CASE STUDY

INDEPENDENT LINING CONTRACTOR: LIMITED INDUSTRIAL HYGIENE SURVEY

This study proves that personal and ambient styrene air sample results were below applicable Occupational Safety and Health Administration (OSHA) and American Conference of Governmental Industrial Hygienist (ACGIH) occupational exposure limits when testing the EnviroCure®-Felt CIPP liner.

THE CHALLENGE

Terracon Consultants, Inc. (Terracon) conducted an industrial hygiene survey on November 9 and November 10, 2021, for independent lining contractor at the Planters Court Site in Fairfax County, Virginia. The scope of the survey included:

1. **Personal Exposure Air Sampling**
   - Styrene organic vapors for five representative employees.
2. **Ambient Air Sampling**
   - Styrene organic vapors at various potential exposure locations during the field operations.
   - Incidental direct readings for total volatile organic compounds (TVOCs) using a photoionization detector (PID) during key exposure activities.
3. **Process Wastewater Sampling**
   - Styrene water samples from steam condensate produced during curing process.

United Felts participates in studies like this to ensure that CIPP installation using EnviroCure-Felt mitigates and reduces styrene emissions, and their associated smells, from trenchless rehabilitation jobsites while also falling well-below the EPA standards.

For CIPP, a tube saturated with a styrene-based polyester resin is installed through the deteriorated host pipe. Once the old pipe has been lined with this material the polymerization step begins with a curing procedure. Curing involves heating the resin to harden it, which strengthens the host pipe. Upon completion, the old sewer pipe has a new tight-fitting structural lining extending its useful life.

When rehabilitating pipes using a styrene-based polyester resin system, during the installation and curing process, small concentrations of residual styrene monomer can be emitting and detected at the jobsite. These emissions can sometimes be detected within connections to the host pipe. After the tube is cured, the styrene eventually dissipates to a non-detectable concentration, so styrene exposure is short-term. Breathing elevated concentrations of styrene can create respiratory

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PROJECT SNAPSHOT

PROJECT
Limited Industrial Hygiene Survey, Sanitary Sewer Upgrade Project

OBJECTIVE
To measure styrene exposure with a personal exposure air sampling, ambient air sampling, and process wastewater sampling. An independent lining contractor requested that Terracon evaluate potential worker and potential work area safety exposure to styrene during their CIPP operations in Fairfax County, Virginia for comparison to regulatory exposure standards.

TESTING GROUP
Terracon Consultants, Inc.

DATES
November 9-10, 2021

LOCATION
Planters Court, Fairfax County, VA

UNITED FELTS PRODUCTS USED

EnviroCure®-Felt

issues, and irritation of the eyes, nose, and lungs, but the main complaint during trenchless rehabilitation is an unusual, plastic odor.

Because of the potential health hazards due to working with styrene, the contractor, which uses EnviroCure®-Felt liners in trenchless rehabilitation projects, ran a study through Terracon Consultants to prove that EnviroCure-Felt liners provide styrene mitigation and encapsulation that prevents a dangerous level of styrene from emitting into the environment and from harming people.

EnviroCure-Felt, manufactured by United Felts, is a styrene impermeable polymer coating applied to traditional CIPP liners that eliminates styrene emissions and odor. The proprietary all-felt or hybrid felt/glass liners coated with a styrene barrier vastly reduces, if not eliminates, styrene odors and emissions on the jobsite before, during, and after installation — removing the significant cost and unpredictability of styrene-free resin systems.

THE STUDY

Terracon was provided with the safety data sheet (SDS) for the construction product used in the pipe relining process, EnviroCure-Felt Cured-In-Place Pipe (CIPP). The formula for CIPP includes the main constituent of concern, styrene (CAS No. 100-42-5). Styrene is used as a catalyst in the CIPP formation. Although product formulation is understood to have changed to reduce styrene concentrations, there is still styrene present in the matrix. The contractor requested that Terracon evaluate potential worker and potential work area safety exposure to styrene during their CIPP operations in Fairfax County, Virginia for comparison to regulatory exposure standards.

