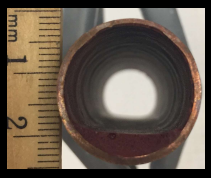
Considerations for Repairing Water Pipes in Place: Studies, Emissions, and Specifications

Andrew J. Whelton, Ph.D.



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November 2, 2017

Stormwater culverts and repairs in the U.S.

12 million+ linear feet of culvert in place (FHWA 2005)

1 million+ existing culverts require rehabilitation (FHWA 2010)

Mechanical failures can be catastrophic (traffic disruption, public safety)

Aging Drinking Water Pipes

Repair or Replace?

Improve water pressure
Decrease water age
Improve water quality
- Increase disinfectant residual
- Decrease biofilm
- Decrease metal contaminants
- Improve color/clarity
- Improve taste/odor

Instead of replacing the damaged pipes, often trenchless rehabilitation approaches are applied

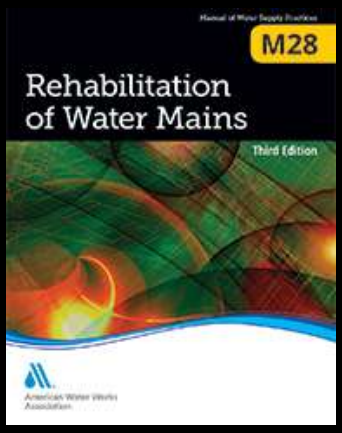
Trenchless Technology Options

Slip lining
Spiral wound pipe
Close fit pipe
Thermoformed pipe
Fold-and-form pipe
Spray-on coating (mortar vs. polymer)
Cured-in-place-pipe (CIPP)
50% of all water pipes

Potential Challenges for Some Options

- Water flow diversion
- Grouting necessary
- Reduction in cross-sectional area
- Structural integrity not improved
- Host pipe must be dry
- Cost

Plastics (=Polymers) are being used for water pipe repairs because of their low cost, corrosion resistance, ease of installation, and estimated long service-lives



Non-structural = Coatings
Semi-structural = Pressure transferred to host pipe
Fully-structural = Independent of host pipe, pipe within pipe

Common approach: Chemically manufacture plastics in the field, in damaged pipes

Education: Formal Plastic Technology Education is Not Common for Water Utility, Consulting Engineers, and Construction Professionals

Typical Civil / Environmental / Construction Courses

Water and wastewater treatment
Water distribution modeling
Water and air chemistry
Environmental science
Hydraulics
Timber, concrete, asphault, steel
Statics, Dynamics, Deforms
Construction management
Soil mechanics
Corrosion science

What we Add

Polymer Chemistry
Polymer Engineering
Surface Science
Construction technology
Industrial hygiene

Purdue at AWWA 2016

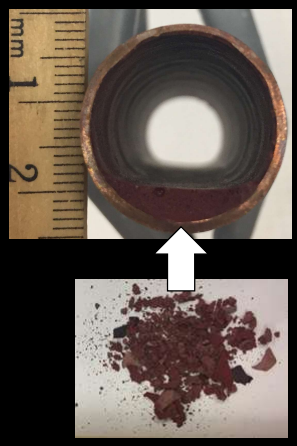
Purdue at WEFTEC 2014

History has Proven Product Testing Standards for Polymer Water Infrastructure Technologies can be Deficient

PB pipe failures (1980s-Pres)

HDPE pipe failures (2002-Pres)

Epoxy coating failures (ongoing)



Polymers Are Not Just Used for Pipes

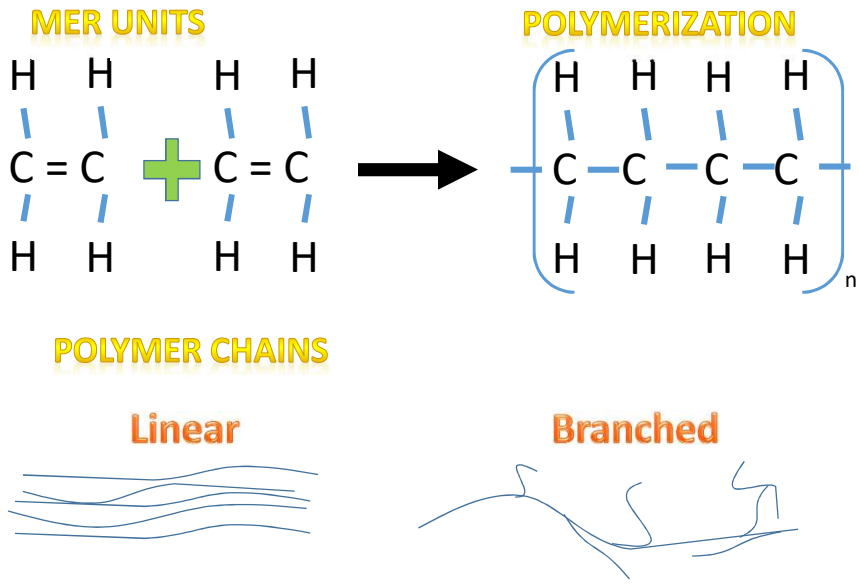
- **Fluid conveyance and insulation pipes:** HDPE, MDPE, PEX, PEX/AL/PEX, PP, PVC, cPVC, FRP, CIPP, and more…
- **Gaskets for flexural interfaces:** Ethylene-propylene-diene-monomer (EPDM), styrene-butadiene-rubber (SBR), nitrile, and more…
- **Coatings for corrosion protection:** Epoxy, polyurethane (PU), polyurea (PEUU), PU/PEUU blends
- **Overwraps for corrosion protection:** HDPE, LDPE, PP
- **Air and water treatment membranes:** Polyamide (PA), polysulfone (PSF), polycarbonate (PC), polyvinylidene fluoride (PVDF), and more…
- **Chemical barrier and geotechnical assets** (i.e., landfills, pipes, water meters, etc.): HDPE, PET, PVC, and more…
- **Water treatment chemicals:** Polyaluminum chloride (PACl), polyacrylamide (PAM), polyDADMAC, and more…

Let's Talk Basics....

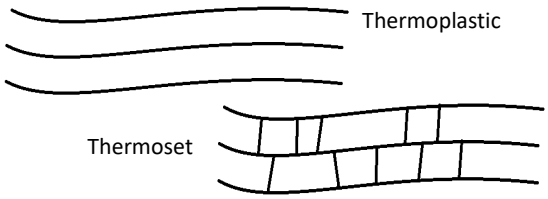
Polymer = *Many…Unit…compound*

- Long-chain molecules of very high molecular weight (n = tens of thousands)
- a.k.a. macromolecules

1. Mer Units, Polymer Chains
2. Molecular weight
3. Morphology (free volume, xtal, xlink)
4. Thermal transitions (Tg, Tm, Tc)
5. Viscoelasticity (HDPE HDD example)



Polymer Chains
(*Think Spaghetti*)



- Crosslinking
- Free volume; Disorder region, less energy required to melt or deform the polymer, HDPE vs. LDPE vs. PEX (HDPE)
- Flexible: LDPE vs. HDPE (free volume)
- Flexible: HDPE vs. PEX (chain mobility)
- Some coatings and in-situ repairs are thermosets (i.e., CIPP)

Amorphous & Semi-Crystalline Polymers

- Some polymer chains can be tightly packed in a regular array (like a metal) = *Crystalline regions*
- When polymer chains are ***not*** tightly packed = *Amorphous regions*

- Crystallization can occur when heated and cooled
- Semi-crystalline polymers: PE (20-65%), PP, Polyester, Nylon, Polyamide, PEEK

How about that orange contractor fence?

