Capabilities Guide

Ductile Iron Pipe Trenchless Use Grows

Tampa Keeps Open Mind On Pipe

New HDPE Resin Offers Many Pluses
A high density polyethylene (HDPE) pipeline project in northern Michigan is serving as the latest example of technology evolution for polyethylene (PE) pipe used in underground pipe applications—and offers a telling case study for a new PE100 resin from The Dow Chemical Company. When the MTD Pipeline goes on line between Manistee and Ludington, MI, during the fourth quarter of 2003, it will mark a significant advancement for HDPE pipe and the completion of the largest PE100 project for smoothwall pressure pipe in North America—both in terms of continuous system length and pipe diameter.

MTD Pipeline LLC, is a joint venture of Martin Marietta Magnesia Specialties LLC, a leading U.S. manufacturer of magnesia-based chemical products, and The Dow Chemical Company (Dow), a leading science and technology company.

The project required the manufacture and installation of nearly 30 miles of pipeline to support the transport of brine solution from a plant in Manistee, operated by Martin Marietta, to a Ludington facility operated by Dow. In late 2002, Martin Marietta signed a long-term agreement with Dow Cal/Mag (Dow’s calcium/magnesium business) to supply brine solution to Dow for use in the manufacture of its calcium chloride products.

Made from DOW DGDA-2490 NT High Density Polyethylene (HDPE) resin, the new resin, which meets ISO qualifications, was specified for the 20-inch diameter SDR 11 pipeline (1.8-inch thick wall). When the project is completed, the pipeline will have required 6.3 million pounds of HDPE, representing the highest volume of PE100 material for any single ISO design-build project in North America. Those involved with the project say, with its many challenges, it is perhaps most significant in that it showcases the benefits of working with the new resin and what the PE100 resin signifies for the pressure pipe industry.

“HDPE continues to evolve and is increasingly being specified for a wide range of applications,” says Kevin Wettstein, marketing manager for polyolefin pipe, The Dow Chemical Company. “This project reflects that new HDPE materials are continuing to gain ground for pressure pipe applications.”

**Rationale for HDPE**

Dow and other PE producers have been touting the performance and cost benefits of HDPE for pipe applications versus traditional materials for years, citing improved strength, durability and advantages related to installation and lifetime cost. While traditional materials such as steel, ductile iron, concrete and PVC continue to be specified for the majority of projects, the MTD Pipeline project is the latest indication that PE has a growing role to play.

Chief among the advantages of HDPE are durability and expected leak-free performance achieved from the corrosion resistance of PE and its ability to be fused to create one continuous pipeline system. These advantages impact installation and maintenance, as well as working life expectancy, overall performance and costs associated with materials. Leak-free performance also helps to mitigate possible risks to the environment.

“Today’s PE materials can support a much longer working life without the gradual compromise of material integrity that comes with some traditional materials,” says Wettstein. “These materials are also dramatically decreasing the costs associated with installations via exciting new trenchless technologies.”

Mike Clark, project manager for Cal/Mag and a lead official on the MTD Pipeline project, cites superior corrosion resistance as perhaps the single-most important benefit of PE. “Unlike steel and other metals, corrosion is not a concern with PE,” says Clark. “Add to that the fusion-weld integrity and you have the basis for a sound argument for HDPE safeguarding the long-term interests of the public and the environment.”
The Michigan Department of Environmental Quality (MDEQ) agrees. The MDEQ contributed to the ultimate decision to use PE for this project, but cites flexibility among the biggest advantages of PE. “The best part of polyethylene pipe is that it’s flexible, which allows you to bore further distances with less concern for fracture,” says Eric Hudy, district representative with the geological and land management division of the MDEQ. Hudy is responsible for reviewing permits for construction work within regulated wetlands, and became involved with the MTD Pipeline early on in the project.

“Because PE also allows for trenchless installation, which enables drilling under wetlands and streams without surface disruption, we determined the overall advantages of PE in this environment made it the best option for this pipeline,” he added.

**Familiar advantages**

The companies involved with the MTD Pipeline project, including the pipe manufacturers, installers and consultants, are also familiar with the advantages of working with PE, so project engineers are quick to note that the decision to use PE was made early on.

