

Plastics News

Study: Pipe with recycled HDPE good for rail uses

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October 25, 2017



A three-year study of corrugated high density polyethylene pipe used for drainage underneath a commuter rail line in Pennsylvania found "no discernible differences" in performance between the pipe made from virgin resin and one made from recycled material.

Pipe experts say the results of the field and lab evaluation mark an important step toward validating the

use of pipe manufactured with recycled plastic for railroad applications and most likely highway uses, too.

HDPE pipe with post-consumer materials has been used for decades in agricultural applications but railroad specifications require pipes be made with 100 percent virgin materials. The big concern has been that the service life of the pipe could be compromised by the presence of contaminants in the recycled content.

However, to incorporate more sustainable and cost-effective practices, the transportation industry has expressed interest in using pipes made with recycled content — if the long-term performance is equivalent to pipes made with virgin materials, according to Michael Pluimer, who worked on the study while earning his doctoral degree at Villanova University in Philadelphia.

Villanova conducted the study with the Southeastern Pennsylvania Transit Authority (SEPTA) on HDPE pipe made from 49 percent post-consumer content as part of SEPTA's sustainability initiatives. The university funded the study along with the National Cooperative Highway Research Program (NCHRP).

Starting in October 2013, Pluimer and a team of university engineers monitored the performance of pipe installed underneath the passenger rail line near Doylestown. Then, they evaluated the pipes' service life in terms of fatigue and stress cracking based on an accelerated lab study.



The results indicate both pipes should have a service life that exceeds 100 years. An 11-page synopsis of the study says the pipe made with 49 percent post-consumer material would be expected to last between 180 and 600 years before cracking but Pluimer said other factors can enter the equation when making projections beyond 100 years.

"While the pipe may be predicted to last [a couple of hundred years] relative to brittle stress cracking, we usually just report that it will last in excess of 100 years based on the service life prediction model," Pluimer said in a phone interview. "This is true for both virgin and recycled pipes in this study."

With indistinguishable performances and at least a century of service expected for both kinds of pipe, pipe with recycled HDPE would present new environmental and possibly economic considerations for the marketplace.

"It's a more sustainable alternative in that it uses fewer virgin materials so it's friendlier from an environmental standpoint," Pluimer said. "Beyond that, there could be cost benefits as well."

Historically, concrete has been the primary material used for railway drainage followed by metal and then plastic, which could be PVC or HDPE. If HDPE pipe with post-consumer becomes a new option, it should drive down costs through increased competition, according to Daniel Currence, director of engineering for the corrugated pipe division of the Plastics Pipe Institute, a trade association based in Dallas.

"Our position is anytime you allow additional materials to compete, you're going to get the best price," Currence said in the same phone interview.

About the test



Proper drainage is important to maintenance of railway track beds. Even small increases of moisture in the underlying layers of rocks and gravel can reduce bearing capacity and stability, which in turn affects track degradation rates.

Corrugated HDPE is often used by the rail industry for culvert and drainage applications because it resists corrosion and abrasion, has a long service life and is flexible. SEPTA was interested in learning about how pipe with recycled HDPE would perform and last, too.

The pipes for the study were donated by Advanced Drainage Systems, a manufacturer based in Hilliard, Ohio, with a recycling operation in Pennsylvania. Sixty feet of corrugated HDPE pipe was installed underneath the commuter rail line about 25 miles from Philadelphia. Thirty feet of pipe was made from virgin HDPE and 30 feet from HDPE with recycled content.

The pipes were installed end to end in the same trench and joined at the center with a watertight gasket. Although SEPTA design requirements call for at least 5.5 feet of cover from the top of the pipe to the bottom of the railroad tie, the minimum was reduced to 2 feet to put the products through demanding test conditions.

About 36 trains with up to six rail cars then passed over the pipes every day. The rail cars weigh 75 tons when empty, and each holds up to 109 passengers. Data about the pipe performance was captured using strain gages and extensometer instruments.

"After three years of service, both pipes are performing well with no discernible differences noted," concludes the 11-page synopsis written in 2016. "The measured strains and deflections on both pipes are minimal and well below industry recommendations."

In the lab, test specimens from the pipe with virgin materials and the pipe with recycled materials were evaluated at different stress and temperature conditions. Additional tests were conducted on test pipe manufactured with a blend of 95 percent post-consumer content with 5 percent carbon black masterbatch, which would be expected to last between 160 and 250 years before brittle crack failure, according to study results.

The research demonstrates how the plastic pipe industry is taking a leadership role in providing the transportation industry with more choices, according to PPI President Tony Radoszewski.

"This gives the specifier and design community — whether it's railroads, or as we look to the opportunity to use those products in state highways and even private work — a whole new level of confidence that incorporating recycled products is a viable solution for interested parties that want to have a demonstrated sustainable product and use for the long term," Radoszewski said in the phone interview. "I don't think our competing industries are really leading in that way as much as we are."

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