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Different Polymer Chain Sizes Provide Polymers Different Properties

Questions

- Which one is stiffer? More flexible?

Metals vs. Polymers

- Processing temperature lower
- Energy required to break polymer bonds lower

Polymers can be Selected Based on their Thermal Transitions

PVC vs. HDPE

FLOW

T_m — Polymer chains begin to flow

RUBBERY

T_g — Long chains begin to wiggle/ move

RIGID

T_c: Crystallization temperature: As you cool the polymer, chains crystallize [slow vs. fast cool affects crystallinity]

Polymers are *Viscoelastic*

Elastic = Recoverable

Viscous = Permanent Loss

Silly Puddy & Velveeta Cheese

- Long chain nature suggests reorganization during deformation / stress
- Polymers are both elastic AND viscous
- Observed by "creep" and "stress relaxation"

July 2006
Big Dig Ceiling Collapse
Boston, MA

Certain Additives, Fillers, Reinforcements can Improve Polymer Properties

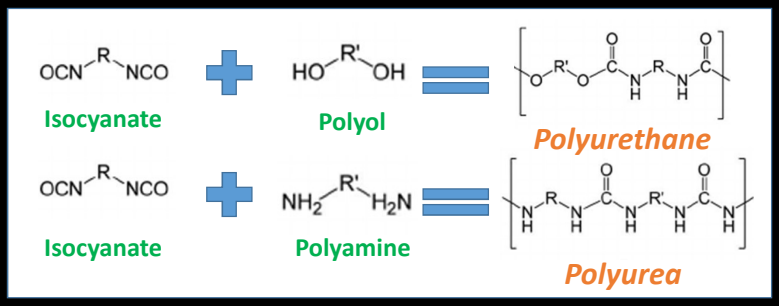
Additives: Improve the visual, process, environmental resistance, or degradation properties

Such as absorbers, antioxidants, antimicrobials, colorants, impact modifiers, UV stabilizers, lubricants, plasticizers

Fillers: Reduce cost (i.e., $CaCO_3$)

Reinforcements: Increase the structural / mechanical properties (i.e., GF, PET fiber, CNF, aramid)

Several repair technologies chemically manufacture the product – Inside the Asset



Chemical Emission
vs.
Mechanical Performance

What is Typical in Drinking Water

Total organic carbon (TOC): 1 – 6 mg/L

pH 6.5 – 8.5

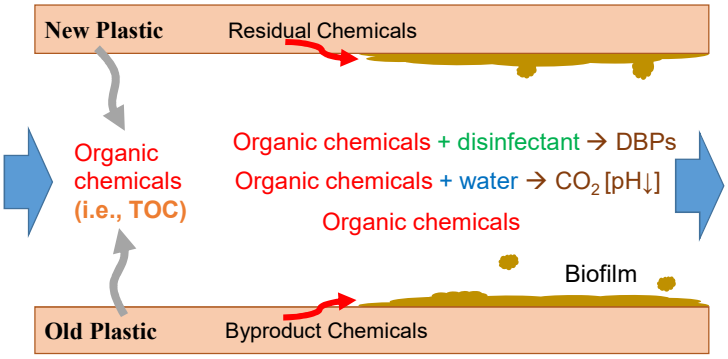
Disinfectant residual to limit microbial growth (i.e., chlorine, chloramine, etc.)

Individual contaminants

Disinfectant byproducts (DBP)

Drinking water odor: < 3 TON

What we Know from Polymer-Drinking Water Interaction Studies



BIG Misconceptions

EPA tests plumbing products to determine if they are safe – No they do not

EPA transferred product testing authority to NSFI – No they did not

NSF(I) Standard 61 – "Health Effects" Testing

For plastic coatings… (plastic pipes = different procedures)

No water testing during the first 4 days of product use

No water testing for total organic carbon (TOC)

No water testing for generated disinfectant byproducts (DBP)

Water pH effect not evaluated for plastic pipe leaching

All drinking water disinfectant chemicals not considered

No organism growth impacts considered

No taste or odor impacts considered

No test results are made public even for 'approved' products

NOT A REGULATORY BODY, NO ENFORCEMENT CAPABILITY

Testing lab with 2,100 employees globally; all sectors, all continents except Antarctica

For U.S. and Canada Epoxy Drinking Water Applications, Only a Few Studies have been Conducted

Year	Epoxy Test Condition	Water Quality Impacts
2017	1 NSFI approved formulation; pH 8, 6.5; Free chlorine, Monochloramine	1. BADGE, BFDGE hydrolyzed and decayed 2. BPA, BPF did not decay 3. BPA, BPF, and triethylenetetramine (TETA) reacted with both disinfectants 4. BADGE did not react with disinfectants
2007	1 NSFI approved formulation; pH 8; Free chlorine, Monochloramine	1. TOC 6.3 mg/L (new), 1.7 mg/L (day 30) 2. BPA, phenol, 4-nonylphenol (4-NP), styrene, toluene, benzaldehyde 3. Odor caused "plastic/solvent-like/glue" 4. Disinfectant loss occurred 5. DBPs were produced (THM & HAA5)
2002	5 NSFI approved formulations; 2 coatings	1. Total BTEX ranged from 0.2 to 48 mg/L 2. TOC ranged from 34 to 345 mg/L
1989	1 formulation in lab; 3 field storage tanks	1. MIBK, *o*-,*m*-,*p*-xylene; ethoxy ethyl acetate; methyl benzaldehyde 2. Disinfectant loss occurred 3. DBPs were produced (THM) 4. Water soaking caused more rapid leaching than air drying 5. MIBK and xylenes detected in storage tanks

Year	Epoxy Test Condition	Water Quality Impacts – Studies from Outside the US and Canada
2016 (Finland)	Six old coatings were tested in the field	1. BPF, 4-NP, 4-t-octylphenol rarely found; trace concentrations 2. BPA was detected in majority of samples; Maximum (cold water) 250 µg/L and (hot water) 23,500 µg/L 3. Older epoxy leached 4-20x more BPA than newer epoxy
2014 (France)	3 coatings	1. Epoxy #3 showed increasing leaching during 5 months 2. BPA only found in absence of disinfectant, no BPF found at all 3. 2,4,6-trichlorophenol (TCP), a BPA chlorination by-product sporadically observed in the chlorinated water
2014 (France)	27 old coated water tanks 200 old coated pipe sections	1. TANKS: No BPA, BPF or TCP 2. PIPES: High frequency of BPA and BPF detection, sometimes with maximum values around 1 µg/L
2009 (France)	1 coating, 1 hr after installation	1. Benzyl alcohol (345 µg/L), monoglycidyle ether of butane diol (12 µg/L), diglycidyl ether of butane diol (386 µg/L), diaminodiphenylmethane (72 µg/L) 2. Total flavor number: 6 "glue and bitter almond" to 2.5 "bitter flavor"
2007 (France)	Five 1-10 year old coatings were tested	1. No detectable TOC 2. GC-MS analysis found no epoxy specific compounds resulting from 4 epoxies 3. 1 epoxy showed evidence of leaching of 4-*t*-butyl phenol (4-TBP), and the presence of halogenated 4-TBP products, with a max. 2.2 µg/L
2004 (Spain)	5 coatings	1. BPA of 0.02-0.03 µg/cm^2, benzyl alcohol of up to 180 µg/cm^2; phthalates of 0.04-0.3 µg/cm^2, benzaldehyde, 4-NP, etc.
2002 (Korea)	3 coatings	1. BPA from unit area of epoxy resin coating was in the range of 1.68 to 1,734 µg/m^2 2. Higher risk of BPA leaching to drinking water during a summer season 3. Microbial growth was higher with epoxy than in a stainless steel tank