Martin Marietta engineers are long-time proponents of PE pipe, having engineered steel replacement projects with American Society for Testing and Materials (ASTM) PE3408 resin for more than 15 years, and opted from the outset for the development of PE100 resins specifically – to support the MTD Pipeline project.

“Pipeline engineers, designers and operating companies are demanding materials that meet rigorous performance standards, including resistance to slow crack growth and rapid crack propagation, and the ability to perform under higher operating pressures,” says Wettstein. “With its unique challenges, this project is an excellent example of how new resins are impacting pipeline infrastructure development, providing new benefits to end-users and offering increased performance.”

**Challenging project**

In addition to the high-pressure requirements associated with transporting liquid chemicals a distance of 27.5 miles, the MTD Pipeline project also presented several challenges associated with environmental impacts was also among the critical considerations.

After extensive end-user qualification – including product trials related to pipebursting, long-term performance, fusion and drilling considerations – the companies recognized that DOW DGDA-2490 NT HDPE resin represented the best choice for the unique challenges of the project.

“Additional tests showed that the material will not only enable the pipe to endure the frozen sandy environment once it was installed, but also to enable it to endure installation, which began in March when temperatures were still below freezing. In fact, temperatures were as low as minus 15 degrees F when initial pipe shipments were unloaded at the site. While engineers would have preferred to begin installation during the warmer months of April or May, the scope of the project required that installation begin in March in order to be completed by October.

While the course of the pipeline runs primarily along existing utility right-of-ways, the project also required extensive directional drilling under five rivers and scores of roads and highways. The longest drill of the project, under the Little Manistee River basin, required a pull of more than 3,200 feet – one of the longest North American projects with HDPE.

Also, because the pipeline was being installed across nearly 30 miles of pristine countryside between two popular resort towns (an area that sees its population increase by a factor of six during the summer), working life integrity associated with environmental impacts was also among the critical considerations.

Made via UNIPOL II Process Technology, Dow’s proprietary manufacturing technology, the new resin features a superior combination of significantly improved long-term hydrostatic strength. These qualities make the resin suitable for a variety of pipe applications, including natural gas distribution, industrial piping, mining, oil and gas, sewage and municipal water lines.

Following the product trials, officials from Missisagua, Ontario-based KWH Pipe, one of three manufacturers that supplied pipe for the project, and Gary House Excavating (the Mount Pleasant, MI-based company that installed the pipe), concurred with Martin Marietta for use of the pipe materials.

**MTD Pipeline Specifications**

| Overview | Largest PE100 ISO design-build project in North America |
| Location | Between Ludington and Manistee, MI. |
| Time to Completion | 9 Months |
| Length | 27.5 miles (2,200, 65-foot HDPE pipe lengths) |
| Diameter | 20 inch/SDR 11 |
| Material | Replacing steel with DOW DGDA-2490 NT High Density Polyethylene Resin |
| Volume | 6.3 million pounds of HDPE |
| Directional Drilling | About 28,000 total feet of pipe |

**Tests**

Getting a resin specified into an underground construction project requires comprehensive product testing. Trials conducted on DOW DGDA-2490 NT HDPE resin ran the typical gamut, but two tests carried the most weight in the assessment of the material. The first was the hydrostatic sustained pressure test, in accordance to ISO 1167. The minimum required strength (MRS) classification is determined in
Michigan Project

 accordance to ISO 9080 and listed by the Plastic Pipe Institute (PPI). The maximum pressure a pipeline can operate at is calculated from MRS for a 100-year lifetime. The other critical test was the Pennsylvania North Test (PENT), a determination of pipeline life expectancy measured by slow crack growth resistance - resistance to leaks caused by crack growth due to defects or damages from internal pressure. (A pipe industry expert from Dow, Dr. Jimmy Zhou, Ph.D., is one of three inventors of the PENT test.)

 Results from the pipeburst tests, conducted at Gary House Excavating, were considered exceptional by all standards. The test was designed to test the resin's ability to withstand 150 pounds of pressure. Not only did the resin pass the test, but the pipe burst only after the pressure was increased to 900 pounds - approximately six times the maximum operating pressure (MOP) for this project (150 pounds).

