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World Leader in Resin Technology

CaseHistory

Large Diameter Sewer Pipe

Resin	Vipel® F010 Bisphenol A Epoxy Vinyl Ester
Composite Application	Large Diameter Sewer Pipe
Manufacturing Process	Filament Winding
Diameter	11 feet, 2 inches (3.4 meters)
Pipe Section Length	28 feet (8.5 meters)
Total Installed Length	500 feet (152 meters)
Installed	2005
Location	Denver Metro Area

Lightweight composite pipe is easily moved with less expensive equipment.

The 28-foot pipe sections were lowered through a 29-foot wide "window" then rolled into place.

An ingenious combination of old concrete and new fiber-reinforced polymer (FRP) composite saved precious time while preventing a potentially serious wastewater problem in metropolitan Denver.

The old concrete started as a huge box culvert installed in 1977 to convey wastewater from primary treatment to secondary treatment facilities of the Metro Wastewater Reclamation District. The new composite is 500 feet (152 meters) of large diameter pipe that Belco Manufacturing Company made with corrosion-resistant Vipel® F010 bisphenol A epoxy vinyl ester from AOC. With an inside diameter of 11 feet, 2 inches (3.4 meters), the pipe is believed to be the largest composite sewer pipe ever made in North America.

The original 12 feet wide by 9 feet high (3.7 by 2.7 meters) culvert was designed to be filled to capacity; but shortly after being put in service, the operational depth of the conduit was lowered. Wastewater flow levels were typically 10 to 14 inches (25 to 36 centimeters) below the culvert ceiling - a situation that wastewater engineers know can lead to a highly corrosive environment.

The corrosion problem started when naturally decomposing wastewater components released hydrogen sulfide gas into the space between the water flow line and culvert ceiling.

Large Diameter Sewer Pipe, cont.

After bacteria above the waterline ingested the gas, they secreted sulfuric acid that, in turn, aggressively attacked the culvert ceiling and non-submerged sidewall surface. Concrete was spalling, metal rebar was exposed, 35% of the original 14-inch (36-centimeter) thick roof was gone, and the roof's structural integrity was in jeopardy.

Part of concrete structure remains

Due to very limited construction space, District engineers sought a solution that would keep the undamaged lower portion of the concrete culvert in place. The roof and about 4 inches (10 centimeters) of the upper sidewalls would be removed, leaving a U-shaped concrete channel.

The sewer line in need of repair conveys about 50 million gallons (189,270 kiloliters) of wastewater on an average day. To keep a 24/7 flow moving through the treatment plant, engineers designed a by-pass system using pumps and 3.8 miles (6 kilometers) of flexible thermoplastic pipe. To reduce costs and the potential for problems, engineers specified that the temporary by-pass be in service for as little time as possible.

Belco custom-designed the pipe to fit precisely into the "trench" created by removing the damaged portion of the existing concrete culvert.

Composite pipe designed by Belco specifically for the project offered the best solution for speed of installation. The custom pipe fit precisely into the U-shaped channel which served as a trench. A concrete grout was injected between the trench inner wall and pipe outer wall. Cables held the pipe in place to keep the pipe from getting buoyant in the wet grout before it cured.

Concrete grout was poured in the space between the pipe and trench wall.

The pipe was joined together using butt-and-strap composite joints that were applied internally. Installation during October through December required the use of a plastic tent around joint sites to shelter the newly laminated joints against cooler temperatures which could retard cure. The Vipel resin formulated by AOC technical service performed well under these circumstances.

Longer lengths and lighter weight

"We considered topping the remaining concrete with a new precast concrete 'cover' that would be PVC-lined to protect the concrete from corrosive attack," said Ted Knutzen, engineer for URS Corporation, the engineering design firm for the project. "But because composite pipe could be made in longer lengths, the composite provided the opportunity to reduce installation time."

New precast concrete would have been made in 8-foot (2.4-meter) long sections. In contrast, the composite pipe was manufactured in 28-foot (8.5-meter) sections. "With one composite length for every three to four concrete lengths, composite piping reduced the number of joints, resulting in less installation time," said Guy Gentry, Engineering Manager for pipe manufacturer Belco Manufacturing.