In Summary: Epoxy Created Inside Water Infrastructure

In the USA and Canada

- There has been wide variability in chemical leaching from across NSFI Standard 61 products
- Many chemicals that are released have no US drinking water standard
- TOC level found as high as 345 mg/L
- Free chlorine and monochloramine react with chemicals that are released
- Regulated DBPs can be formed by leached chemicals
- Odors can be caused

Outside the US and Canada

- There has been wide variability in chemical leaching from across products
- BPA leaching expected to be greater in summer (warmer) months
- Found 250 µg/L BPA in cold water and 23,500 µg/L BPA in hot water
- Chemical leaching can occur for months, years
- Epoxy leaching increased during the first 5 months of a 6 month study
- Microorganisms can grow because of epoxy leaching
- Odor and bad flavor can be caused

Observations

There is very little information available about chemical leaching from epoxy materials used for drinking water pipes and tanks

Much less information for polyurea and polyurethane coatings

Dr. Stephen Randtke et al. (2017), Leader of recent WaterRF water pipe lining study

"Since epoxy formulations, application methods, curing times, and other factors vary among manufacturers…the results are not necessarily representative of those that would be obtained using other applications or epoxy formulations"

What to Do With Specifications?

Require products to pass a more representative leaching tests

Determine your pass/fail thresholds: Contaminants and surrogate indicators (i.e., TOC, odor, etc.)

Contractors create plates which are leached Compare results to predetermined acceptability criteria

Request for BIDs, Select PREqualified contractors based on their material's compliance with the performance criteria

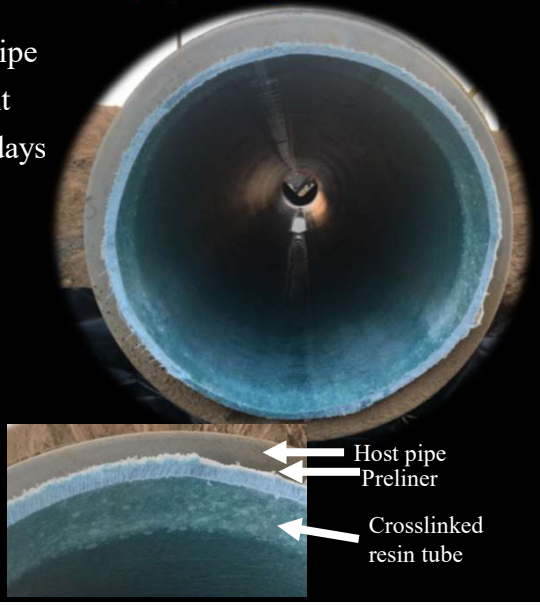
Require field testing to validate performance or nonconformance

Cured-in-place-pipe (CIPP) technology for sanitary sewer, storm sewer, and potable water pipe repairs

Resin impregnated tube hardened inside a broken pipe

Curing methods: Hot water, Steam, UV light

Deliberate curing time: Hours to many days



Resin Types
- Polyester (est. most popular)
- Vinyl ester (est. > cost of polyester)
- Epoxy (est. >> cost of polyester)

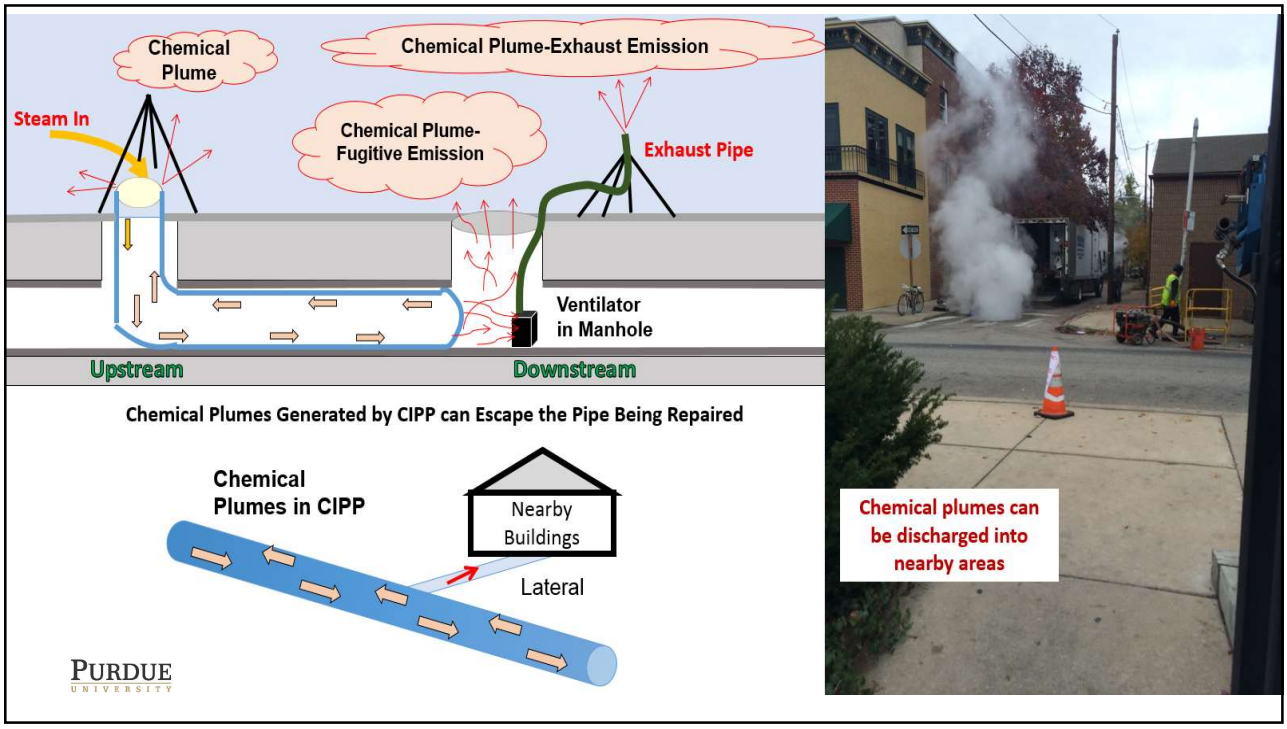
People also say "Styrene resin" vs. "Non-styrene based" resin
Resin + Solvents + Fillers + Catalysts + Initiators are added to create an uncured resin tube

Method to insert uncured resin tubes
- Air inversion
- Water inversion
- Pull in place

Sometimes resin may leave the tube and flow into cracks and sewer laterals. May not cure.
Tubes sometimes have a plastic coating. Plastic "preliners" sometimes used.

