

Repairing Damaged Sewers with Cured-in-Place-Pipe (CIPP) Sewer Lining



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Cured-in-Place Pipe Safety Study

In 2016, Purdue researchers began investigating chemical emissions and exposures caused by cured-in-place-pipe (CIPP) water pipe repair sites. CIPP is the most popular water pipe repair technologies used in the U.S. Because this technology uses raw chemicals in the field and manufacturers a new plastic pipe inside an existing damaged water pipe, chemicals can be emitted into the environment and enter nearby buildings. CIPP is used for sanitary sewer, storm sewer, and drinking water pipe repairs.

Questions? Contact us at CIPPSafety@purdue.edu

- Download free:
- New emergency responder & health official study
 - 6 State Lining Report & Recommendations
 - FL DOH Factsheet
 - NIOSH 2019 report
 - NEHA 2017 webinar
 - CDPH 2017 Safety Alerts
 - ATSDR 2005 Report
 - Scientific studies
 - FAQs
 - Videos
 - And more...

CIPP projects, practices, and chemicals

Sanitary sewer, storm sewer, drinking
water pipes (4 inch to >8 feet diam.)

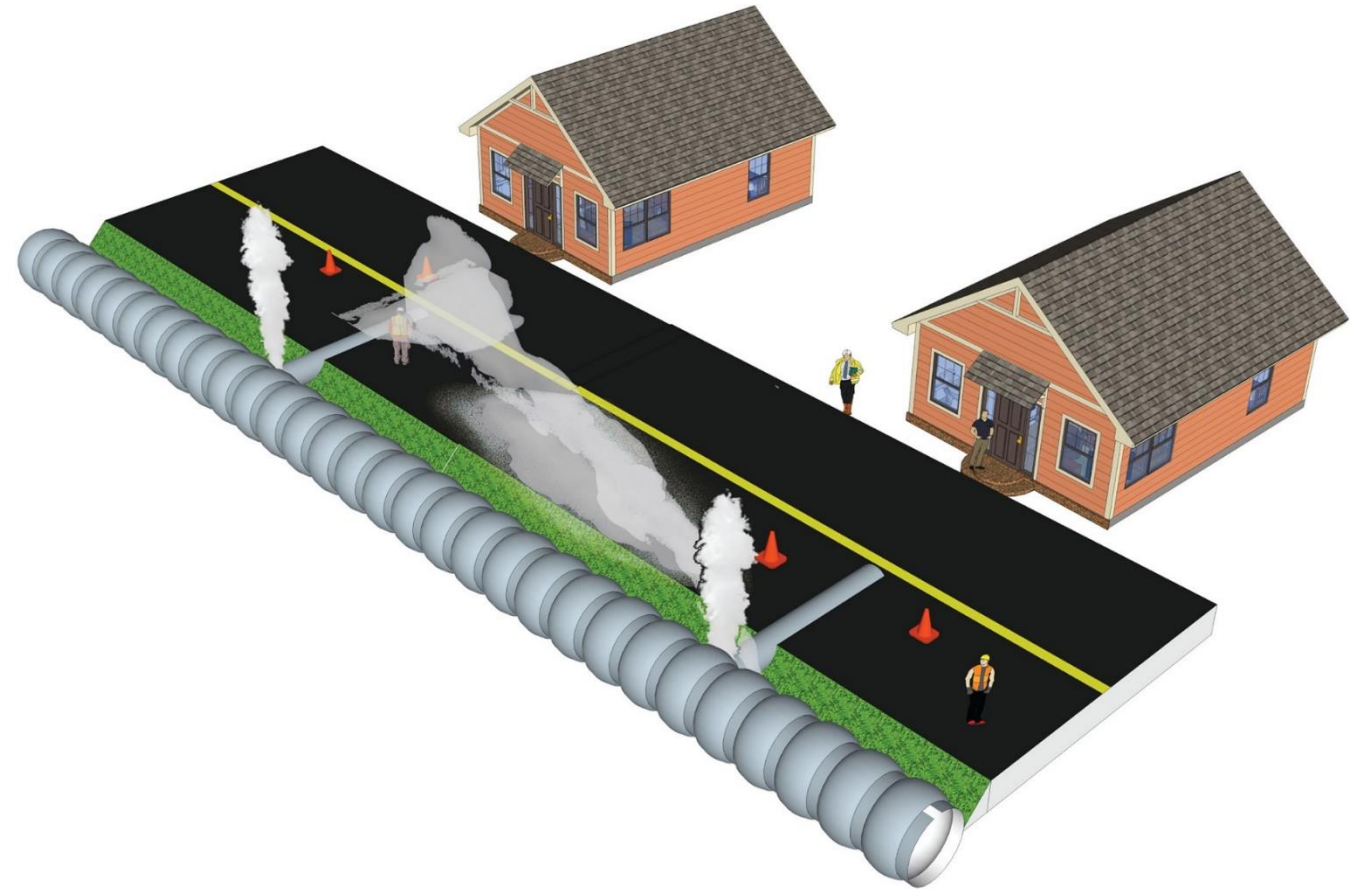
Can be 60-80% less expensive than
other pipe repair options

