

## General Questions

### Why was the study conducted?

The study published in *Environmental Science and Technology Letters* was conducted to determine what materials can be released into the air by the cured-in-place-pipe (CIPP) process used to repair sanitary sewer and storm sewer pipes and assess the toxicity of the emitted materials.

### Where can I obtain the files for this study?

Go to the *Environmental Science and Technology Letters* website [<http://pubs.acs.org/journal/estlcu>] and download the following three groups of files:

1. A PDF "Manuscript" file,
2. A PDF "Supporting Information" file that contains a list of CIPP air incidents and other materials,
3. Five (5) videos in .AVI format (est. 100 MB total)

### What is CIPP?

Today, the cured-in-place-pipe or CIPP process is used to repair about 50% of all water pipes in the U.S. It is used for repairing sanitary sewer, storm sewer, and drinking water pipes. The CIPP process is also used to repair pipes outside the U.S.

The CIPP process involves chemically manufacturing a new plastic pipe inside an existing damaged pipe. If the damaged pipe is not repaired, it may fail and will ultimately need to be replaced. An advantage of the CIPP technology is that a new plastic pipe is created without the need for digging up the damaged pipe. CIPP repairs can be less expensive compared to other alternatives. The CIPP process was invented in the 1970s.

### Who funded this study?

This project was primarily funded by the National Science Foundation RAPID response grant program: [https://www.nsf.gov/awardsearch/showAward?AWD\\_ID=1624183](https://www.nsf.gov/awardsearch/showAward?AWD_ID=1624183). The National Science Foundation supports basic research that helps transform the future. Funds were also provided by public donations sought through crowdfunding. Purdue University also provided financial support.

### Who was involved?

The study was carried-out by Purdue University professors, graduate and undergraduate students. Team members included civil, environmental, and materials engineers, and pulmonary toxicologists. The team received assistance from Purdue University industrial hygienists and engineering staff. Air monitoring was conducted in Sacramento, California and on Purdue University's campus.

### Have there been incidents where chemicals released by CIPP installation processes have caused health impacts?

There is evidence that CIPP construction activities have exposed workers and members of the public to chemicals. The Purdue researchers found 49 building and ambient air chemical contamination incidents reported in the media and literature. This incident list can be found in the "Supporting Information" PDF file of the newly published study. Building evacuations, reports of illness, fire department responses have been documented.

The purpose of the newly released study was not to determine the short- or long-term human health impacts caused by CIPP chemical exposure. The study's purpose was to determine what materials were released into the air by CIPP installation process and provide a basic and preliminary assessment of the acute toxicity induced by the emitted materials using mouse lung cell lines.

## Did you ask workers if they had experienced health impacts?

No, the Purdue team did not discuss health impacts with any CIPP workers. The new study was solely focused on determining what materials can be released into the air by the CIPP processes. Additionally, a basic cellular toxicity assay was performed by the Purdue team to begin screening for possible differences in toxicity of the emitted materials based on different CIPP sites tested. Based on the new study, the Purdue team strongly recommends that an independent worker health study be conducted. Interviewing CIPP workers was not the focus on the newly published study. More future controlled laboratory studies are needed to investigate the potential health hazards associated with exposures to CIPP emissions to possibly inform and establish new safety and operational guidelines.

## How do I donate to help the Purdue team continue their CIPP research?

Thank you for visiting this page. This new study would not have been possible without support from many individuals, including concerned citizens, some of whom contacted us asking for help after believing they were exposed to CIPP chemicals. Please go to <http://Giving.Purdue.edu/WaterPipeSafety> and consider donating whatever amount you believe this new study provides to you and the public. Funds would be used for supporting air testing supplies, to publicly distribute results, and other activities.

## Was the study reviewed by experts in the field before publication?

Yes. Before publication, the study (or manuscript) was subjected to peer-review by the American Chemical Society's journal Environmental Science and Technology Letters. First, the manuscript was submitted to the journal for consideration. There was no guarantee that the manuscript would be published by the journal. Next, the manuscript was reviewed by three experts in the field chosen by the journal who looked at the study's originality and scientific importance of the topic, the quality of the work performed, and the appropriateness for the journal. Based on their recommendations and the consideration of the journal Editor, the manuscript was accepted for publication. Publication of this study was not guaranteed and the Purdue researchers do not know who the persons were that provided feedback. This anonymity is common and important so that the experts can provide honest feedback. Environmental Science and Technology Letters is a well-respected peer-reviewed journal (i.e., impact factor of 5.3). Questions about the peer-review process should be directed to the Environmental Science and Technology Letters journal and American Chemical Society.