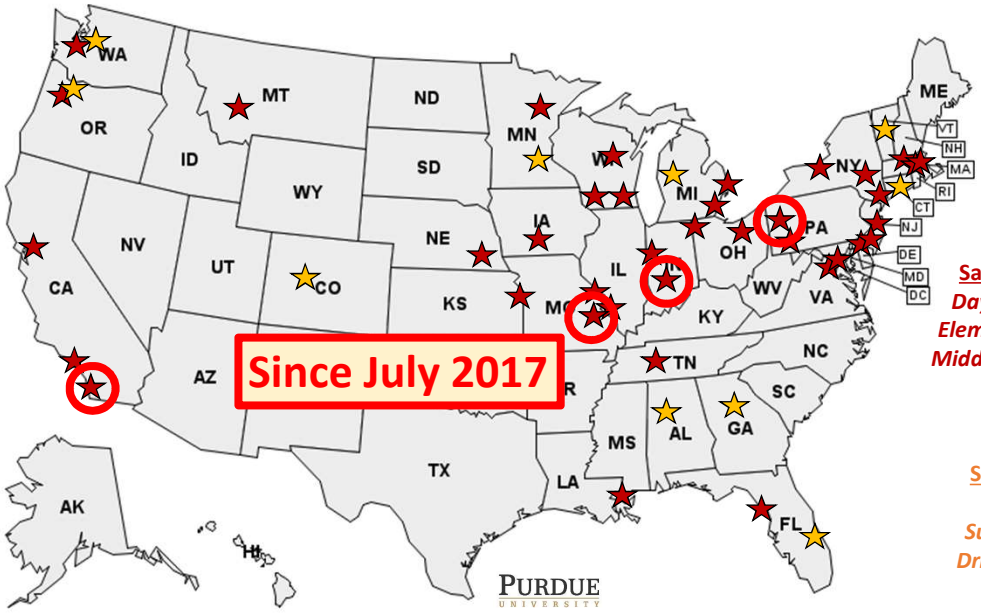
Method to polymerize resin
- Thermal – Steam injection (most popular)
- Thermal – Hot water recirculation
- UV – Light exposure (est. most growth)

Cooldown method
- Forced hot air
- Forced ambient air
- Recirculated water



Are chemical emissions a problem?

CIPP Air and Water Contamination Incidents We Know About



Sanitary Sewer
Day care centers
Elementary schools
Middle/High schools
Offices
Homes

Storm Sewer
Fish kills
Surface water
Drinking water

Contractor and Municipality Statements to the Public

"styrene vapor of at most few ppm"
"is not a human health risk"
"is safe for people and animals"
"it is harmless steam"
"no hazardous conditions posed"
"don't be alarmed"
"50 ppm styrene is the safe exposure level"
"open windows to allow ventilation"
"place plastic bags filled with water and wet towels over drains/sinks/toilets"
"pour 1 gallon, 1-2 cups water down drains"
"some people are offended by this odor and are fearful of it; even though the concentrations they smell present no harm"

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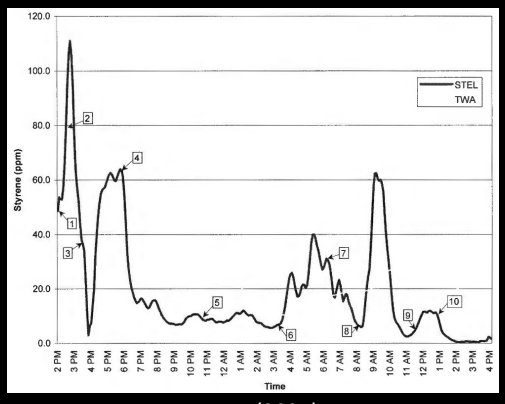
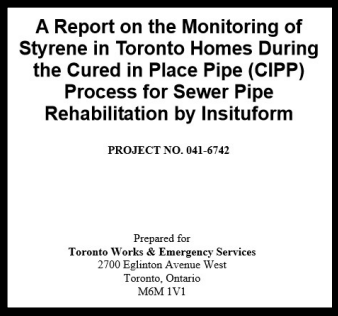
Only 4 CIPP air monitoring studies have been conducted in the past 16 years



Bauer (2004)


A Report on the Monitoring of Styrene in Toronto Homes During the Cured in Place Pipe (CIPP) Process for Sewer Pipe Rehabilitation by Insituform

PROJECT NO. 041-6742

Prepared for
Toronto Works & Emergency Services
2700 Eglinton Avenue West
Toronto, Ontario
M6M 1V1

AirZone, Inc. (2001)

ATSDR (2005)

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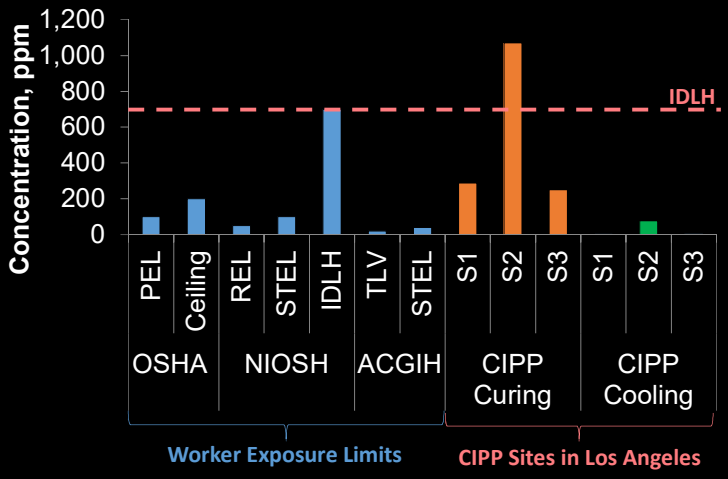
2015, Styrene Exiting a CIPP Sewer Manhole Exceeded the NIOSH IDLH

IDLH: a concentration from which a *worker* could escape without injury or without irreversible health effects in the event of respiratory protection equipment failure



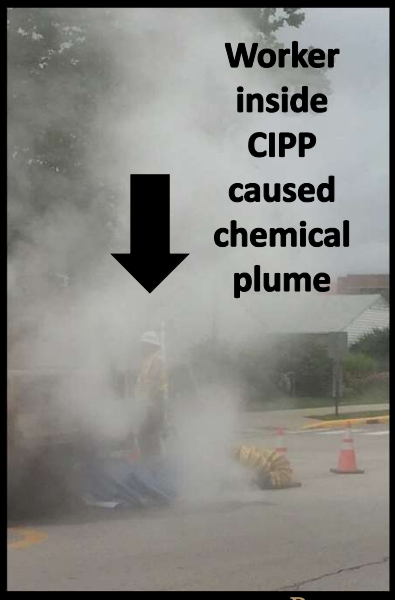
Adjari (2016)

2016 US NSF RAPID Response Study

To better understand materials emitted from CIPP sanitary sewer pipe and storm water pipe repair installations and their potential toxicity

