

CONSIDERATION OF POLYPROPYLENE PIPING FOR INDUSTRIAL FACILITIES

Polypropylene piping remains leak-free, even under extreme conditions

Industrial performance is a key element of a country's economic well-being. Industrial growth in the United States typically indicates a strong economy and opportunities for construction firms and mechanical/electrical/plumbing companies that create new structures or manufacturing plants, or expansions of existing plants.

The industrial market has been growing in recent years, and the industrial construction market has been growing along with it. The market research firm IBISWorld reports that over the past five years (2014-2019), industrial building construction in the U.S. has grown by 4.5 percent to reach revenue of \$45 billion in 2019.

The construction is spurred in part by historically low vacancy rates. According to the fourth quarter 2018 MarketBeat report from Cushman & Wakefield, industrial net absorption throughout the U.S. rose to an all-time high of 284.9



Tough, versatile polypropylene pipe is well-suited for many industrial applications.

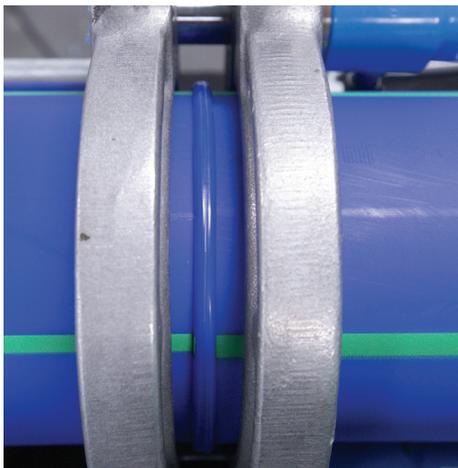
million sq ft in 2018. This means the U.S. industrial sector has now notched more than 240 million sq ft of net absorption for five consecutive years — the sector's strongest run ever. In addition, the real estate firm Jones Lang LaSalle reported that in 2018 total net absorption and total



new construction in the industrial market both exceeded 200 million sq ft.

A PIPING OPTION BEYOND METAL

Designers of piped process, chilled and heated water systems and plumbing and potable systems for industrial applications should be aware that they have options beyond traditional metal pipe. In fact, polypropylene pipe often represents a superior option for many applications, including general utility services such as cooling water, reverse osmosis/deionized water, chemical transport, inert gases, glycol, and others. In addition to possessing



A properly executed heat-fusion on polypropylene pipe creates a single piece with no leak paths.

widespread code approval for many industrial applications, polypropylene pipe is compatible with a long list of media and also can be quickly evaluated for approval on a case-by-case basis for special circumstances.

Polypropylene pipe may be used in new plant construction or when re-piping plants whose existing piping is beyond its useful life span. Polypropylene pipe is suitable for transporting numerous fluids in a wide range of industrial applications, including heated and chilled water for space heating and cooling, chiller condensate, chemical transport, process cooling, and potable water.

Polypropylene pipe excels in industrial applications for many reasons, but one of the most prominent is its long life. Many manufacturing plants are owned rather than leased and as such become an integral component in manufacturers' asset portfolios.

In fact, industrial manufacturers often customize their plants to meet their specific manufacturing needs. This enables investing for the long-term and makes polypropylene pipe, with an estimated 50-year lifespan, more attractive than steel pipe, which typically has an anticipated lifespan of roughly 20 years.

In addition to its much longer life, polypropylene will never scale or corrode the way metal pipe does.

PHYSICALLY AND CHEMICALLY RESISTANT TO DAMAGE

Polypropylene pipe is both physically and chemically resistant to abuse that can damage other piping materials. Polypropylene is a thermoplastic polymer that is made up of chains of carbon and hydrogen. The blend of long and short hydrocarbon chains results in a material that is resistant to physical impacts and stress.

As a hydrophobic material, polypropylene does not corrode or leach into the water it transports. It also does not suffer from reductions in flow caused by scaling the way steel pipe does. This can be particularly important in industrial applications that may have very precise flow rates needed to maintain a manufacturing process, or for process cooling. The flow rate the system is designed for will be the flow rate that is maintained for decades.

Although steel pipe is routinely specified for industrial applications, polypropylene pipe is often a better





choice for applications that call for up to 180°F fluids at 100 psi. Polypropylene is joined by heat fusion, which creates a bond as strong as the pipe itself. When done correctly, the joint created has no leak paths. This minimizes the possibility of leaking pipes that can create hazardous conditions in a manufacturing plant, or cause manufacturing operations to be interrupted while piping is repaired or replaced.

