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CENTER FOR UNDERGROUND INFRASTRUCTURE RESEARCH AND EDUCATION

CUIRE RESEARCH TEAM FOUND EXISTING LITERATURE ON CHEMICAL EMISSIONS OF STYRENATED CIPP NON-CONCLUSIVE

A four-month study on the review of published literature pertaining to chemical emissions of styrene-based resin used in the cured-in-place pipe (CIPP) process found that existing studies do not adequately capture worker exposures or levels in the surrounding areas to which workers or citizens may be exposed. The study started last December and completed on April 6, 2018, by researchers at the University of Texas at Arlington (UTA)'s Center for Underground Infrastructure Research and Education (CUIRE), and the Institute for Underground Infrastructure (IKT) in Germany. The team determined that spatial variation of concentrations, and variations in concentrations with different meteorological conditions, are not well determined.

Most of the steam-cure studies captured temporal variation in emissions, by measuring concentrations before, during and after curing. The studies were less complete in capturing spatial variation in concentrations. Most studies measured styrene around the termination manhole, or inside the manhole or sewer pipe itself. Maximum values at the outlet point and inside the terminal manhole ranged from 20 to 1,070 ppm, which are levels that exceed some exposure limits. However, since workers and certainly the public should not typically enter or stand directly at the termination manhole in the exhaust plume, this information is not very helpful.

At the steam-cured sites, additional field measurements of styrene concentrations surrounding the terminal manhole are needed. Only four of the steam-cure studies measured concentrations at locations surrounding the terminal manhole (at least 3 ft (1 m) away, not in the manhole itself or in the exhaust plume). On one project, employees walked the construction area periodically but spent most of the time in their work trucks due to the cold weather. Hence, these measurements were likely not typical of worker exposures. Additional worker exposure data should be collected to capture variability in source emission rate, meteorological conditions, and the worker's location with respect to the terminal manhole.

Atmospheric concentrations of compounds are functions of the source emission rate, meteorological conditions, and the receptor location. Since concentrations are expected to vary as a function of distance from the manhole, measuring at few locations gives an incomplete picture. In addition, concentrations are expected to vary with wind speed and wind direction, so measuring on one day does not capture what levels may be under differing meteorological conditions.

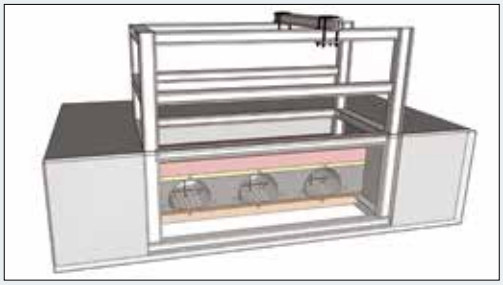
These earlier studies also do not adequately capture variations in emission rates from different kinds of pipes (different diameters, lengths, etc.). The overall results of the project at UTA/CUIRE/IKT indicated that the 21 papers reviewed have questionable methodologies, and therefore, the results presented are not conclusive. The researchers recommended additional sampling and data evaluation and analysis as a second phase of this study, as proposed in their final report.

UPDATE ON STRUCTURAL DESIGN METHODOLOGY FOR SPRAY APPLIED PIPE LINERS IN GRAVITY STORM WATER CONVEYANCE CONDUITS

To reduce emergency projects and impacts to the travelling public, departments of transportation (DOTs) can use spray applied pipe linings (SAPLs) to renew deteriorated gravity storm water conveyance conduits and culverts provided they are discovered prior to loss of soil-structure interaction. A structurally SAPL is a standalone application that inhibits further deterioration and can structurally renew severely damaged culvert and drainage structures. The primary materials used for spray applied lining generally fall into two broad categories of cementitious materials and polymers such as epoxies, polyurethanes and polyureas.

The primary objective of this two-year study is to develop design equations for structural renewal of gravity storm water conveyance culverts with both cementitious and polymer materials. Both circular and arch shapes with span larger than 36 in. will be considered. The design equations will use loadings as detailed in the American Association of State Highway Transportation Officials' (AASHTO's) Load and Resistance Factor Design (LRFD) Bridge Design Specifications. Additionally, practical limitations on the use of these design equations will be included.

As part of this research, a soil box testing is planned for late summer at CUIRE laboratory at the University of Texas at Arlington (Figure 1). This testing program will simulate the 32-kip wheel load condition under the pavement with a shallow cover on the culvert. The SAPL thicknesses



Soil Box Testing for an Arch Shape SAPL with three Thicknesses of Same Material

currently selected for cementitious materials are 0.5, 1.0, and 2.0 in. and for polymer materials are 0.25, 0.5, and 1.0 in. So far, several vendors with cementitious, geo-polymer, and polymer SAPLs have expressed an interest to participate in this testing. These vendors include A.W. Cook, AP/M Permaform, CentriPipe, Epoxytec, Milliken, Raven Lining Systems, Sprayroq, The Strong Company, Standard Cement, and Vortex. Some of these vendors have already signed up or gone through a laboratory testing program established through the AASHTO's National Transportation Product Evaluation Program (NTPEP) Technical Committee (TC) for SAPLs in an effort to implement this new technology. More vendors are expected to join the program. For more information on NTPEP, visit *http://www.ntpep.org/Pages/SAPL.aspx*.