Pipes can be repaired in 1-3 hours
instead of days or weeks

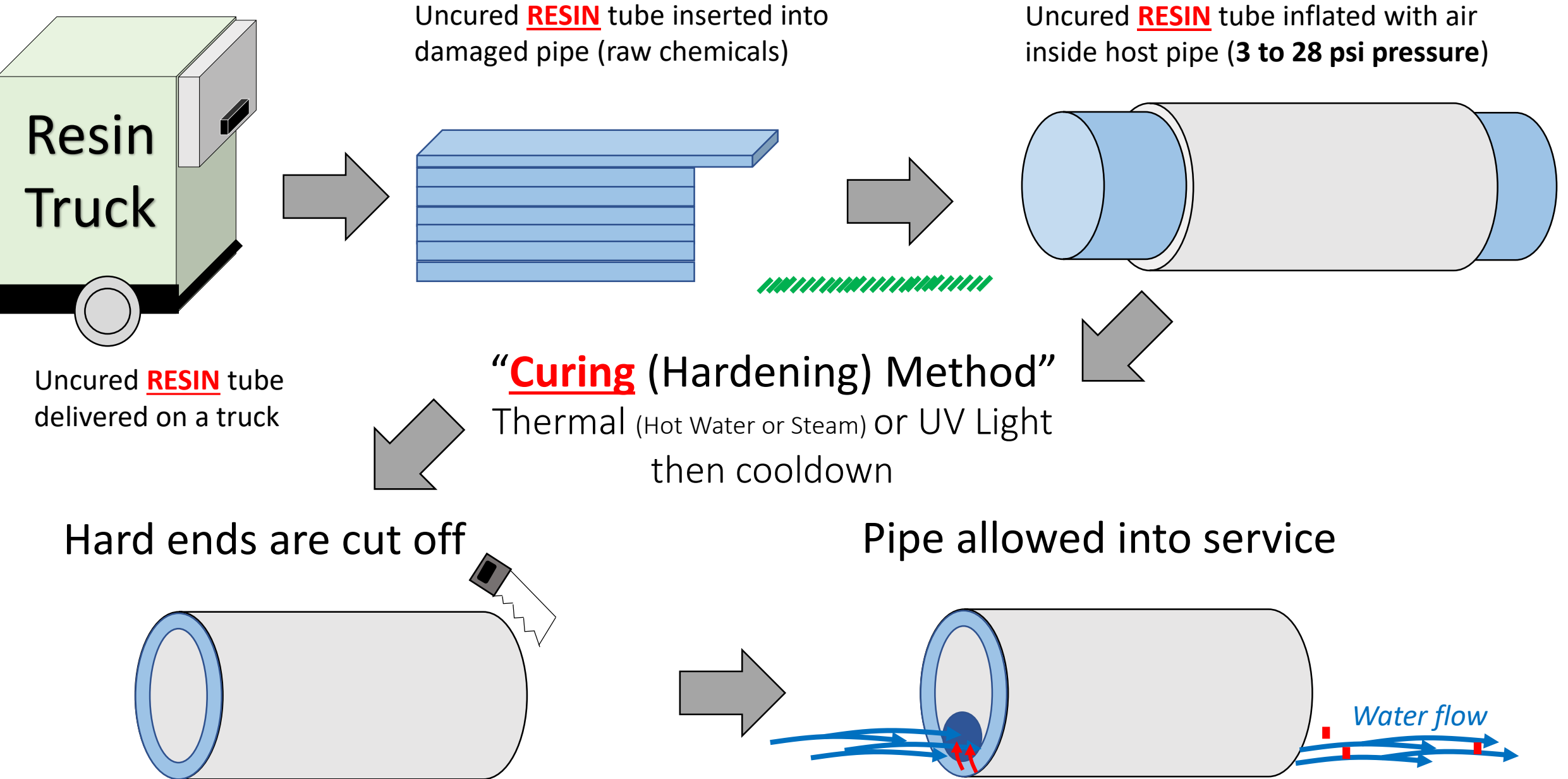
Curing Popularity: Steam >> hot water > UV light