 “Based on this test alone, we believe this pipeline is going to last for at least 100 years, if not longer,” says Kittlaus. “We never would have imagined a plastic resin could perform this well.”

 A third test that was also critical to the selection of this resin was the rapid crack propagation (RCP) test, designed to measure the pipe's resistance to a fast crack running a long distance initiated by third party damages. Results showed that the pipe would remain in the RCP-free operation zone as long as temperatures are above 10 degrees F. Regardless of operating pressure. In comparison, the RCP-free zone for a standard PE3408 material is around 50 degrees F according to a research report from the Gas Research Institute.

 The logistics and supply of extruding and installing a 27.5-mile pipeline is a challenge in and of itself—that's why three pipe manufacturers were called into the project to provide finished pipe extruded from the Dow resin. KWH Pipe, Performance Pipe and Quail Piping all provided lengths of PE100 pipe for the MTD Pipeline.

 Officials from KWH Pipe are also long-time proponents of HDPE for underground pipe applications and are impressed with the strength of the new PE100 resin from Dow compared to existing HDPE resins. It was the enhanced strength of the resin that enabled KHW to down-gauge the pipe and still achieve the required performance characteristics.

 “PE’s record speaks for itself and this PE100 resin from Dow ran very well,” says Paul van Warmerdam, president and CEO of KHW Pipe. “The long-term hydrostatic strength of the resin allowed us to decrease the thickness of the pipe, without sacrificing the integrity.”

 “It seems that about the only way to hurt this pipe is to cut a hole in it,” adds Gary House, president and CEO, Gary House Excavating.

 The performance benefits resulting from the resin’s strength and durability were also among the key factors that ultimately convinced Martin Marietta that the material was right for the job. Kittlaus specifically cited the resin’s ability to support a higher SDR pipe, which allows a higher product volume flow rate since the pipe producers are able to increase the inside diameter while maintaining a thinner wall.

 “The original design called for a 20-inch diameter SDR 7, which requires a 2.8-inch thick wall. But with this PE100 resin from Dow you can easily run an SDR 11, which enables you to reduce the wall thickness to less than two inches,” says Kittlaus. “This opens up the inside diameter and provides a 25 percent flow improvement, which increases output over time, meaning that the material essentially provides a "built-in" capacity upgrade.”

 In addition, being able to use a thinner wall enables a faster fusion, which in turn means less time and cost is required for installation.

 House estimates that his group saw a 40 percent improvement in the rate of fusing for the MTD Pipeline. “Thanks to this material, we were able to fuse 2,800 feet of pipe per day - versus roughly 2,000 feet for more typical projects,” he said.

 The down-gauge also means less pumping is required to convey the brine through the pipeline, eliminating the need to install a pump station as originally planned, further adding to the cost savings that can be attributed to the use of this resin.

 “No doubt about it – the ability to down-gauge provided cost savings all around,” says Cal/Mag’s Clark. “The pump station alone would have come with a price tag of about $500,000. Combine that with the savings we generated on pipe materials, and we’re already over $1 million.”

 Bright future

 By all counts, the MTD Pipeline project represents a significant step forward in the use of PE for pipeline development projects, and those involved expect that this project will prompt the underground pipe industry to sit up and take notice.

 Dow officials anticipate that PE successes such as this project, combined with the growing market for pipe infrastructure rehabilitation, may prompt civil and private sector engineers to more seriously consider new PE materials for construction projects in the coming years.

 “This project is truly a significant advancement for the pipe industry, as we are seeing more and more engineers converting to new materials and standards,” says Wettstein. “New regulations and an aging pipe infrastructure are driving change in the U.S. pressure pipe market. Dow is committed to developing new technologies that support the highest performing HDPE resins, and has established dedicated resources and state-of-the-art facilities for this purpose.”

 KWH Pipe’s van Warmerdam also believes that the ISO standards, which have been commonly used in Europe for underground pipe applications for years, are beginning to gain traction in the United States and Canada and will eventually be specified regularly in North America.

 “We as an industry are generally resistant to change, but over time, as more companies move to PE materials that meet ISO standards, PE100 materials such as this new resin from Dow will gain a larger share of the market. The ISO standards are coming to North America – it’s not a question of if, but when.”