Polypropylene pipe is resistant to many types of chemicals, thus making it ideal for the processing and transport of aggressive mediums and materials in industrial applications. Most polypropylene pipe manufacturers in North America can quickly and easily assess chemical compatibility when provided the proper operating parameters.

FAST INSTALLATION REDUCES DOWNTIME

One of the numerous benefits of polypropylene pipe in industrial applications is its fast installation time relative to welding metal pipe. The latter requires an open flame, another considerable PP



At a paper mill in Wisconsin, more than 19,000 ft of polypropylene pipe, connected by roughly 4,250 fittings and valves and more than 7,300 fusion welds, were installed with zero leaks at any of the joints.

benefit. Thanks to its light weight and heat fusion joining method, polypropylene pipe can typically be installed much faster than welding steel or brazing copper pipe. Depending on the pipe size and wall thickness, polypropylene pipe can weigh up to 70 percent less than comparably sized metal pipe. The combination of this lighter weight and faster joining method can lead to labor savings of 25 to 30 percent compared with welding and installing steel pipe.

In addition, polypropylene pipe is safer to work with: no welding means no airborne debris that can cause eye injuries, its lighter weight reduces the risk of back and muscle injuries, and the heat fusion process requires no glues or solvents and releases no VOCs. Finally, no hot work permits or flame watches are required.

For new industrial facilities, all of these factors mean the facility can be up and running sooner.



For existing facilities, this means a piping changeout from metal pipe to polypropylene pipe can be done with an absolute minimum of downtime. And everyone knows time is money.

The heat fusion joining method, which produces virtually leak-free connections, can be made even faster and more efficient by gaining proper training and maximizing the efficiency of fusion tools and maintaining the proper crew-to-tool ratio. Tools are largely available for rent or purchase nationwide and several polypropylene pipe manufacturers provide in-depth knowledge and support. In many cases, a trained (more skilled) installer can be working multiple fusion machines with another trained apprentice (set up). In addition, when it is time for

growth of the facility and an expansion of the piping system, fusion outlets are quick and inexpensive relative to metal tees. Also, one polypropylene piping manufacturer offers a hot tap tool that allows a branch line or outlet pipe to be installed while the system is still pressurized. This enables the system to be expanded without any downtime.

Offsite fabrication of polypropylene pipe also offers labor and time savings. Some manufacturers offer custom-made, fabricated spools that can be shipped directly to job sites ready for installation. The custom spools are made in a controlled environment by trained personnel, which can eliminate job site variables such as weather. Having spools fabricated offsite frees up construction personnel

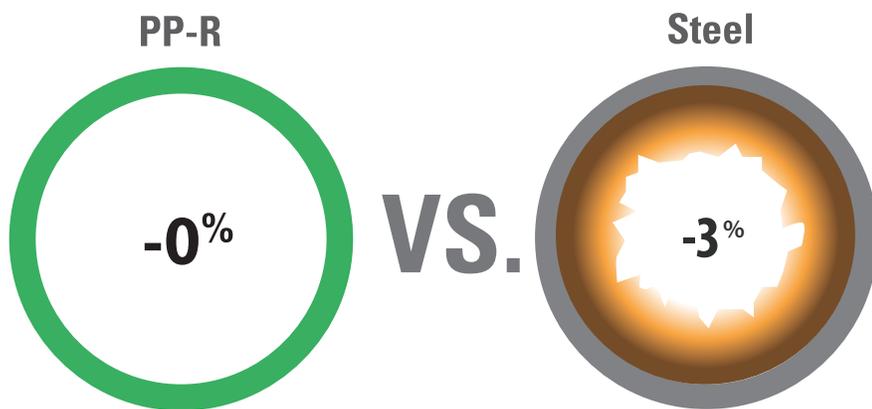
for other tasks, and can help ensure construction schedules are met. One polypropylene piping manufacturer also offers a “scan-to-fab” service in which laser measurements are used to create highly accurate drawings while dramatically reducing measurement man hours.

EXAMPLE 1: LABOR SAVINGS AT WISCONSIN PAPER MILL

Examples from the field demonstrate the versatility, durability, and problem-solving ability of polypropylene pipe in industrial applications.

A paper mill in Wisconsin needed to expand its manufacturing capability to meet the unique demand of producing brightly colored papers. This involved storing and distributing more than 24 different liquid dyes from supply tanks to multiple distribution points throughout the mill.