---

## What Can I Do?

### CIPP Companies

Re-evaluate worksite safety practices and personal protective equipment (PPE) considering the recent discoveries. This would include workplace monitoring to fully characterize the materials emitted and materials workers have been and are exposed to. Do not permit chemicals to migrate outside the CIPP. Do not provide medical advice to persons who claim to be chemically exposed. Report all interactions with persons who complain about odors or illness to health departments immediately. If a building becomes or is suspected to have been contaminated, contact the fire department and health department. Provide residents nearby health department contact information to report problems. Direct any persons that contact you about odors or health complaints to the health department.

## Members of the Public

Find out if CIPP technology has been, is being, or planned to be used in your community. Utilities and municipal governments responsible for sanitary sewer, storm water, and drinking water pipes are the most likely organizations that would approve its use. State transportation agencies also sometimes use CIPP for stormwater culvert repairs. Contact your elected officials and ask that the health department oversee CIPP construction projects and document and track odor and illness complaints.

If you believe you are being exposed to CIPP chemicals, seek medical attention. Contact the fire department if you believe chemicals have entered your building or property where you believe the chemical exposures are taking place. Consider evacuating that area. The only way currently to determine to what chemicals and amounts you have been exposed is to sample and chemically test the air when the incident occurs. If the building is ventilated, the chemicals are often expelled and follow-up testing may indicate no chemicals. Immediate building ventilation however does not always resolve the building chemical contamination problem.

CIPP contractors and utility, municipal, and consulting engineers are often not trained in medicine, epidemiology, or industrial hygiene practices. Utility, municipal, and consulting engineers are also often not trained in plastics technology. While their concerns for your health may be valid, you should report all odor and illness complaints to health departments. You should seek medical advice from health professionals, not CIPP contractors, utility, municipal, and consulting engineers.

## Health Departments

Learn about the CIPP process, safety risks, document and investigate chemical emissions and chemical exposures caused by the construction practice. Require that utilities notify you about any odor complaints and illness reports associated with CIPP activities. Require that CIPP contractors immediately alert you to odor complaints and illness reports associated with CIPP activities. Ask that fire departments notify you about odor complaints and illness reports associated with CIPP activities. Purdue University offers training if desired. Contact [CIPPSafety@purdue.edu](mailto:CIPPSafety@purdue.edu) for additional information.

## Worker Safety Agencies

Learn about CIPP process and safety risks. Investigate chemical emissions and exposures at worksites. Consider CIPP contractors have multiple crews of varying expertise (A, B, C teams), installation conditions, materials, and installation processes (hot water, steam, and UV curing). The Purdue research team can assist in training if desired. Contact [CIPPSafety@purdue.edu](mailto:CIPPSafety@purdue.edu) for additional information.

## Municipalities, Utilities, Engineering Companies

Do not permit your employees to enter CIPP sites without appropriate personal protective equipment (PPE). Steam cured CIPP installations can emit particulates, droplets, organic and water vapors into the air. Other CIPP process also involve raw chemicals. PPE selection decisions should consider information listed on the material SDSs, but *also* the chemicals *created* during the CIPP installation. Material SDSs do not describe the chemicals that are - created- and emitted during the CIPP curing and cooling processes. Material SDSs also do not describe all the chemicals that are used in a product. Some chemicals in the raw chemicals and uncured resin tube inserted into the damaged pipe, while not listed on an SDS, can still be emitted into the air during a CIPP installation based on the Purdue team's observations.

To protect workers, the public, and environment require that CIPP companies capture the chemicals and prevent them from migrating outside the CIPP or off-site. Require air monitoring to confirm chemicals are not released. If no air testing is conducted, you cannot determine if the capture method is effective. Absence of an odor does not mean chemicals were not released. Sometimes chemicals can be present but will not have odor. Provide the health department pre-notification every time a CIPP installation is conducted. Provide residents contact information for the health department should they need to report problems. Advise the contractor tell persons who complain about odors and illnesses to contact the fire department and health department. When complaints are directed to the staff about

chemical exposure, those persons should be directed to health departments. If records are recorded, these must be provided to the utility so they are not hidden from FOIA through 3<sup>rd</sup> parties.

Purdue University offers training for utility, municipal, and consulting engineers on the design, use, and aging of plastics technologies used for water infrastructure. Contact [CIPPSafety@purdue.edu](mailto:CIPPSafety@purdue.edu) for additional information.

## Fire Departments

Consider evacuating buildings when CIPP caused chemical contamination incidents are suspected or confirmed. Direct potentially exposed persons to receive medical assistance. Notify the health department when incidents occur. Apply appropriate chemical air testing methods to document the chemical exposures.

Purdue University offers training for emergency responders and security professionals. Contact [CIPPSafety@purdue.edu](mailto:CIPPSafety@purdue.edu) for additional information.