The lighter weight of the composite made it easier to handle and allowed for the use of less expensive equipment, added Gentry. Composite density is about 120 pounds/cubic foot (1,922 kilograms/cubic meter), and the nominal pipe wall thicknesses are only 1.375 inches (3.5 centimeters) thick. Concrete density is about 400 pounds/cubic foot (6,400 kilograms/cubic meter), and wall thicknesses are typically 8 to 10 inches (20 to 25 centimeters) thick.

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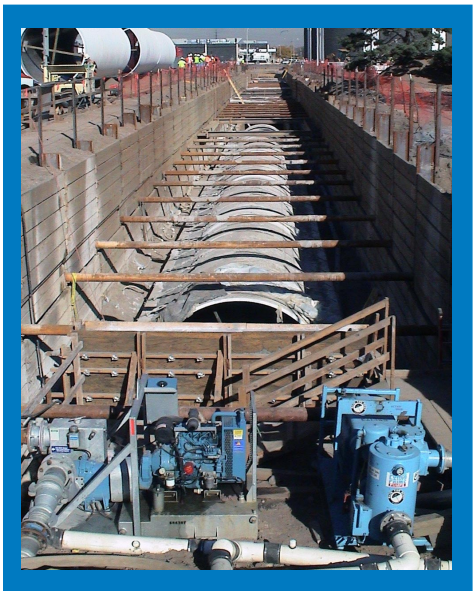
General contractor Stanek Constructors, Golden, Colorado, completed the composite pipe installation within the 52 days specified for the by-pass. The pipe was supplied through Process Equipment Corporation, a Belco Manufacturing representative located in Boulder, Colorado.

Superior corrosion resistance
Another advantage of composite made with Vipel® F010 vinyl ester is its inherent long-term resistance to the corrosive effects of moisture and sewer gases. "We understood the lightweight and corrosion-resistant benefits of FRP composites," said Knutzen, "but many of us in civil engineering are more familiar with concrete. It is easier for us to recognize quality in concrete manufacturing and installation. To help us better understand composites, Guy Gentry and the people at Belco were very helpful in providing information, data and photographs."

Belco manufactured the composite pipe in accordance with the standards of AWWA M-45 and ASME RTP-1. The pipe was made using the filament winding process in which resin-impregnated glass fiber reinforcement is wound in a computer-designed pattern around a metal mandrel. The resin cures into a permanently crosslinked state to create a fiber-resin composite cylinder with excellent mechanical and physical properties.

"The Vipel F010 resin processes very well," commented Gentry. "Our winder operators really appreciate the resin's user-friendly characteristics. The resin wets well and has a predictable cure. AOC technical service is very good, too. Corrosion Specialist Geoff Ward is very helpful. We can always count on him if we have a question or need help."

About Belco Manufacturing
Belco Manufacturing Co. Inc., Belton, Texas, custom designs and manufactures corrosion-resistant composite products and systems for the chemical processing, pulp and paper, water and wastewater, metal and mining, petroleum, electronics, and power generating industries. For more information on Belco capabilities, contact Engineering Manager Guy P. Gentry, MSCE, PE, by phoning (254)933-9000 or e-mailing ggentry@belco-mfg.com.



Five hundred feet of composite pipe were installed.

About AOC
Headquartered in Collierville, Tennessee, AOC is a leading global supplier of resins, gel coats, colorants, additives and synergistic systems for composites and cast polymers. AOC is the North American leader in resins for corrosion-resistant applications. AOC products are manufactured in facilities strategically located in North America, Europe and Asia. AOC-owned manufacturing plants are ISO 9001:2000-certified, use proprietary technology to ensure resin batch-to-batch consistency, and follow Six Sigma-Lean principles for improved efficiency and quality. Corrosion-resistant composites are a priority at AOC. For more information, contact Ben Bogner by e-mailing bbogner@aoc-resins.com or phoning (630) 665-2675.

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