The Planter's Court site in Fairfax, County, VA consists of an approximate 226 linear foot (LF) section of 8" diameter sanitary sewer line between two manholes located in a residential development near the address (4315 Planters Court, Fairfax County, Virginia.) Terracon was requested to conduct industrial hygiene (IH) monitoring during the field work for sanitary sewer lining operations at the site on November 9 and November 10, 2021, with the purpose of providing data to The contractor regarding chemical exposure to workers from construction products used during the pipe relining process.

During the field operations, personnel wore personal protective equipment including safety glasses, cut resistant gloves, hard hats, high-vis vests, steel-toed boots, hearing protection, and full-body harness (for personal entering the

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IMPACT

1

Personal and ambient air sample results were below applicable Occupational Safety and Health Administration (OSHA) and American Conference of Governmental Industrial Hygienist (ACGIH) occupational exposure limits.

2

The highest direct-reading peak PID measurements for styrene were during the curing process at the upstream manhole (MH #1) and downstream manhole (MH #2) with peak readings of 3.6 parts per million (ppm) and 108 ppm, respectively.

3

Direct peak PID readings for styrene collected during the other key exposure activities (i.e. opening of refrigerated truck, liner prep, liner inversion, and liner cutting) ranged from 0.0 ppm to 2.7 ppm.

4

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EnviroCure-Felt liners **prevent a dangerous level of styrene** from emitting into the environment and from harming people.

manholes). Two trained personnel entered the upstream and downstream manholes during the pre-liner installation and after product curing to cut the excess liner. Personnel entering the manhole followed confined space safety measures including checking setup of confined space entry retrieval system, setup and activation of area ventilation, and donning of specific safety gear (full-body harness, gloves, hardhats, safety vest, and multigas detectors), per the confined space permit requirements.

The job tasks and locations of the field crew monitored included:

- Equipment setup around upstream and downstream manholes
- Pre-liner prep and installation
- CIPP prep, inversion, and installation
- Condensate line installation in downstream manhole
- Product line curing with process monitoring at upstream and downstream manholes
- Entering manholes to cutting excess product line after curing
- Running a remote-controlled CCTV device through the cured liner to inspect and cut holes at inlets

THE RESULTS

Terracon concluded the following based on the results of this survey:

1. Personal and ambient air sample results were below applicable Occupational Safety and Health Administration (OSHA) and American Conference of Governmental Industrial Hygienist (ACGIH) occupational exposure limits.
2. The highest direct-reading peak PID measurements for styrene were during the curing process at the upstream manhole (MH #1) and downstream manhole (MH #2) with peak readings of 3.6 parts per million (ppm) and 108 ppm, respectively.
3. Direct peak PID readings for styrene collected during the other key exposure activities (i.e. opening of refrigerated truck, liner prep, liner inversion, and liner cutting) ranged from 0.0 ppm to 2.7 ppm.
4. Styrene was detected in the two water samples collected from the steam condensate during curing at concentrations of 200 micrograms per liter (ug/L) and 120 ug/L.

The EnviroCure®-Felt coating is structured with layers of several flexible polymer materials. Unlike traditional CIPP coatings, EnviroCure-Felt creates an impermeable barrier the entire length of the liner that does not allow styrene molecules to pass through the coating. When the ends of the liner are secured, the styrene emissions are contained within the reefer truck protecting crew safety. Furthermore, **United Felts offers a pre-liner to protect against styrene transfer via lateral connections into existing structures.**

EnviroCure®-Felt Creates an Impermeable Barrier the Entire Length of the Liner

1. **Inner Felt Layer - With Styrene Barrier Coating**
2. **Felt Liner Layers - Resin Saturated**
3. **Pre-Liner - Optional**