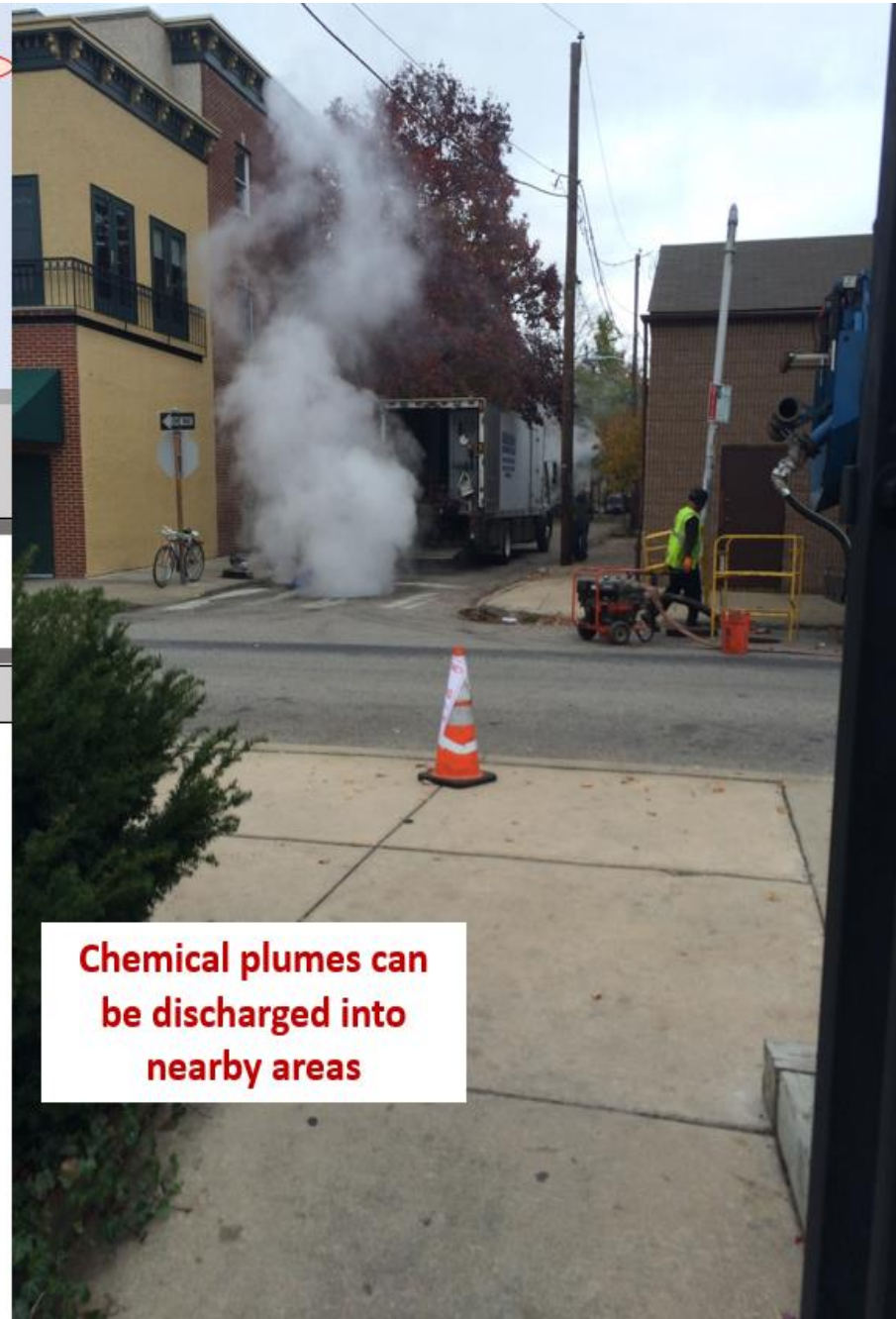
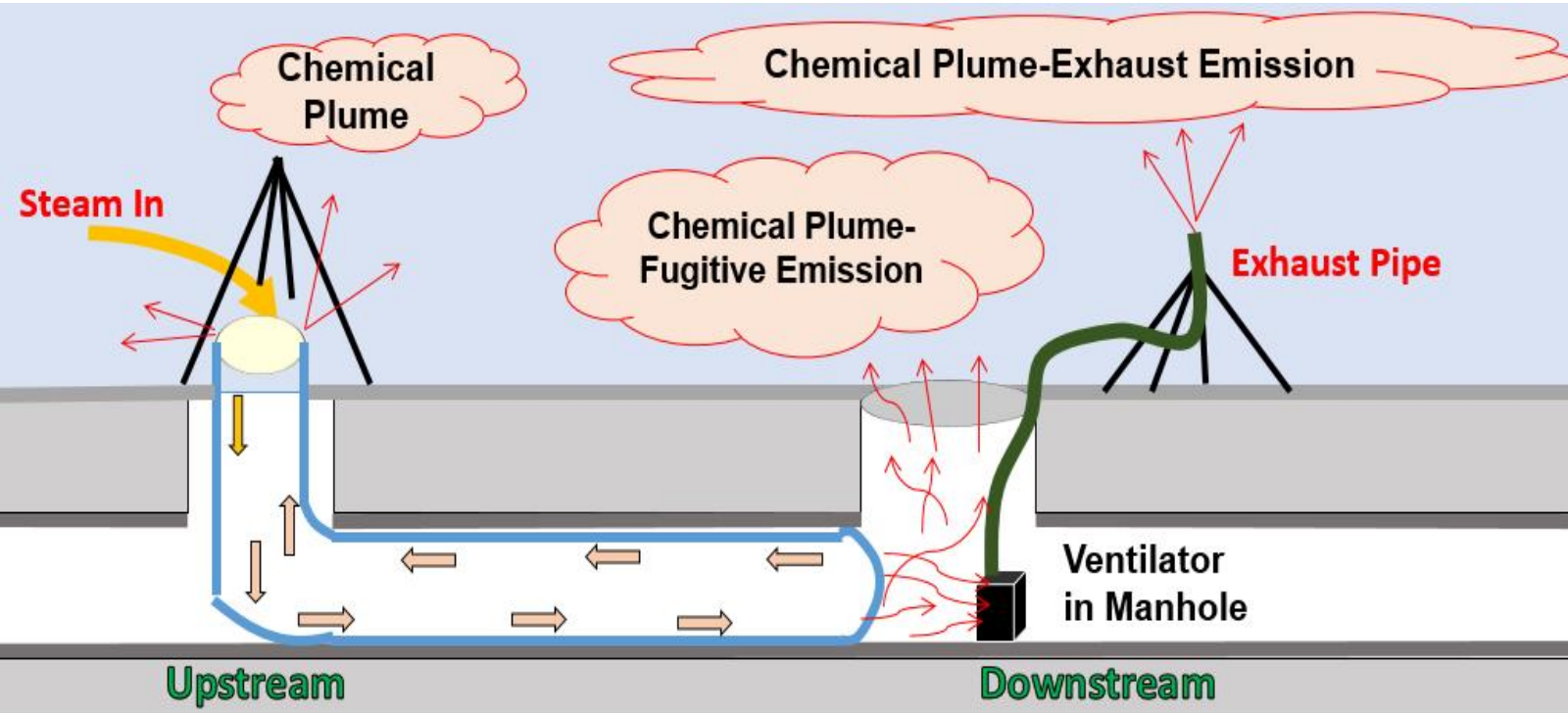
CIPP Resins Popularity: Unsaturated polyester > vinyl ester >> epoxy

Styrene Popularity: Styrene >>>> Nonstyrene Resin Types



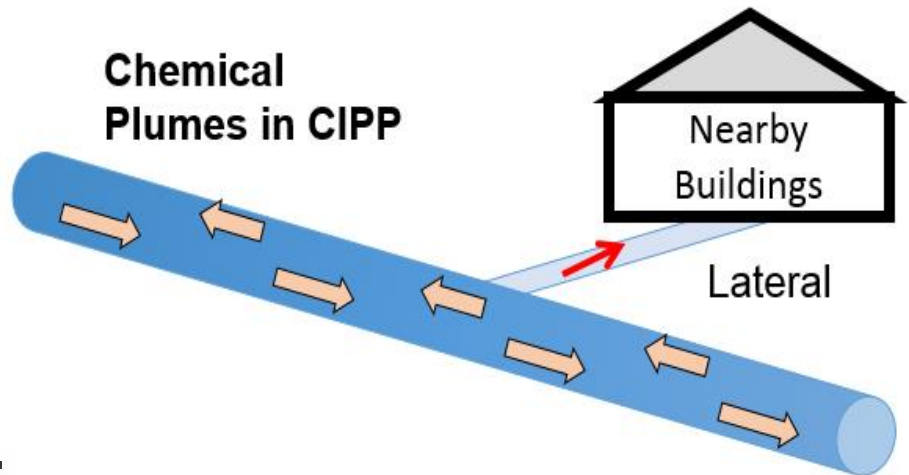
Popup worksites that manufacture a plastic pipe (or liner)