Objectives

1) Conduct air sampling and analysis for 7 steam CIPP installation sites that use non-styrene and styrene resins
2) Characterize the raw materials, materials emitted, and their magnitudes
3) Evaluate chemical plume toxicity to mouse lung cells
4) Identify worksite safety issues and provide recommendations on future technology use



http://www.NSF.gov

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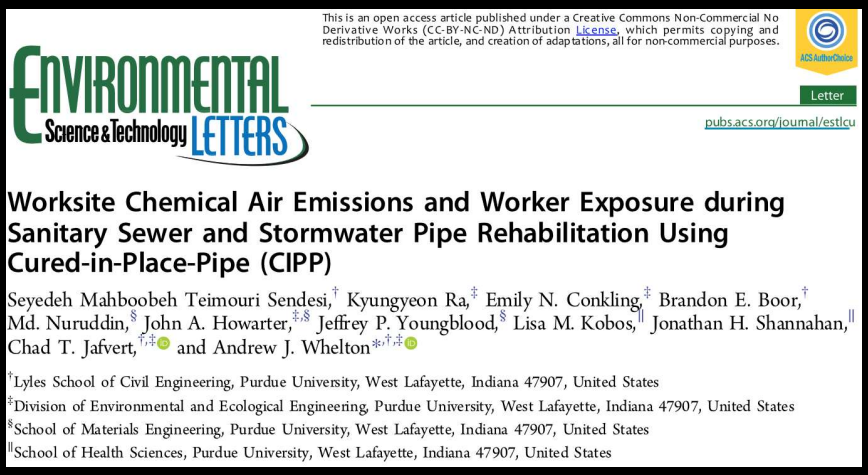

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Letter

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Worksite Chemical Air Emissions and Worker Exposure during Sanitary Sewer and Stormwater Pipe Rehabilitation Using Cured-in-Place-Pipe (CIPP)

Seyedeh Mahboobeh Teimouri Sendesi,[†] Kyungyeon Ra,[‡] Emily N. Conkling,[‡] Brandon E. Boor,[†] Md. Nuruddin,[§] John A. Howarter,[‡,§] Jeffrey P. Youngblood,[§] Lisa M. Kobos,[∥] Jonathan H. Shannahan,[∥] Chad T. Jafvert,[†,‡] and Andrew J. Whelton*[,†,‡]

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FREE Download: A new air monitoring study report, its Supporting Information file that lists 59 chemical exposure incidents, and download the five videos.
Visit http://pubs.acs.org/doi/ipdf/10.1021/acs.estlett.7b00237
Published: July 26, 2017

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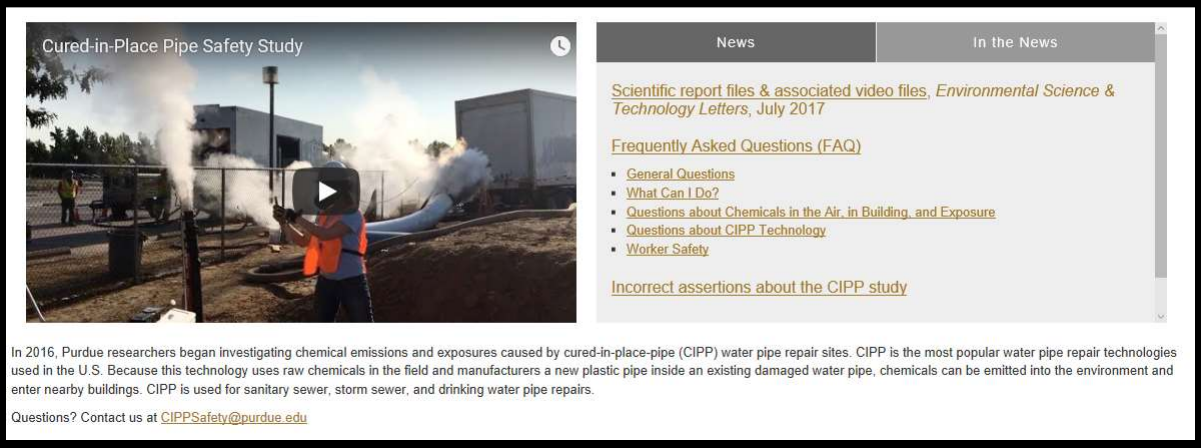

More information can be found at
http://CIPPSafety.org *or* https://engineering.purdue.edu/CIPPSafety

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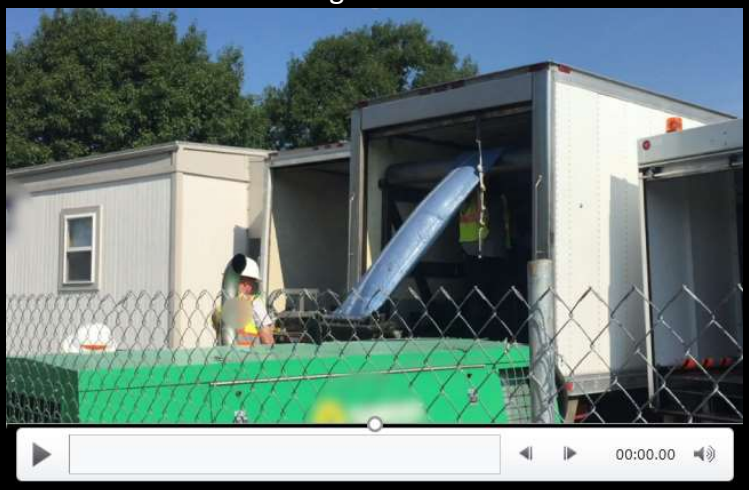
Uncured resin tube being inserted into a manhole

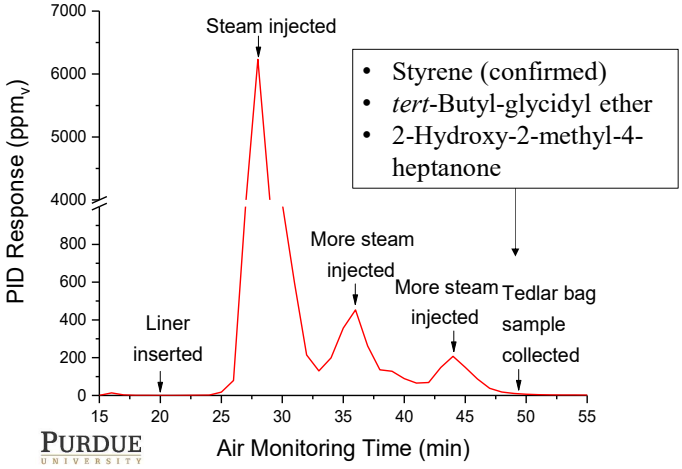


Materials being emitted from an Exhaust pipe ➔

Go online to view these free videos
http://pubs.acs.org/doi/ipdf/10.1021/acs.estlett.7b00237

Before uncured resin tube was cured

Results: Chemicals were emitted from the uncured resin tube *before* installation and from the downstream manhole *during* installation



