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- CHST and CIT (Board of Certified Safety Professionals)
- Chair, NASSCO's Health and Safety Committee
- Member, NASSCO's CIPP Safety Workgroup
- President, St. Louis Chapter ASSP
- Subject Matter Expert for NIOSH CIPP study
- Author Health Risks Assessment from Cured-in Place Pipelining Fugitive Styrene Emissions in Laterals



# History of StyreneEmissions Research

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## **Learning Objectives**

Summary of history of Styrene Emissions and regulation from various agencies

NASSCO sponsored research, findings and best practices

Recommendations for worker and public health protective measures

Protective measure cost implications

### Defining the Challenges & Concerns with CIPP

- Specifically steam-cured CIPP
- Volatile organic compounds (VOCs)
- NASSCO formed an industry-wide workgroup to look at this issue and the work began in late 2017



### Defining the Challenge – CIPP Technology

- A tube is saturated with resin, inserted into a pipe and cured to form a pipe-within-a-pipe Tube
- Fabric Reinforced or unreinforced
- Thermoplastic coating Resins
   ✓Polyester (styrene)
  - ✓ Vinyl ester (styrene)
  - ✓ Epoxy (no styrene) Chemical Sensitizer
  - ✓ Styrene free vinyl ester Chemical Sensitizer
  - ✓Curing by Heat, light or ambient temperatures

# Defining the Challenge - CIPP Styrenated Resin

- Used for 50 years with CIPP
- Can contain up to 40% styrene
- Most of the styrene becomes part of the CIPP
- Low odor threshold (≈ 0.1 ppm)



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### NASSCO sponsored research, findings and best practices.

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#### **NASSCO** sponsored research – Phase 1

Emission Study University of Texas – Arlington - Center for Underground Infrastructure Research & Education (CUIRE)

- Dr. Mohammad Najafi Completed in 2018
- Literature review of 21 previous CIPP emission studies
- A scope of work for Phase 2 study Results
- Concluded that previous studies were inconclusive
- Report available at NASSCO.org

### **NASSCO** sponsored research – Phase 2

Louisiana Tech University

- Trenchless Technology Center (TTC)
- Dr. Elizabeth Matthews
- U.S. Army Corps of Engineers Engineer Research and Development Center (ERDC)

Focus on quantifying worker and public exposure to steam-cured CIPP emissions

### **NASSCO** sponsored research – Phase 2

# Phase 2 Emission Study Testing and samples collected at nine CIPP jobsites

- Varying diameters, lengths, weather conditions and geographic location
  - Modeled air dispersion of emissions
  - Evaluated potential health risks to workers and public
  - Report available at NASSCO.org

- Two locations on steam -cured CIPP jobsites at risk with styrene exposure
  - Exhaust discharge
  - Liner transport truck
- NASSCO and TTC guidelines in next section

- Dr. John Matthews at TTC LaTech University ODispersion of styrene from the liner transport truck
  - Correlate site-specific liner information with styrene concentrations

Via the following methods

- Styrene breakthrough studies through common thermoplastic coatings
- $_{\odot}$  Lab scale simulations and modeling

○ Field testing with loaded refrigerated trucks

- Better Understanding the Styrene Break-Through times for the various coatings
  - Nylon Longest break-through
  - Polyethylene Medium break-through
  - $\circ$  Polyurethane Fastest break-through
- Aids in understanding ways to improve coating technologies and provide styrene containment understanding

VOCs in Laterals University of Waterloo (CATT) & Aegion

- Completed in 2020
- Dr. Mark Knight Waterloo University and Dennis Pivin, CSP✓VOCs in laterals with wet & dry P-traps
  - ✓ Evaluated VOC measurement equipment

VOCs in Laterals - University of Waterloo (CATT) & Aegion Study

Results:

1) Styrene will not enter buildings from laterals if the p-traps are functional.

2) Styrene in laterals with functional traps will move into the main once the lateral is re-established

Published in the scientific journal ASCE – Health Risks Assessment from Cured-In-Place Pipe Lining Fugitive Styrene Emissions in Laterals.

### Upcoming NASSCO 2024 sponsored research – Styrene Treatability Study

The effects of styrene cure water from cured-in-place pipe installation methods on conventional secondary biological treatment processes that are considered as typical publicly-owned treatment plants (POTW) in the continental United States. This scope addresses concerns with inhibition of biochemical oxygen demand (BOD) removal and ammonia-nitrogen removal (nitrification) in POTWs.

### Upcoming NASSCO 2024 sponsored research – Styrene Treatability Study

- <u>Phase 1</u>. Conduct a literature review to define likely bio-inhibition thresholds for styrene regarding BOD removal and nitrification. Compare these concentrations to those reasonable worst-case concentrations projected to be present at POTW.
- <u>Phase 2</u>. Conduct batch respirometry tests to validate bio-inhibition thresholds using biomass from three types of biological treatment facilities.
- <u>Phase 3 (Optional)</u>. If bio-inhibition thresholds determined in Step 2 are less than the reasonable worst-case concentrations projected to be present at POTW headworks or styrene is present at concentrations exceeding practical quantitation limits (pql), it is recommended to conduct continuous flow testing under representative conditions to determine if impacts are mitigated under more representative loading conditions

 Recommendations for
 worker and public health protective measures

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## **TTC Phase 2 Study**

- Exhaust discharge
- 15-foot radius perimeter
- Stack minimum 6 feet high
- Inside perimeter < 5 minutes</p>
- Over 5 minutes, proper PPE
- Protect the public by maintaining a work zone perimeter around the job site
- Liner transport truck
  - Wear proper PPE when opening door and entering truck





## P3 Safety Recommendations

- Emissions from the Cold Storage Trucks
  - TTC Recommendations open doors and vent under below industrial limits
  - If limits are exceeded wrapping liner, heavier coatings, or PPE
  - $\circ~$  NASSCO job site air monitoring
  - testing for styrene in refer when workers must enter (PID/detector tubes)
  - Have PID alarm set at 20 ppm and not enter if alarmed
  - $\circ~$  Impervious coatings and ventilation





## NASSCO Recommendations

#### From NASSCO Styrene Guideline 2023

Refrigerated Storage Unit – Heat-cured CIPP

Four recommendations:

- 1. Job site air monitoring installation companies use different tube coatings, have various amounts of liner, and follow various installation procedures.
- Testing for styrene level in the refrigerated storage unit when workers must enter. Typical testing instruments are photoionization detectors (PIDs) and detector tubes.





## NASSCO Recommendations

From Styrene Guideline 2023

 If using a PID, if styrene levels > ACGIH TLV STEL\* of 20 ppm, PID should alarm, and worker should exit storage unit.

4. Impervious coatings and ventilation reduce levels. Respiratory protection if options not available, and levels exceed STEL of 20 ppm.

> \*American Conference of Governmental Industrial Hygienists (ACGIH)
> a. Threshold limit value time weighted average (TLV-TWA) - 10 ppm
> b. Threshold limit value short term exposure limit (TLV-STEL) – 20 ppm

### Future Technologies for CIPP VOC Emissions

Mitigation Techniques

 Barriers
 Carbon Filtration
 Thermal Oxidation





## Thank You!