Chemical plumes can be discharged into nearby areas

Chemical Plumes Generated by CIPP can Escape the Pipe Being Repaired

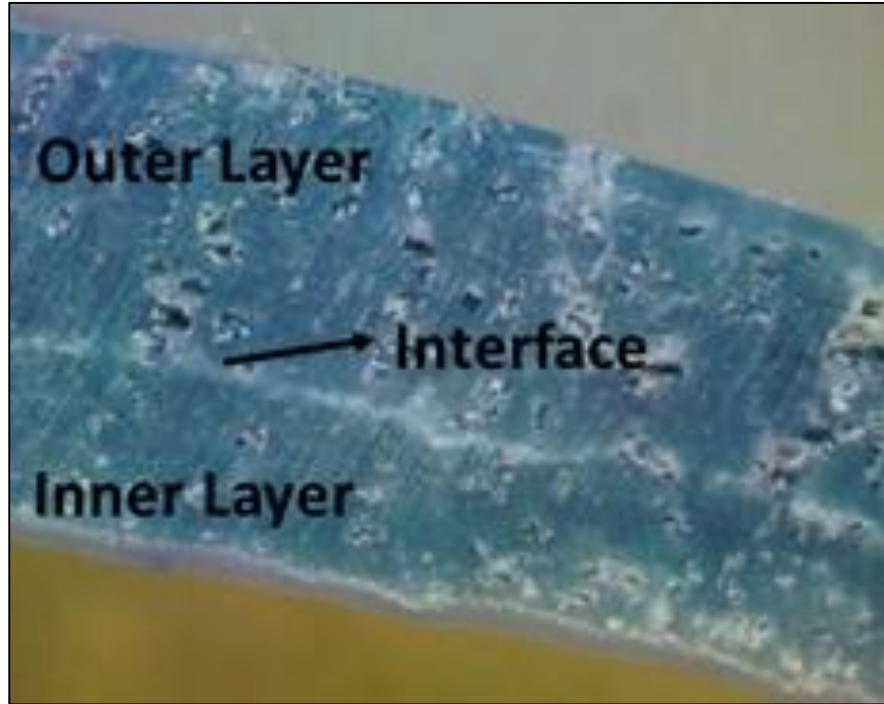


Reinstate lateral connections by robot cutting

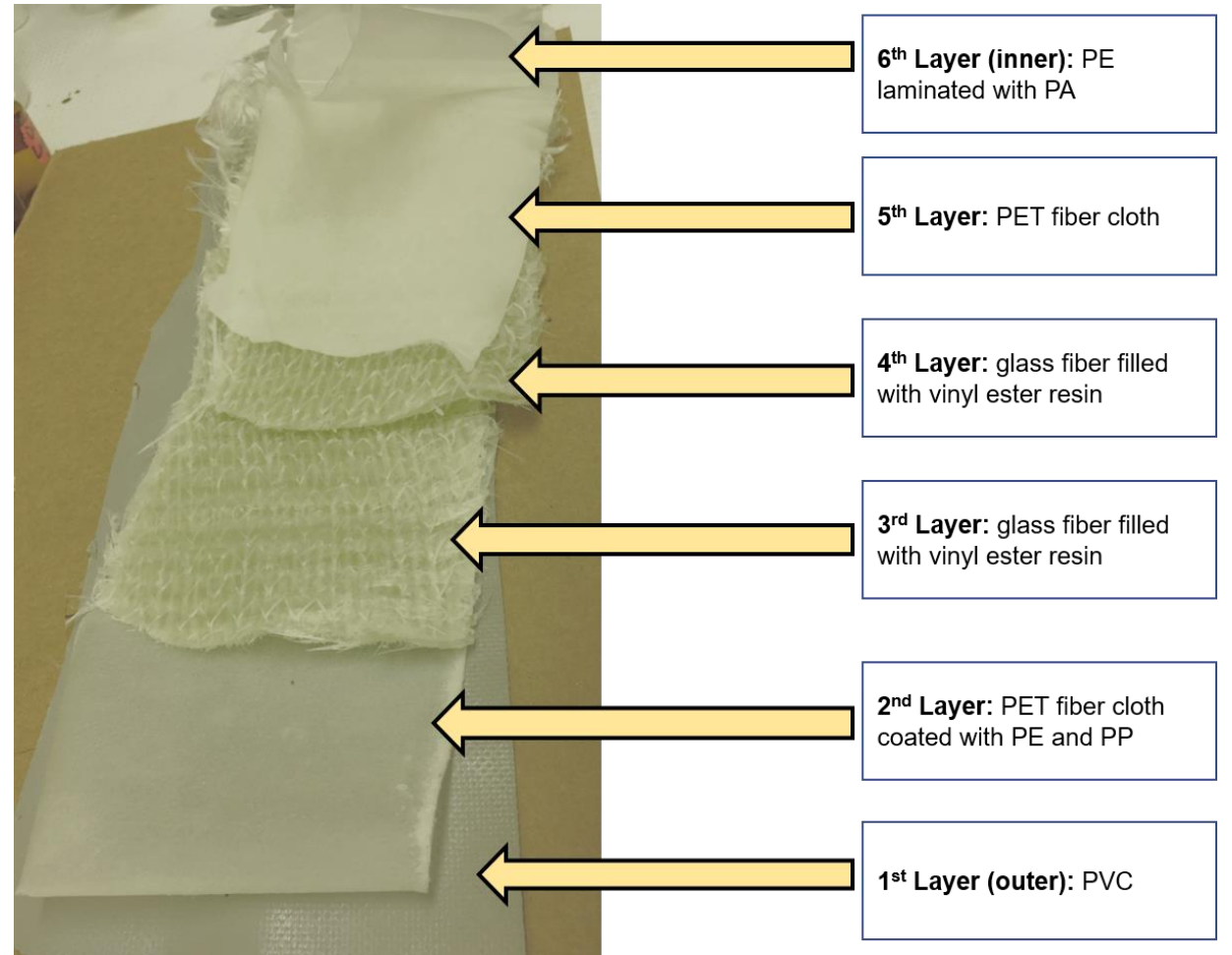


Sewer laterals that connect to the pipe being repaired are not sealed off from the property. The uncured resin tube can bulge into the sewer lateral.