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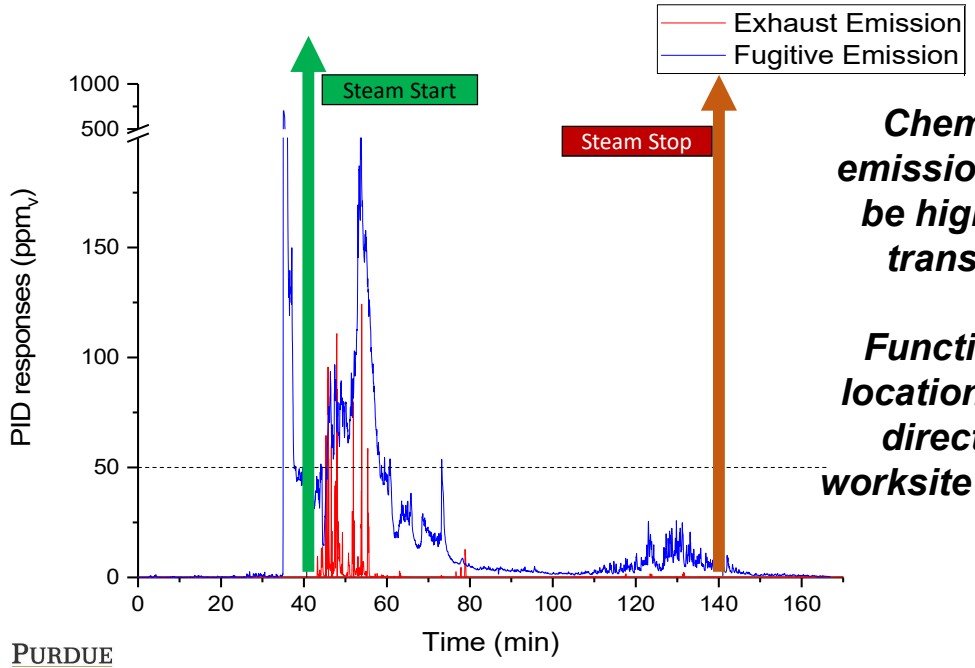
This is a Multiphase Chemical Mixture, NOT Steam (particulates, droplets, partially cured resin, etc.)

We Found Several Compounds Emitted into the Air at the CIPP Sites and Some, but Not All, were Present in the Uncured Resin Tubes

Acetone	
Acetophenone	Hazardous Air Pollutant
Benzaldehyde	
Benzoic acid	
BHT	
4-*tert*-Butylcyclohexanone	
4-*tert*-Butylcyclohexanol	
Dibutyl phthalate	Hazardous Air Pollutant / EDC
Phenol	Hazardous Air Pollutant
Styrene	Hazardous Air Pollutant/ Ant. Carcinogen*
1-Tetradecanol	
Tripropylene glycol diacrylate	
1-Dodecanol	

Additional literature indicates that the emission of other HAPs, carcinogens, EDCs, and compounds may occur



Chemical emissions can be high and transient

Function of location, wind direction, worksite activity

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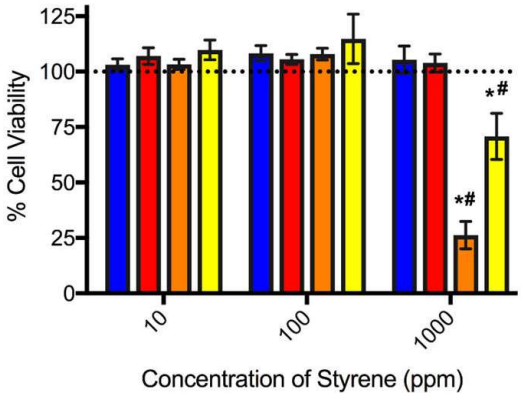

1,000+ ppm has been reported at a CIPP site

Mouse lung cell experiments indicated that toxicity occurred and future health impact investigations are necessary

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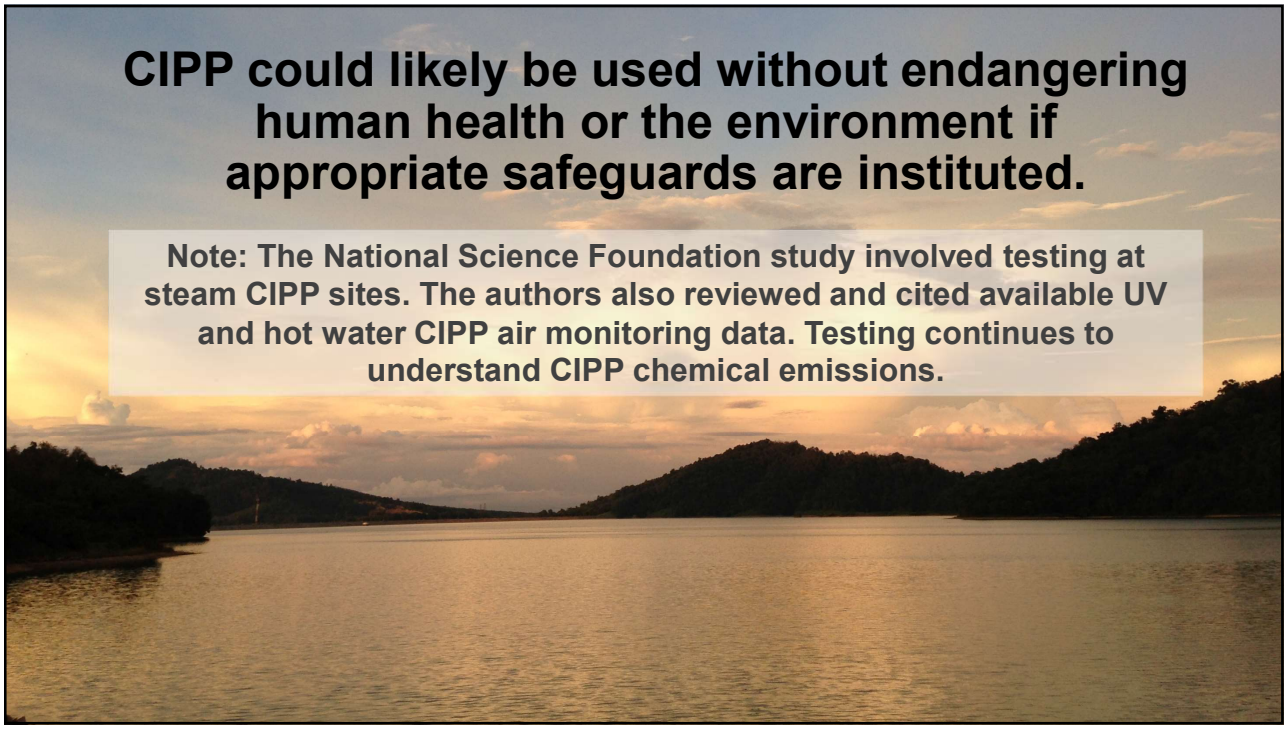
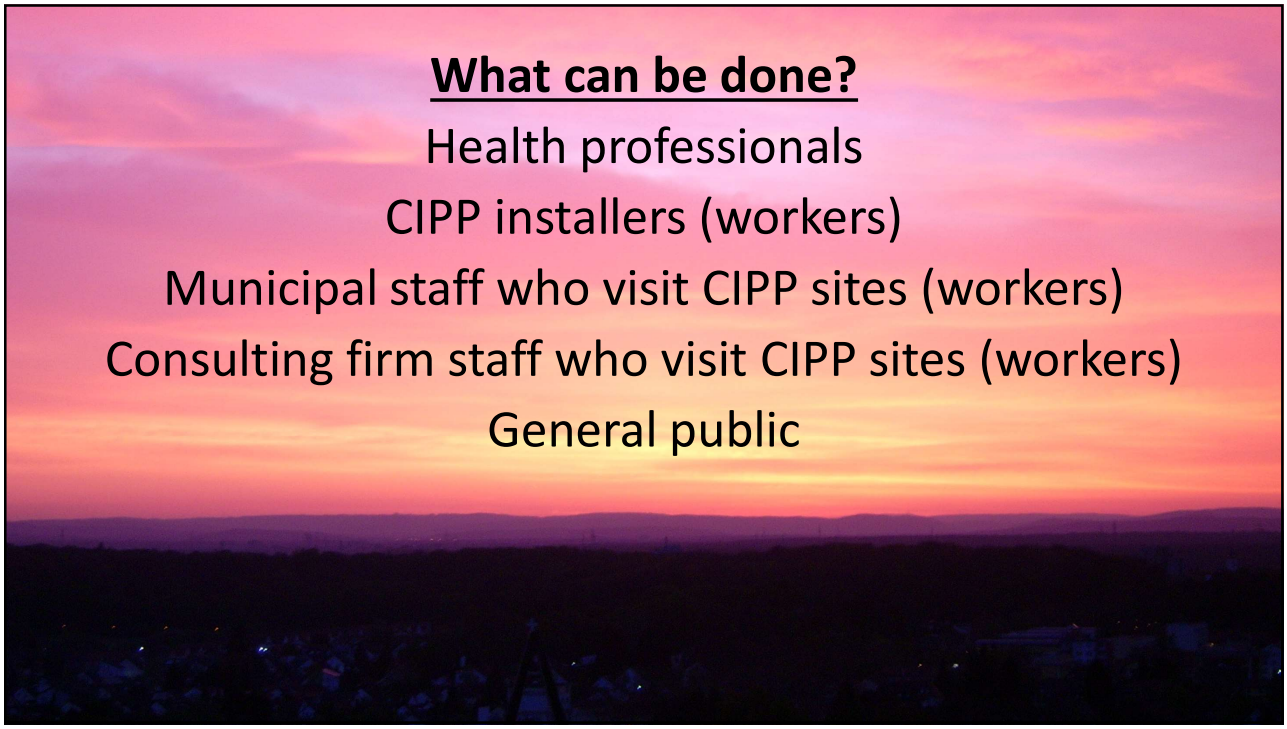
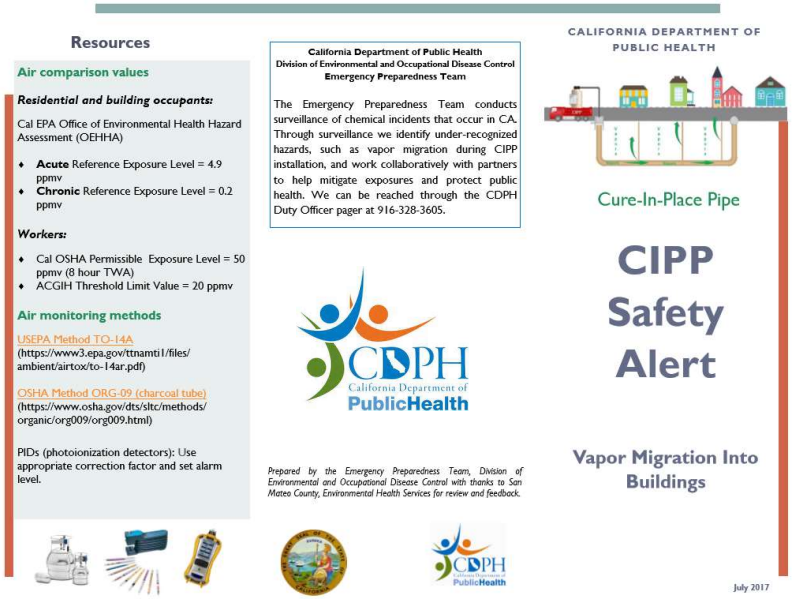