Other aspects of this project include a national DOT survey, field data collections through site visits to actual SAPL installations, considerations for impact of corrugations and additional reinforcement, development of performance specifications, and computational modeling through finite element analysis. The project is scheduled to complete in December 2019.

To participate in this unique project, DOTs and vendors can contact Jeffrey Syar, P.E., Administrator, Ohio DOT Office of Hydraulic Engineering, Phone: (614) 275-1373, Email: *Jeffrey.Syar@dot.ohio.gov*; or Dr. Mo Najafi, P.E., Phone: (817) 272-9177, Email: *najafi@uta.edu*, the Principal Investigator for this project.

CUIRE TO DEVELOP DESIGN AND INSTALLATION GUIDES FOR PIPE-IN LINER© PRODUCT

CUIRE is a research, education and outreach organization and is a part of the University of Texas at Arlington's (UTA's) Department of Civil Engineering. Since its inception in 2002, CUIRE has focused on assembling exceptional and broad-reaching engineering and technical talent to address the needs of underground infrastructure on a regional, state, national and international scale. Through a research contract with Asoe Hose Mfg. Inc., China, for their Pipe-in Liner© product, CUIRE will develop a complete Design Guide with equations and sample calculations and an Installation Guide, which includes pre-planning, planning, installation, delivery and closeout and safety precautions. Both these documents will be prepared for U.S. market. Pipe-in Liner© is a Fabric Reinforced Flexible Plastic Pipe (FRFPP), as shown in Figure 1.

The Asoe's Pipe-in Liner© product is a trenchless technology method using lining with inserted hoses to renew water, gas and oil pipelines and are classified into four different series:

1. Pipe-in Liner© W series are used to rehabilitate water main pipes and other types of water pressure pipes at normal temperature.
2. Pipe-in Liner© O series are used to rehabilitate oil pipes onshore or offshore.
3. Pipe-in Liner© G series are used to rehabilitate gas pipes onshore or offshore.
4. Pipe-in Liner© H series are used to rehabilitate pipes in municipal hot water systems. The H series can resist temperatures up to 95 C (203 F). Asoe is the first company in the world to develop this type of solution to renew hot water pipes.

The Pipe-in Liner© can be used to install a liner where pressure rating is greater than that of the host pipe, and where the host pipe is in structurally sound condition, but has localized corrosion perforations and/or leaking joints. The new pipe must be reduced in diameters as a separate operation prior to installation into the host pipe. Long continuous lengths can then be inserted in a single operation. Depending on site conditions, section lengths up to 13,000 ft can be inserted in a single pull. This method is available over a range of diameters from 5 in. to 40 in.

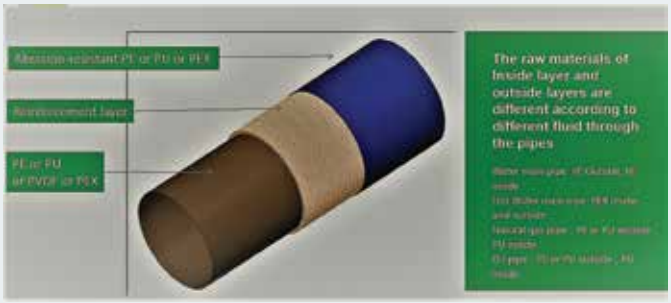


Figure 1 -- Pipe-in Liner© Structure

Asoe manufactures different hoses, including through-the-weave polyurethane (PU) lay-flat hoses and fire hoses. Jacketed fire hoses are lined with ethylene propylene diene monomer (EPDM), polyurethane (PU), nitrile butadiene rubber (NBR), PVC, and natural rubber (NR). Asoe designs and manufactures hose couplings, which work with Asoe hoses. According to different technical requirement in different applications. The materials applied in couplings are aluminum, carbon steel, stainless steel, and PE.

For more information, contact ASOE by email sales@asoehose.com, Phone (281) 971-8693, or Website *asoehose.com/contact_us.html*.

CUIRE TO HOLD 17TH ANNUAL PIPELINE AND TRENCHLESS TECHNOLOGY ENGINEERING/ INSPECTOR SCHOOLS IN FORT WORTH

CUIRE will hold its 17th annual pipeline and trenchless technology engineering/inspector training and certification schools on Monday and Tuesday, Jan 28-29, 2019, at the Fort Worth Convention Center in Fort Worth, Texas, in conjunction with the Underground Construction Technology Conference (UCT 2019). Attendees may register for any of the following half-day Schools:

Monday, Jan 28 –
Morning (8:00 AM – 12:00 Noon)

- Advanced Horizontal Directional Drilling (HDD) School (Part One)
- Geotechnical School (Part One)
- Pipe School (Part One)

Monday, Jan 28 –
Afternoon (1:00 PM – 5:00 Noon)

- Advanced Horizontal Directional Drilling (HDD) School (Part Two)
- Geotechnical School (Part Two)
- Pipe School (Part Two)

Tuesday, Jan 29 – ***Morning***

- Mud School
- Microtunneling and Pilot Tube School
- Pipe Lining and Renewal School

For more information, contact CUIRE at 817-272-9177, email *cuire@uta.edu* or visit *cuire.org*.