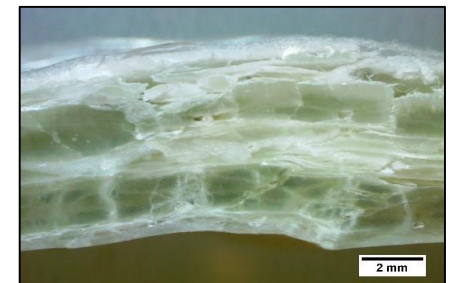
Uncured resin slugs in laterals that off gas: CIPP companies add 3-15% excess resin by volume per ASTM F1743 “to allow for the change in resin volume due to polymerization, the change in resin volume due to thermal expansion or contraction, and resin migration through the perforations of the fabric tube and out onto the host pipe.”



Cross-section of new thermally cured CIPP with PET felt layers



Cross-section of new UV cured CIPP with fiberglass layers

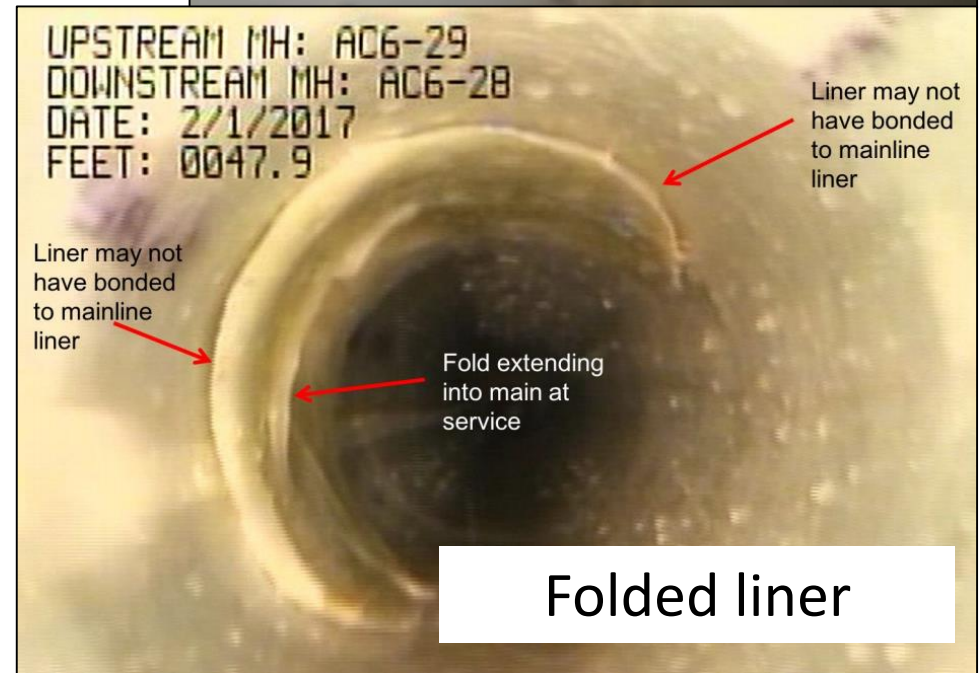


1. Pinholes (direct pathways to outside)
2. Blisters (curing too hot, creates pinholes)
3. Ripped liner
4. Bad lateral cutouts
5. Folder liner

**A Vendor Claim:
>70% of CIPPs
have defects**



Bad lateral cutout



Folded liner

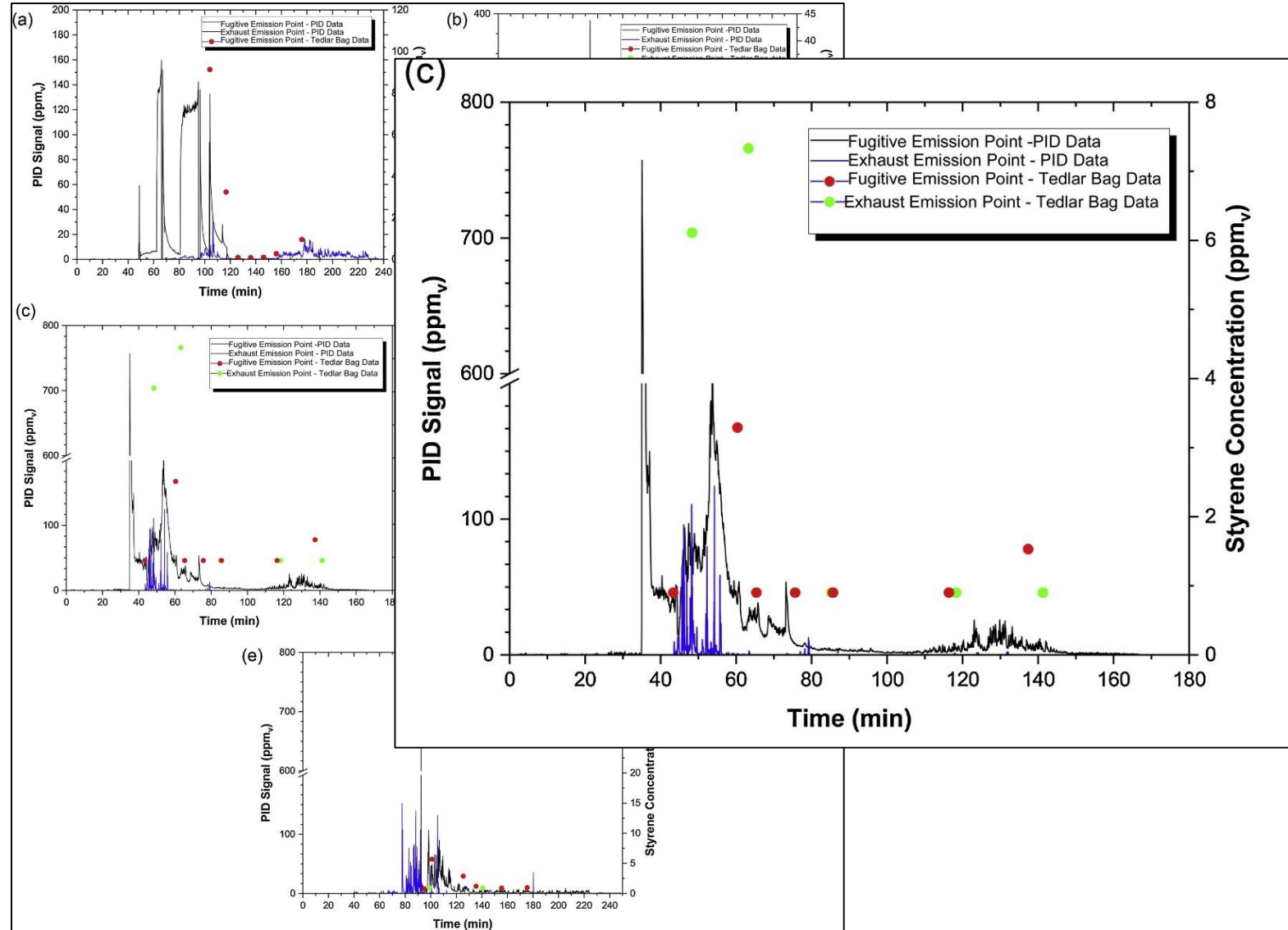
Material safety data sheets do not list all the chemicals that...