---

## Questions about Chemicals in the Air, in Building, and Exposure

### I have been told that being exposed to the steam is safe. Is it safe?

While steam is used at some CIPP installations, the Purdue team found the white chemical plume emitted from CIPP sites was not steam. The Purdue team recommends people avoid contact with materials emitted during CIPP installation because no data was found regarding the exposure's short- and long-term health impacts. No evidence was found that indicated the exposure to materials emitted was safe.

### If chemicals enter my building because of CIPP activity, what should I do?

You should consider evacuating everyone and call the fire department and health department for assistance. The Purdue team did not find that CIPP chemical contamination incidents are safe. The most conservative approach is to evacuate the building until it is deemed safe. If upon reentry you again detect a CIPP related odor, immediately notify the fire department and health department again.

Consider seeking advice from medically trained individuals. CIPP contractors, utility, municipal, and consulting engineers are not medical experts and are not qualified to advise you about whether or not the chemical exposures you may have experienced are safe. The health department can have the authority to demand contractors stop work if they believe there is an imminent public health hazard.

### How can chemicals from the CIPP activity get into my building?

Many different ways. Hot water and steam cured CIPP processes involve pressure and sometimes this pressure causes chemicals to escape the worksite and enter nearby building sewer laterals. These laterals connect to buildings and chemicals then can enter the building through wet and dry drains. Just because your drain has water in it does not mean you are protected. If contractors are using pressure for CIPP activities, there are conditions where that water can be blown out of the plumbing trap into the building.

Sometimes resin is squeezed out of the contractor's uncured resin tube after or while they insert it into the existing damaged pipe. Because the resin is away from the main tube it does not rapidly harden along with the rest of the

CIPP. Over time chemicals in the resin could partition to the air and then travel up building laterals and into buildings through drains.

Wastewater generated during some CIPP activities can have high levels of chemicals. If this wastewater is discharged to sewer pipes, chemicals in the CIPP wastewater can travel down the sewer pipe and some can partition into the air (sewer pipes often are not 100% completely full). These chemicals in the air then can travel up building laterals and into buildings through drains.

Chemicals that are emitted into the air at the worksite can migrate into nearby buildings through open windows and doors. Air exchanges for commercial buildings have been suspected to withdraw contaminated air into the building.

Sometimes CIPP is used to repair pipes inside buildings. Chemicals emitted from the construction activity could enter the air.

These are the just a few examples of how CIPP chemicals could enter a building.

## **If chemicals enter my building because of CIPP activity, will they contaminate my belongings?**

Possibly. Odor indicative of the CIPP installation would be an indicator that the chemicals entered your building. Follow the advice of health officials regarding how to safely decontaminate affected items. Decontamination should be accompanied with chemical testing – to prove chemicals are not above exposure limits. Also, lack of odor does not mean chemicals are not present. Many chemicals can be present at levels that do not cause odor.

## **Is the odor I smell when CIPP is installed caused by styrene?**

While styrene has a characteristic odor, there is no evidence that the odor detected during a CIPP installation (that has a styrene resin) is only caused by styrene. The new study shows that multiple VOC and SVOC chemicals are emitted into air during CIPP installations. The odor someone detects may be attributed to one or more of these chemicals in the air. Sometimes a single odor can be caused by the presence of multiple chemicals. The Purdue team found no evidence the odor at CIPP sites is only caused by styrene.

---

## **Questions about CIPP Technology**

### **If I use styrene-free resin, is that safer?**

The new study shows that styrene was emitted into the air when a styrene-free CIPP was installed. The contractors installed both styrene and styrene-free resin with their equipment. The researchers believe this was caused because the contractors accidentally contaminated their equipment. Contractors do not chemically test their equipment before installing a new CIPP so if any contamination exists from a prior installation, it could possibly be emitted into the air during their next installation.

The new study shows that some different chemicals were emitted into the air when the styrene-free resin was used. To determine if a resin is “safer”, one would need to examine potential exposure routes and understand what materials were emitted (particulates, vapors, droplets), the dose, duration of exposure, health impacts caused by that exposure. Switching to styrene-free CIPP does not mean the process is safer. To make that declaration, independent testing data are needed. None are currently available to make this determination.

### **Is using UV CIPP safer than steam cured or hot water cured CIPP?**

No studies were found that determined which chemicals are emitted from the ultraviolet light (UV) CIPP process into air. To determine safety, independent testing data are needed. None are currently available to make this determination. While UV CIPP does not involve steam, hot water, or forced air, raw chemicals and high-powered UV light is used in CIPP manufacture. An uncured resin tube is also the starting material for the CIPP.