Finding the right distribution piping material was a top priority. Stainless steel was considered, but prices were extremely high at the time and facility staff reported that some of the dyes eat through stainless pipe in a matter of weeks. The challenge was in finding a single solution



As a hydrophobic material, polypropylene pipe does not suffer from reductions in flow caused by scaling the way steel pipe does.



that was less expensive than polytetrafluoroethylene (PTFE) tubing or welded stainless steel, more resilient and thermo-dimensionally stable than glued chlorinated polyvinyl chloride (CPVC) or polyethylene (PE) tubing, and with greater chemical resistance than stainless steel or CPVC. That led the project's engineer to PP.

It paid dividends for the facility. In all, more than 19,000 ft of pipe, connected by roughly 4,250 fittings and valves and more than 7,300 fusion welds, were installed with zero leaks at any of the joints.

In addition, the installation took place during the hot summer months and in lower levels of the paper mill with minimal air circulation. The installation crews appreciated the light weight and fast installation of PP. The fast installation also saved money.

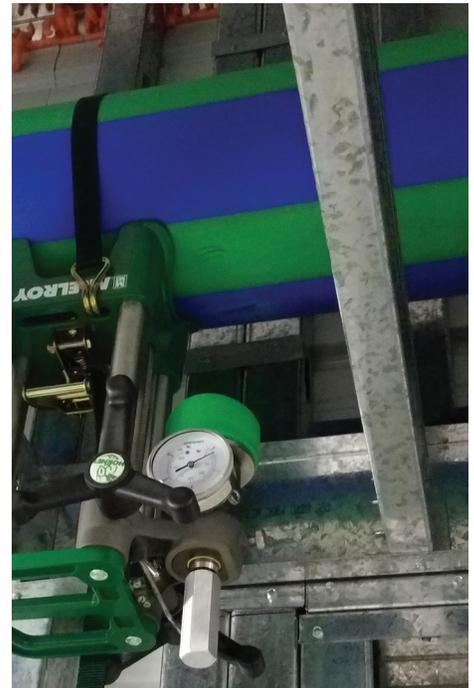
"The men kept a positive attitude working with [the polypropylene pipe] because installation was easy and fast. When you accomplish a lot in a day, you go home feeling good," said the project manager. "And, doing some cost comparisons between 316 stainless and [the polypropylene pipe used in the installation], we saved about 58 percent of the install labor and 51 percent on material cost."

EXAMPLE 2: VERSATILITY AT ILLINOIS MANUFACTURING FACILITY

An Illinois plastics manufacturing facility desired a leak-free process cooling piping system with the flexibility to accommodate frequent equipment re-configurations. A polypropylene piping system installed in a trench beneath the floor, with fittings emerging at intervals for machine hook-ups, provided the toughness and versatility this customer desired.

The old process piping system for this manufacturer's 16 machines had consisted of 6-in. PVC pipe running overhead at the ceiling, but dripping condensation and a lack of flexibility for machine re-configurations led the company to choose a system that placed the pipe in mechanical trenches behind each run of machines. The polypropylene system easily handles the 40°F cooling water provided to the machines and the 100°F return water to the chiller.

"It will be nice to not have pipes sweating and dripping, which was a problem when we had the PVC overhead," noted the engineering manager at the plastics manufacturer. "Another



Versatile fusion tools allow polypropylene pipe to be heat-fused in spaces in which welding metal pipe would be difficult or impossible.

nice feature of the [polypropylene] pipe was that we could get longer continuous lengths of pipe, so we had fewer joints to deal with."

EXAMPLE 3: MINIMAL DOWNTIME AT KANSAS INJECTION MOLDING FACILITY

An injection molding facility in Kansas had begun to incur losses because its existing carbon-steel piping was experiencing excessive



At a manufacturing plant in Illinois, polypropylene pipe in a trench provided the flexibility to accommodate frequent equipment re-configurations.

corrosion, but replacing 300 ft of welded steel for a manufacturing process that runs 24/7 was not going to be easy: A mere half-second loss in production time can cost an injection-molding facility tens of thousands of dollars.

So, it was a nail-biting proposition when the facility's maintenance supervisor needed to replace a large portion of pipe used to transport cooling water to more than 20 injection-mold and thermoforming machines. The dilemma was how to replace 300 ft of 10- and 16-in. welded steel pipe for a manufacturing process that virtually never stops.

Once again, the solution was polypropylene pipe, which is completely non-corroding and will not break down, weaken, or scale like metal piping systems. The installation included the construction of a new 10,400-gal outdoor chilled-water tank, 16-in. supply and return piping to and from the tank, and assorted lengths of 12- and 10-in. piping connecting a 16-in. header to the various injection-mold presses.

Speeding this daunting task along was the fact that PP can be fabricated offsite and shipped to the job site ready to install. The fabricated piping sections, some of which were 15 ft or longer,



were lightweight enough for just two men to carry into the installation space and hoist into place, negating the need and cost of mechanical lifts.