- ...are present in the resin brought onsite,
- ...are created during CIPP manufacture,
- ...are released into air during CIPP manufacture,
- ...remain in the new CIPP after manufacture, or
- ...can be released into the air and water after CIPP manufacture.

Methylene chloride Benzene Benzaldehyde Toluene

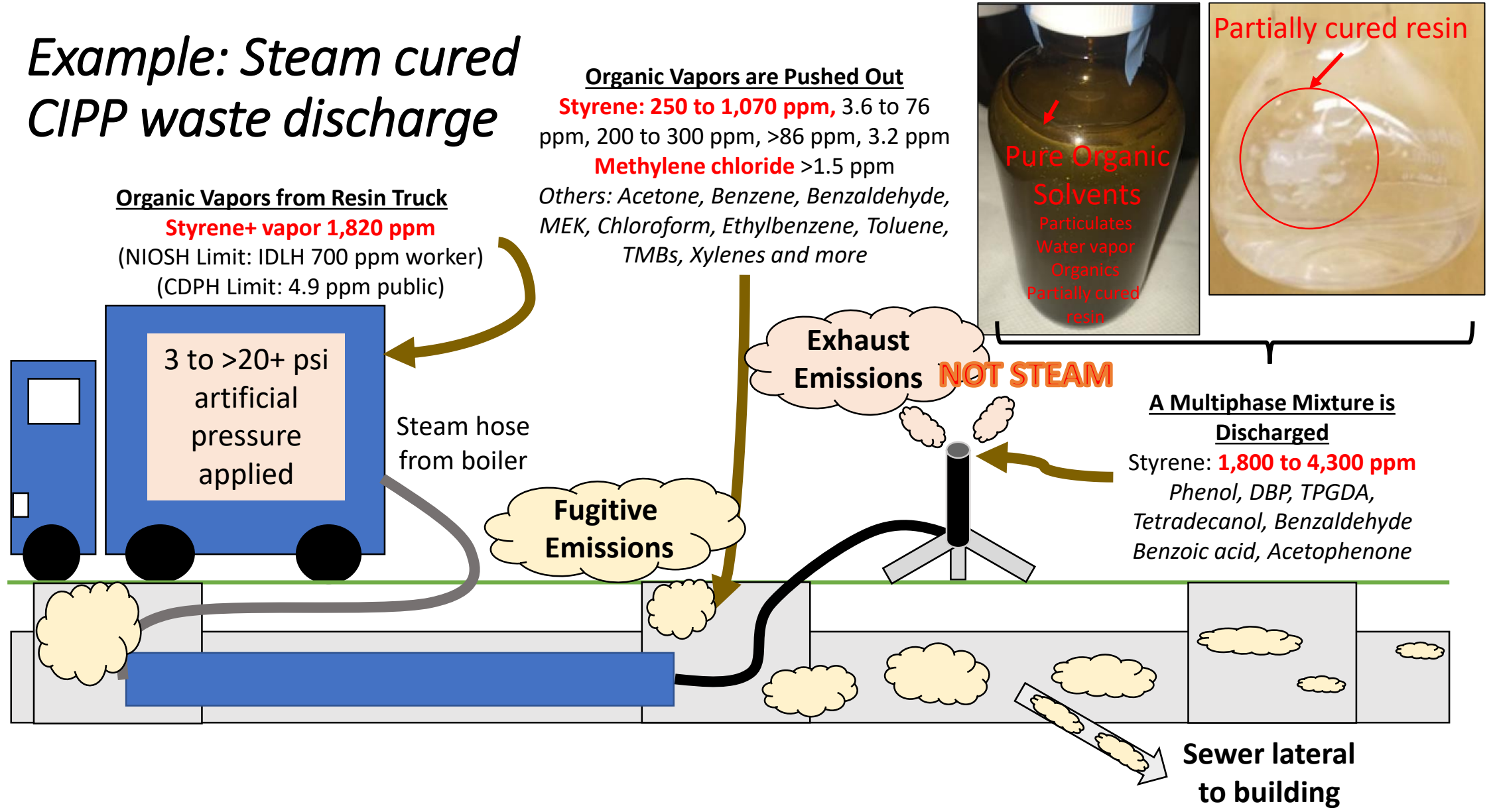
Phenol Acetone Phthalates Phthalates and more...