CIPP could likely be used without endangering human health or the environment if appropriate safeguards are instituted.
Note: The National Science Foundation study involved testing at steam CIPP sites. The authors also reviewed and cited available UV and hot water CIPP air monitoring data. Testing continues to understand CIPP chemical emissions.


What can be done?
Health professionals
CIPP installers (workers)
Municipal staff who visit CIPP sites (workers)
Consulting firm staff who visit CIPP sites (workers)
General public

July 2017 California Safety Alert

Health professionals should learn about CIPP technology, emissions, and how to investigate and respond to incidents



Resources

Air comparison values

Residential and building occupants:

Cal EPA Office of Environmental Health Hazard Assessment (OEHHA)

- **Acute** Reference Exposure Level = 4.9 ppmv
- **Chronic** Reference Exposure Level = 0.2 ppmv

Workers:

- Cal OSHA Permissible Exposure Level = 50 ppmv (8 hour TWA)
- ACGIH Threshold Limit Value = 20 ppmv

Air monitoring methods

USEPA Method TO-14A (https://www3.epa.gov/ttnamti1/files/ambient/airtox/to-14ar.pdf)

OSHA Method ORG-09 (charcoal tube) (https://www.osha.gov/dts/sltc/methods/organic/org009/org009.html)

PIDs (photoionization detectors): Use appropriate correction factor and set alarm level.

California Department of Public Health
Division of Environmental and Occupational Disease Control
Emergency Preparedness Team

The Emergency Preparedness Team conducts surveillance of chemical incidents that occur in CA. Through surveillance we identify under-recognized hazards, such as vapor migration during CIPP installation, and work collaboratively with partners to help mitigate exposures and protect public health. We can be reached through the CDPH Duty Officer pager at 916-328-3605.

CDPH California Department of PublicHealth

Prepared by the Emergency Preparedness Team, Division of Environmental and Occupational Disease Control with thanks to San Mateo County, Environmental Health Services for review and feedback.

CALIFORNIA DEPARTMENT OF PUBLIC HEALTH

Cure-In-Place Pipe

CIPP Safety Alert

Vapor Migration Into Buildings

July 2017

https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/CDPH%20Document%20Library/CIPP%20Alert%20final.pdf

A September 2017 Document was Also Posted "Additional Considerations"

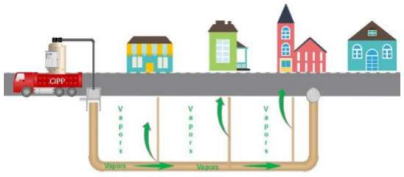
Cure-In-Place Pipe (CIPP)
Additional Considerations for Municipalities

CDPH California Department of PublicHealth

Background

CDPH Alert

The CDPH Cure-In-Place Pipe (CIPP) Safety Alert, issued in July 2017, is not a comprehensive engineering guide for controlling chemical releases; rather, its purpose is to raise awareness and provide some steps that should be considered by municipalities permitting CIPP projects in their jurisdiction.



Concerns

Studies of chemical releases during the installation and curing of CIPP are limited and protocols for controlling exposures have not been developed. Safety Data Sheets (SDS) do not describe all of the compounds present in the raw materials or emitted into the air during CIPP installation.

https://www.cdph.ca.gov/Programs/CCDPHP/DEODC/CDPH%20Document%20Library/CIPP%20additional%20considerations.pdf

Workers should Request Help from NIOSH

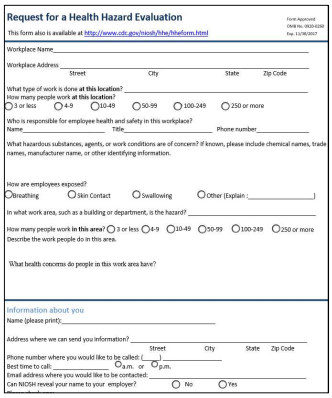
National Institute of Occupational Safety and Health

Employees, union officials, and employers can request a free Health Hazard Evaluation from NIOSH

NIOSH evaluations are done at no cost to the employees, union official, or employers

Health Hazard Evaluations help workers learn what health hazards are present at their workplace and recommends ways to reduce hazards and prevent work-related illness.

