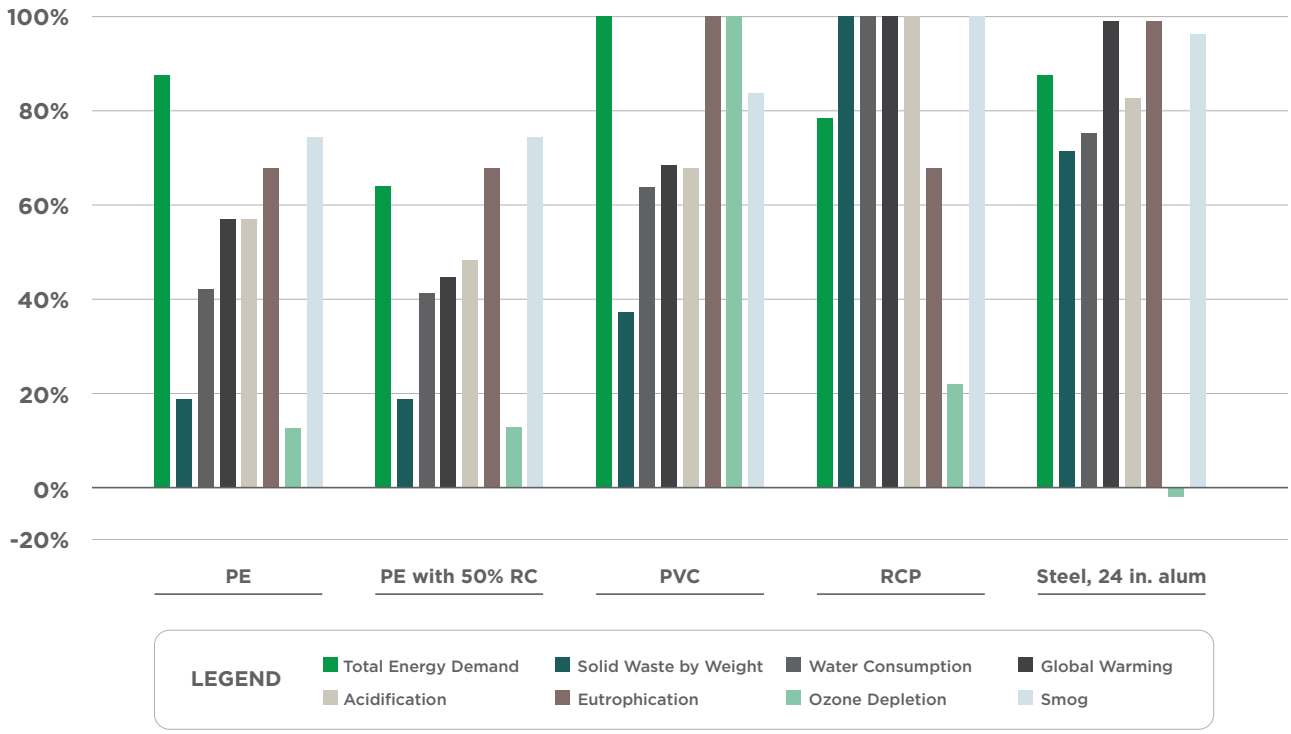
[4] Krah Group. Structured Wall Pipes System. Online. Applications (krah.net). Issue 2019-10-10.

6 Joint Technology: Electrofusion

The unique KUSTOMFLO electrofusion joining technology ensures watertight and permanent joints, as the whole piping system becomes a seamless unit. Each electrofusion wire is protected by a plastic film and integrated into the pipe walls prior to shipping for waterproofing up to 30 psi or higher. A high-strength bell and 125 mm nesting interlocking complete the advanced design.

7 Sustainability

With its inherent ductility, durability, chemical and corrosion resistance, and proven performance capability in extremely demanding applications such as potable water, natural gas distribution, nuclear safety water, and numerous others, HDPE pipe has become the most ecological and cost-effective choice for water management. In a life cycle analysis[5] conducted on drainage alternatives, the global warming potential for corrugated HDPE pipe was found to be 59% lower than that of reinforced concrete pipe.



[5] LIFE CYCLE ASSESSMENT OF NORTH AMERICAN MUNICIPAL STORMWATER PIPE SYSTEMS. March 2020. Franklin Associates, A division of ERG. Prepared for The Plastics Pipe Institute.

Not Just a Pipe, But a System

KUSTOMFLO pipes are only part of the solution. A watertight network and reliable water management system call for customized connections as well.

KUSTOMFLO products include plain end, bell spigot with gasket, gasket bell, flange and electro-fused joints. All connections are customizable. Additionally, HDPE pipes and connections can be effectively joined to legacy materials in cases where only parts of an infrastructure are being upgraded. In fact, it is already a common practice to insert an HDPE sleeve inside a degrading RCP pipe for all the advantages listed above.

KUSTOMFLO in Action:

HDPE vs. Concrete

The challenge:

In 2019, the frequency and intensity of rainfall events prompted many government bodies to impose more restrictive regulations to avoid the risk of sewer overflows. As a result, one municipality needed to repair and bring into compliance a portion of its stormwater drainage infrastructure. They called on Soleno to provide them with an HDPE product that would meet the needs of their project. Today, this product is known as KUSTOMFLO.



The context:

The worksite, active from June to November, offered limited space between neighbouring homes to carry out the work, which involved replacing 350 metres of pipe at the bottom of a 7-metre deep trench. The pipe had to be able to carry a significant amount of water while withstanding the combined pressures of the weight of the overlying fill and the water table.



The solution:

KUSTOMFLO pipes were ideal for the project's complex requirements. Unlike concrete, their light weight eliminated the need for a crane, allowing for quick installation with just an excavator and greatly reducing time and costs. With their high compressive strength, the pipes handled external pressures with ease, and the large diameter and smooth surface easily accommodated the storm sewer system's high water flow. The KUSTOMFLO HDPE manhole did not need to be oversized, another advantage over concrete.



A Lasting Comparison: HDPE vs. Concrete

Even though both concrete and HDPE materials were used across the full expanse of this project, the HDPE KUSTOMFLO pipes showed significant advantages over concrete, as seen below. KUSTOMFLO was more cost-effective, time-saving and flexible, as well as safer and easier to install.



RP-1 VS. RP-3



RP-1		RP-3
1.5 days	Speed of installation	1 hr
✕	Mobilization	✓
$53,000	Cost	$20,500
39,000 kg	Weight	4,000 kg
✕	Lifespan	✓

The results:

Soleno managed all logistics and technical support, resulting in an affordable and sustainable solution that was completed on time and on budget. The installed 2200 mm and 2400 mm HDPE pipes are approximately 15x lighter than the previous concrete pipes. While the new pipes are smaller in diameter, they can handle the same water flow, as well as the pressures of the overfill, water table and frequent passage of cars on the roadway above.

Soleno supported its clients in the design, procurement, delivery and implementation of this project with a dedicated technical team and a constant presence on the site.

As infrastructure demands and climate transitions continue to shape the challenges of today's water management systems, we hope this white paper has provided you with the insights and facts you need to consider HDPE for your next large diameter project. And if you think transitioning to HDPE for your water management needs is too great a challenge, think again: our team is on hand to guide you every step of the way. We invite you to speak with one of our experts to hear how HDPE can drive sustainable innovation in your next project.

Ready to rethink water management?

Get in touch with an expert