Calibrated PIDs at CIPP worksites **do not** predict health risk. PID under and overestimated styrene levels by 10x to 1000x



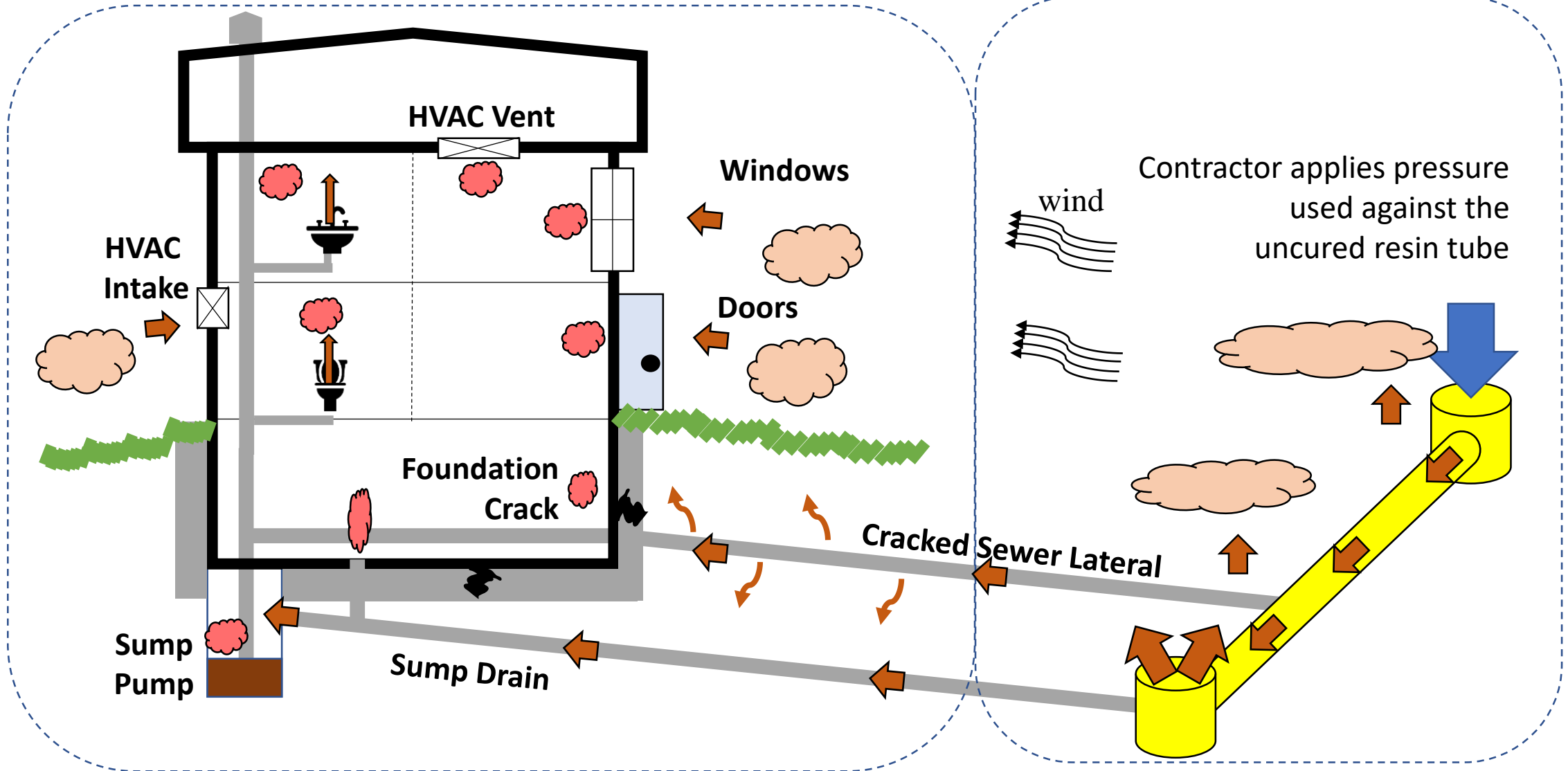
Concentrations differ by activity: Setup vs. Curing vs. Cooldown vs. Mechanical cutting