This helped the installation—originally estimated at three days—to be completed in just 24 hours.

An added benefit of polypropylene pipe on this project is its inherent low thermal conductivity (R-value of 1 or more depending on the pipe size and standard dimension ratio) which can make insulation unnecessary or reduce the amount of insulation in certain indoor applications. Not only does this save installation costs, it creates a cleaner, more uniform installation in which the pipe is exposed for easy inspection.

“The fact that we didn’t have to insulate the pipe is a huge benefit,” said the facility maintenance supervisor. “None of the indoor pipe had to have any insulation, even though we are carrying 55°F water in an 80°F ambient space.”

He added that despite some extremely warm, humid days since the pipe was installed, he had yet to see a drop of condensation on the pipe. “I have one flange where carbon-steel pipe meets the

polypropylene pipe. I can put a hand on each and feel that the PP is barely below room temperature while the carbon-steel pipe is really cold.”

“I’m a 100-percent believer in [polypropylene pipe] now for sure,” added the mechanical contractor’s project manager.

INDUSTRY SUPPORT

Lance MacNevin, PEng., Director of Engineering, Building & Construction Division, the Plastics Pipe Institute, Inc. (PPI) said PPI has tracked a strong increase in interest of polypropylene pressure pipes for several applications, including industrial piping and process water. In January 2018, PPI announced the creation of the Polypropylene Pressure Pipe Steering Committee within its Building and Construction Division. This new group focuses entirely on polypropylene pressure pipe and is a significant development for PPI in supporting this industry. PPI is the major North American trade association representing all segments of the plastic pipe industry.

According to MacNevin, PP pressure pipe can be suitable for a wide range of industrial applications due to its high

temperature and pressure ratings, smooth inside wall, resistance to corrosion, erosion, and wear and tear, and the ability to have a virtually leak-free system with heat-fused joints.

In addition, installers like working with polypropylene pipe because of its light weight and the simplicity of heat-fused joints, MacNevin noted. “Using this technology, after the pipes and fittings are prepared for joining, specialized fusion equipment, available from several PPI member firms, will heat the pipe and fitting surfaces and apply the right amount of force to create reliable and consistent joints,” he said.

CONCLUSION

In conclusion, industrial strength and prowess is often depicted in terms of forging and welding steel, and steel pipe has been a de facto choice for many years in industrial applications. However, designers and operators of industrial piping systems are realizing that polypropylene pipe actually represents a longer lasting, more reliable, corrosion-free alternative that represents a triumph of brains over steel’s brawn. 



| PIPE MATERIAL | PP | COPPER | STEEL |
|----------------------------------------------------------|----|--------|-------|
| Impact Resistant | ✓ | ✓ | ✓ |
| Chemical Resistant | ✓ | ○ | ○ |
| Abrasion Resistant | ✓ | ✗ | ✗ |
| Scale Resistant | ✓ | ✗ | ✗ |
| Corrosion Resistant | ✓ | ✗ | ✗ |
| Nontoxic | ✓ | ✗ | ✗ |
| Nontoxic combustion products | ✓ | ✓ | ✓ |
| Resists chemical leaching into water | ✓ | ○ | ○ |
| 50-year rating on both pipe and fittings | ✓ | ✗ | ✗ |
| CONNECTIONS AND FITTINGS | | | |
| Leak-proof connections | ✓ | ○ | ✗ |
| No foreign material (solders) | ✓ | ✗ | ○ |
| Joints as strong as the pipe itself | ✓ | ✗ | ○ |
| Fusion outlet (saddle) and other low cost fittings | ✓ | ○ | ✗ |
| Nontoxic connections | ✓ | ✗ | ✗ |
| OTHER FEATURES | | | |
| Controlled thermal expansion | ✓ | ✓ | ✓ |
| Recyclable | ✓ | ✓ | ✓ |
| Opaque to avoid microbiological growth | ✓ | ✓ | ✓ |
| Inherent R-value | ✓ | ✗ | ✗ |
| Resistant to water hammer | ✓ | ✗ | ✗ |
| No open flames | ✓ | ○ | ○ |
| Connections usable in less than 1 hour | ✓ | ✓ | ✓ |
| Does not easily sweat | ✓ | ✗ | ✗ |
| Stable competitive pricing | ✓ | ✗ | ○ |
| Environmentally friendly piping system (LEED v4 credits) | ✓ | ✗ | ✗ |
| Large diameters 20mm up to 630mm OD | ✓ | ○ | ✓ |
| ✓ = Excellent ○ Sometimes ✗ Not Recommended | | | |