Engineering professor develops 'superlaminate' industrial pipe repair system

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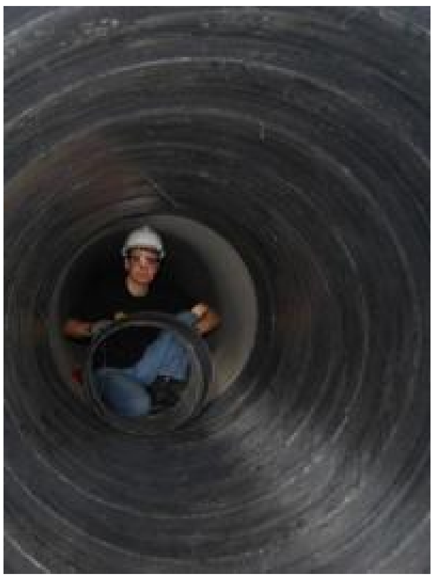

In the innovative PipeMedic repair system developed by University of Arizona civil engineering professor Mo Ehsani, the carbon fabrics of any design (up to a width of 60 inches) are saturated with the resin and run through a special press; the result is a solid "super" laminate with a thickness that can be set from 0.02 to 0.08 inches. Credit: PipeMedic.com

A University of Arizona engineering professor may have a solution to a U.S. infrastructure problem that's growing deadlier each year.

The national Gas Technology Institute (GTI) recently published a test report approving a new technology called PipeMedic that uses carbon and glass laminates to repair and replace failing gas pipelines. GTI is a nonprofit research and development organization serving the natural gas industry.

PipeMedic technology was developed by Mo Ehsani, professor emeritus of civil engineering at the University of Arizona College of Engineering, and a pioneer in the structural application of fiber-reinforced polymers, or FRPs.

Ehsani was a faculty member in the UA department of civil engineering and engineering mechanics for almost 30 years before he left in 2009 to focus on his structural engineering repair business, QuakeWrap, which he founded in 1994. His research at UA had focused on the seismic behavior of structures, and on innovative approaches to repairing and retrofitting civil structures using FRPs.

Ehsani describes PipeMedic as a "superlaminate" because it uses crisscrossing carbon fibers and layers of glass fabric that are saturated with resin, then pressurized and heat-treated to create strips about 0.025 inches thick.

"It works like a stent," Ehsani said. "We coil the laminate around what is essentially a balloon with wheels and insert it into the pipe." The area to be fixed might be 1,000 feet away from the pipe entry point, Ehsani said, which means that pipe can be treated even if it's buried under buildings or roads.

"When the balloon is at the repair area, we pump in air and the laminate unravels and presses against the pipe," he said. "After the epoxy has dried, we deflate the balloon and remove it."

The superlaminates created at Ehsani's production facility in Tucson, Ariz., are shipped in rolls hundreds of feet long, ready for insertion into leaky pipes. The main advantage of Ehsani's laminates over most current methods is that prefabrication enables them to be strength-tested and gives them rigidity. This allows the laminates to be inserted into pipes in cylindrical coil form, which is retained as the balloon presses the laminate against the inside of the pipe.

Currently, most pipe fixes use the "wet lay-up" method, which involves soaking fiber in resin, applying it manually to the problem area, and waiting for it to set, or cure. Precise control is not possible and the strength of the repair cannot be determined until curing is complete, when samples of the cured fiber-resin can be tested to determine whether the fix is up to specification.

Unlike Ehsani's laminates, the wet fiber-resin mix is too squashy to fix large areas. Health and safety are also a problem with wet lay-up because of harmful volatile organic compounds from the resin and associated accelerators and catalysts.

PipeMedic also has the capability to strengthen pipes, culverts and aqueducts made from steel, cast iron, corrugated metal, clay, brick, concrete, and wood. However, the GTI test showed that this superlaminate could actually replace, rather than strengthen, old pipes.

Utility owners are thinking about the next generation of subsurface pipework. Some want to line all new pipe with extra-thick superlaminates, so that when the external pipe eventually fails, the superlaminate becomes the de facto new pipe, but with no new construction.

"Carbon is much too expensive to construct a half-inch thick superlaminate liner that could withstand soil pressures and traffic loads," Ehsani said. "So we have taken a page from the book of the aerospace industry and built a liner using an internal honeycomb structure." This product, called StifPipe, is already in use in a rain catchment system in Brooklyn Bridge Park in New York.

Provided by University of Arizona College of Engineering