Example: Steam cured CIPP waste discharge

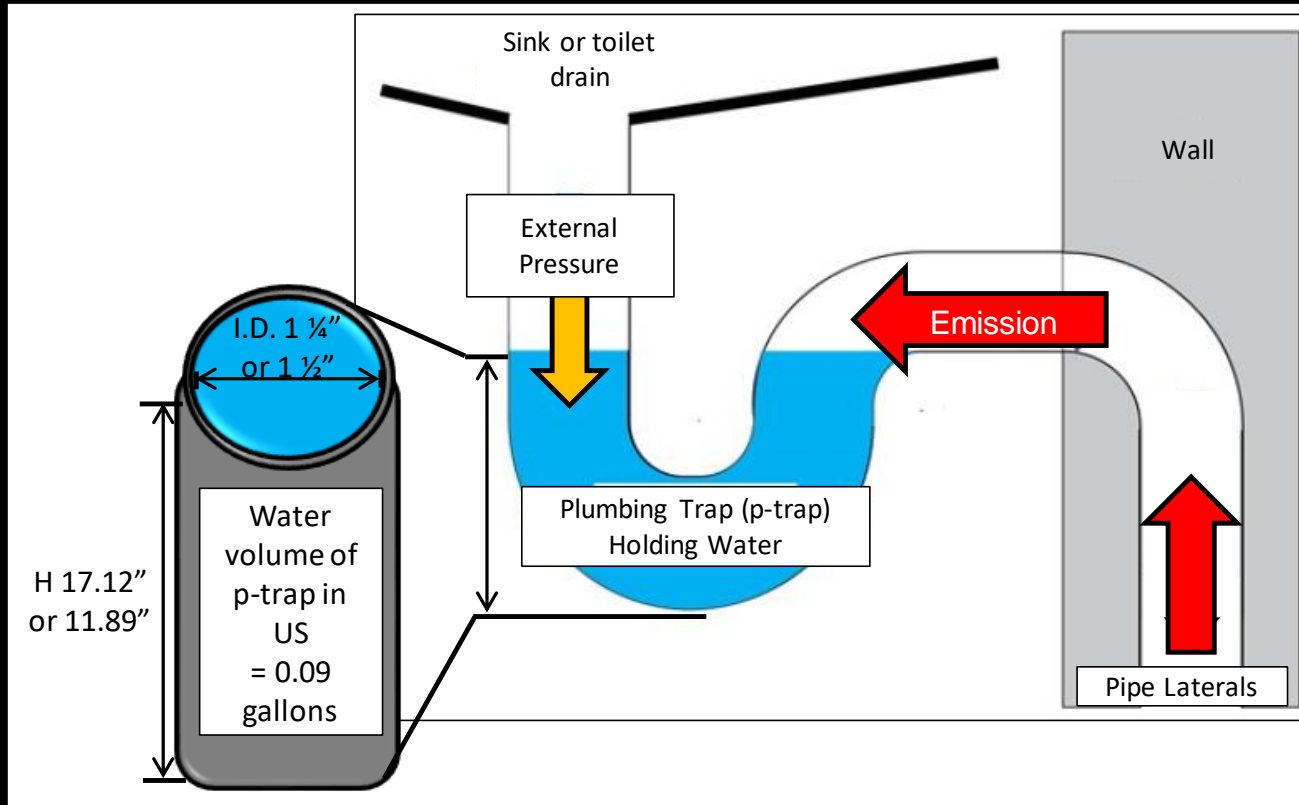


Private Property (not for contractors)

Utility/City Property (Worksite only for contractors)



Pouring water in drains does not prevent exposure during CIPP manufacture



Less than 1 psi pressure
can cause water blowback in an
average plumbing trap (p-trap)

CIPP contractors use
3 to >20 psi pressure at street

Contractors also may say:

- 1) Put a towel in the drains
- 2) Wrap toilet with towel
- 3) Wrap toilet with saran wrap

This implies their chemical waste *will* leave
their worksite and enter private property

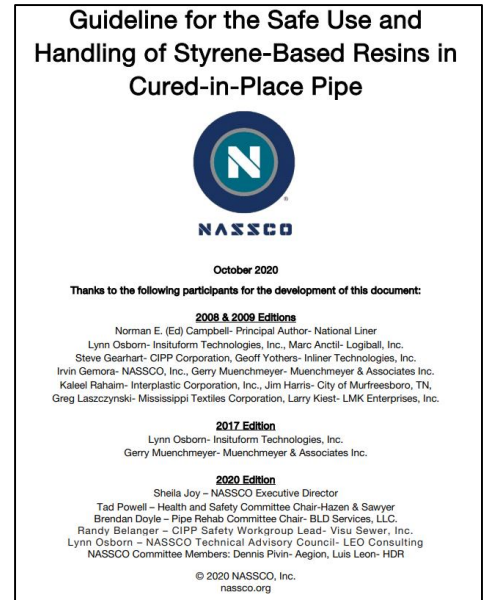
Serious: Contractors claim exposure is like strawberries and do not report to medical professionals.

CIPP companies and engineering consultants encourage CIPP companies to discharge the untreated waste into the air by “...maximizing the flow of air through the curing CIPP...”

Waste types

No water used - UV curing - Waste: Organic vapors, particulates

Water used - Thermal curing waste - Waste: Resin, particulates, organic vapors, water vapor saturated with pollutants



Heat curing resin released 8.87 wt% (as VOCs) into the air.

- Our review showed 67 to 500 tons of CIPP resin can be used per pipe repair
- So, an estimated 6 to 33 tons of VOC is discharged into the air per project
- **CIPP companies are discharging HAP/EDC/CAR air pollution at scales in violation of CAA/NESHAP regulation.**
- **Environmental Assessments under NEPA should (but do not) consider this air pollution.**

New CIPPs release VOCs into the air after being placed into service

“Styrene” isn’t the only chemical of concern. Methylene chloride, acetone, phenol, phthalates, microplastics?, and more

Science and Technology

- ✓ Determined waste discharged from steam CIPP sites was not steam
- ✓ Determined acute exposure causes lung cell damage *in vivo* and worker safety at risk
- ✓ Established handheld PIDs (contractors use) did not reliably describe CIPP caused hazardous atmospheres
- ✓ Developed and tested a CIPP waste sampling, capture and treatment system
- ✓ Created CIPP construction contract specification language for improving project safety
- ✓ Estimated the magnitude of Clean Air Act regulated VOC discharge at CIPP worksites
- ✓ Estimated indoor air contamination caused by the CIPP practice

Service and Translating S&T to Practice

- ✓ Helped 30+ CIPP companies understand their worker safety issues
- ✓ Helped NIOSH better understand CIPP at the beginning of their outreach to CIPP workers
- ✓ Helped OSHA better understand CIPP hazards during their worker fatality investigation
- ✓ Helped California and Florida Departments of Health with factsheets
- ✓ Helped PA law enforcement understand CIPP during criminal inquiry in response CIPP company action
- ✓ Created an online education page for CIPP practices at www.CIPPSafety.org
- ✓ Advised health depts. about testing / decon approaches for CIPP caused building contamination
- ✓ Advised emergency room professionals who called for advice after treating bystanders
- ✓ Helped bystanders who have been exposed find local public health advocates
- ✓ Connected injured and concerned CIPP workers with NIOSH

Some Additional Actions In Progress

- With University of Kentucky and Ohio State University, convened CIPP Public Health Workgroup with local, state, federal agencies
- Identifying CIPP manufacturing procedures and formulations to reduce emissions
- Further determining the chemical complexity and toxicity of waste discharged
- Evaluating acute CIPP emission mixture exposures *in vitro*

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Communities need your help. Questions?

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Learn more at www.CIPPSafety.org

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