Requests can be made in writing or online
https://www.cdc.gov/niosh/hhe/hheform.html


Request for a Health Hazard Evaluation

This form also is available at http://www.cdc.gov/niosh/hhe/hheform.html

Workplace Name

Workplace Address

Street City State Zip Code

What type of work is done at this location?

How many people work at this location?

3 or less 4-9 10-49 50-99 100-249 250 or more

Who is responsible for employee health and safety in this workplace?

Name Title Phone number

What hazardous substances, agents, or work conditions are of concern? If known, please include chemical names, trade names, manufacturer name, or other identifying information.

How are employees exposed?

Breathing Skin Contact Swallowing Other (Explain:)

In what work area, such as a building or department, is the hazard?

How many people work in this area? 3 or less 4-9 10-49 50-99 100-249 250 or more

Describe the work people do in this area.

What health concerns do people in this work area have?

Information about you

Name (please print):

Address where we can send you information?

Street City State Zip Code

Phone number where you would like to be called: ( )

Best time to call: a.m. or p.m.

Email address where you would like to be contacted:

Can NIOSH reveal your name to your employer? No Yes

Workers should Learn More


CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

SEARCH

https://blogs.cdc.gov/niosh-science-blog/2017/09/26/cipp/

CDC A-Z INDEX

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Cured-in-Place-Pipe (CIPP): Inhalation and Dermal Exposure Risks Associated with Sanitary Sewer, Storm Sewer, and Drinking Water Pipe Repairs

Posted on September 26, 2017 by Andrew J. Whelton, PhD; Jonathan Shannahan, PhD; Brandon E. Boor, PhD; John A. Howarter, PhD; Jeffrey P. Youngblood, PhD; and Chad T. Jafvert, PhD.

Watch a NEHA webinar about CIPP Safety and how NIOSH can help


EH Topics | Professional Development | News & Events | Publications | Membership & Communities | About NEHA

NATIONAL ENVIRONMENTAL HEALTH ASSOCIATION

http://neha.org/node/59303

Cured in Place Piping (CIPP)

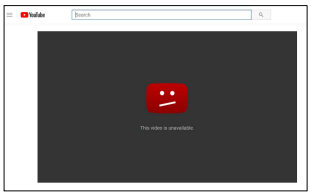
What is a Cured in Place Pipe?

Cured-in-place pipe (CIPP) pipe lining is one of several methods used to repair existing pipelines that don't require that you dig up the pipes. CIPP is a jointless, seamless, pipe-within-a-pipe with the capability to repair pipes ranging in diameter from 4–110 inches. Lining the pipes is less expensive and more efficient than traditional open cut replacement methods, normally installed with little or no digging. The CIPP process involves installing a resin-saturated felt tube that later hardens into a strong "pipe-within-a-pipe."

The use of CIPP for water and sewer line repair and replacement is widespread across the US. There is a possibility of residual chemical release during the process. Most of the studies to date have focused on the environmental impacts of styrene, a major ingredient in the curing process. However, vapors and their effects on indoor air quality are important considerations for utility workers and residents. Many residents notice a smell like that of new plastic during the pipe repair process. This odor may be caused by ingredient used to make the CIPPs or compounds created during the in-situ manufacturing process. One chemical that has received scrutiny is styrene, but other chemicals are also emitted.

Engineers who select, use, and oversee CIPP installations, have a professional and ethical duty to "hold paramount the safety, health and welfare of the public" and make only "truthful and objective statements"

1. Remove claims that emissions are "harmless", "do not be alarmed", purported maximum styrene levels
2. Require chemical emission capture, confirmatory testing, in addition to real-time monitoring
3. Notify current and former employees and stakeholders that short- and long-term health effects of CIPP related exposures are currently unknown

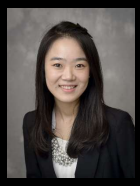


Some Engineers have already begun to remove videos that made incorrect CIPP claims. Others are upgrading their specifications to require emission capture and testing. But some do not know about or did not understand the new CIPP Safety study. Others repeat incorrect assertions.

Where we are today - CIPP

- ❑ Water pipes still need to be repaired
- ❑ CIPP technology use has caused harm and impacted the environment, we are uncertain about the frequency, scale, and extent of impacts
- ❑ Workers and the public are not appropriately informed about what the emissions are and consequences of exposure
- ❑ Emissions, public and occupational health risks should be investigated
- ❑ California Dept. Public Health (2017): "*Utilities, engineering firms, and contractors should not tell residents the [CIPP] exposures are safe*"
- ❑ Emissions should not be permitted to exit the pipe
- ❑ NIOSH has received 1 Health Hazard Evaluation request for CIPP so far

Andrew Whelton, Civil/Environmental Eng.



Kyungyeon Ra Environmental Eng.

John Howarter, Materials Eng.

Md Nurrudin Materials Eng.

Brandon Boor, Air Quality Eng.

Chad Jafvert, Civil/Environmental Eng.

Nadya Zyaykina, Civil/ Environmental Eng.

Mabi Teimouri Civil Eng.

Jonathan Shannahan, Toxicology

Lisa Kobos Health Sciences

Emily Conkling Environmental Eng.

Jeffrey Youngblood, Materials Engineering

+ *26 other people at Purdue University worked on the CIPP study*

The safety of our friends, families, colleagues, and community is important. Let's make certain we do everything we can to protect them from harm.

Daily Herald

Gurnee man killed in Streamwood sewer a rugby athlete called 'String Bean'

October 30, 2016
Reporters: Jake Griffin, Eric Petersen
Photo: John Starks, Daily Herald

Our Stormwater Culvert Repair Technology Study is Investigating Cured-in-Place-Pipe (CIPP) Water Impacts and Material Longevity

Contaminant Release from Storm Water Culvert Rehabilitation Technologies: Environmental & Long-Term Material Integrity Impacts, 2016-2019

(1) Determine the problem scope across departments of transportation (DOTs) (i.e., the extent of use of these technologies and the scale of their impacts to water quality);
(2) Identify the effectiveness of existing construction specifications at minimizing contaminant release from rehabilitated culverts
(3) Determine the degree structural integrity and longevity of rehabilitated culverts are compromised by chemical leaching.

Right Sizing Tomorrow's Water Systems for Efficiency, Sustainability and Public Health, 2016-2019

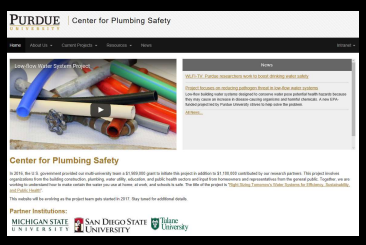
Funded 2016: EPA + Industry

MICHIGAN STATE UNIVERSITY · PURDUE UNIVERSITY · SJSU SAN JOSÉ STATE UNIVERSITY · Tulane University

OUR PROJECT GOAL: To better understand and predict building drinking water quality and health risks posed by declining water usage and low flows.

- ✓ Educational Institutions
- ✓ Architecture and Building Design Firms
- ✓ Water Utilities
- ✓ Construction, Water, Health, and Environmental Associations and Networks
- ✓ Technology Companies
- ✓ Government Agencies

VISIT US ONLINE
www.PlumbingSafety.org



Thank You

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Purdue University Lyles School of Civil Engineering

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