## **If a styrene reduction additive is added to during the CIPP process, is the process safer than if no styrene reduction additive was used?**

No studies were found that determined which chemicals are emitted into air from the CIPP process when a styrene reduction agent is used. To determine safety, independent testing data are needed. None are currently available to make this determination. It cannot be ruled out that the addition of another chemical to the resin matrix could cause unanticipated reactions and result in greater chemical emissions and exposures than would not have occurred without that additive. The purpose of styrene reduction agent use has been to reduce odor, but lack of odor does not mean a process is safer.

---

## **Worker Safety**

### **I install CIPP, what chemicals am I exposed to?**

The chemicals you are exposed to will likely vary based on your work activity and the type of materials you work with. The material SDSs (material safety data sheet) list some, but not all, the chemicals you could be exposed to while working. For example, during steam cured CIPP installation, new chemicals (and materials such as particles, organic vapors, and droplets) are created. There is no material SDS that describes the materials each CIPP installation will release into the air. The new study explains some of the chemicals the Purdue team identified that were emitted as well as a variety of materials such as particulates, organic vapor, water vapor, and droplets.

### **What type of personal protective equipment (PPE) for chemical exposure should I have?**

This will depend on your activity, but you should not be handling the uncured resin tube, working at the site, etc. without proper personal protective equipment (PPE). In light of this new study the Purdue researchers urge workers to sit down and talk with their companies about chemical and worksite safety. Some gloves are insufficient for handling resins and can be rapidly permeated. No one should handle uncured resin with their bare hands. Gloves with greater chemical resistance should be used and the product supplier should be consulted. The material SDS's describe some PPE, but CIPP sites also create new products and emit new and different chemicals into the air. The Purdue team did not find any declarations about what safety equipment will protect workers from the multi-phase materials emitted into the air found during the new study.

Because the short- and long-term health impacts of CIPP related exposures are unknown, the Purdue team recommends respiratory and dermal protection at steam-cured CIPP worksites. Though, respiratory and dermal protection is also recommended for other CIPP technologies. Independent testing data is needed to better understand worksite chemical exposures.

### **I want my worksite/workplace tested. How can the government help me?**

At request of employees, managers, and union representatives a U.S. federal agency called NIOSH, the National Institute for Occupational Safety and Health, can conduct FREE workplace health hazard evaluations (HHE) of CIPP

worksites. A formal request must be submitted here: <https://www.cdc.gov/niosh/hhe/default.html>. NIOSH is not OSHA, the Occupational Safety and Health Administration. NIOSH provides assistance directly to workers about workplace safety questions. In 2017, the Purdue researchers alerted NIOSH to the potential hazards at CIPP sites.

Purdue testing results revealed that multiple types of materials were emitted from CIPP sites: particulates, droplets, organic vapors, and water vapor. Workplace exposure testing should include the materials identified. Also found during the new study was that chemical exposures can be highly variable based on worksite location, environmental conditions and worker activity. Specific chemical exposure assessments should be dedicated to identifying conditions when high concentration, short-duration exposures occur. An 8 hour time-weighted-average (TWA) exposure for a chemical may not appropriately characterize the risk posed to workers. Also needed to be considered is the different work tasks, environmental, worksite conditions, PPE used and atypical conditions.

## **My company says the air testing data they have shows I'm not at risk, am I?**

Results of the new study show multiple different materials such as particles, chemical vapors, and droplets were emitted into the air. The Purdue team has reviewed the very limited number of air monitoring studies for CIPP. Sorbent tubes for organic vapors seem to be the most popular chemical exposure testing method. Worker monitoring sometimes involves wearing a tube on the clothing that adsorbs chemicals during the workday. This would not capture particles or droplets the worker was exposed to. If the worker was exposed to a very high concentration of chemical for 10 minutes, but much less during the rest of the 8 hr workday, the chemical exposure that the laboratory reports would be "averaged out". It may not reveal the worker experienced a very high exposure. Different worker monitoring methods are needed to understand chemical exposures from CIPP installation activities.

## **The PID says I was exposed to a chemical at a certain concentration, is that correct?**

PIDs or photoionization detectors are often used by hazardous materials responders and firefighters to quickly determine the potential that an area requires more testing. PIDs are also used in industrial settings to help detect workplace exposure problems. The PID response does not necessarily mean the chemical the PID is calibrated for is present or the concentration reported is exact. PIDs are good screening tools. More rigorous air sampling and chemical testing is needed to know what chemicals were present and their concentration. PIDs are helpful in determining variations in chemical emission from manufacturing processes. PIDs also have to be maintained, calibrated, the sampling rate should be reported, and persons who use them also need to understand what data they are being provided.

Additional questions? Contact us at [CIPPsafety@purdue.edu](mailto:CIPPsafety@purdue.edu).