

Occupational exposures during cured in-place pipe (CIPP) installations

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September 2019





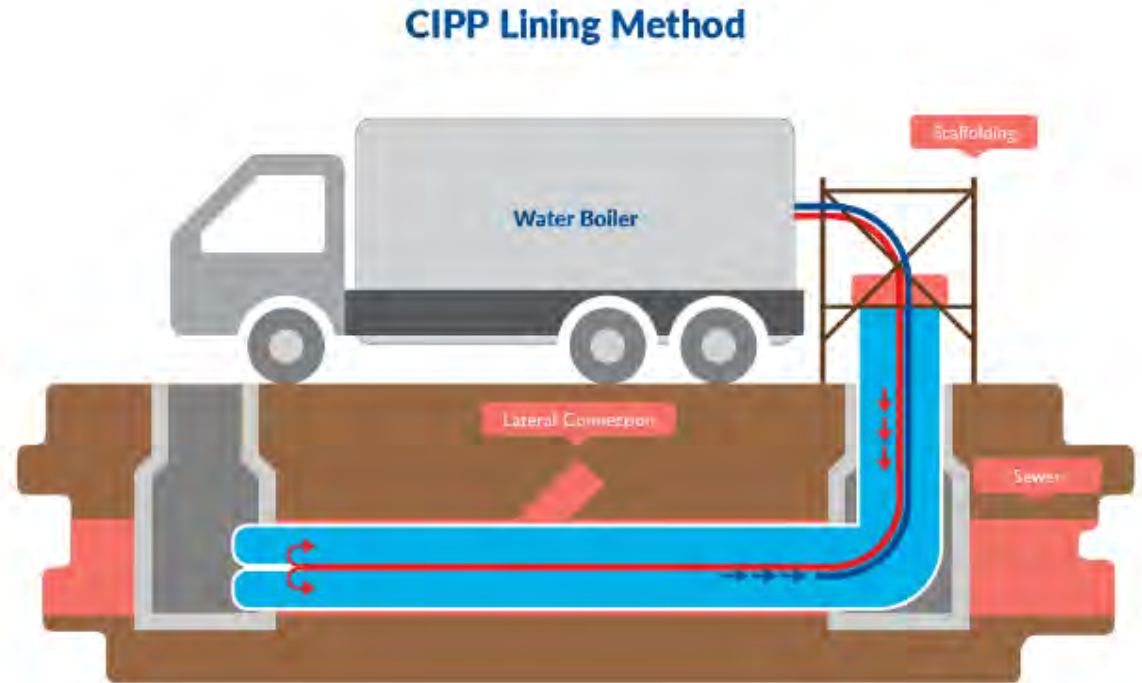
Trenching/Excavation vs. Trenchless

- U.S. water and sewer pipe infrastructure is degrading with 1.6 million miles of pipe reaching an average age of 45 years by 2020
- OSHA National Emphasis Program on Trenching and Excavation Oct 2018
 - Challenges (e.g., road closures, pipes under buildings, cost)
 - Injuries and fatalities
 - 130 fatalities between 2011 and 2016 (Bureau of Labor Statistics)
- Trenchless (CIPP)
 - Benefits (e.g., limited effect on traffic, reduced cost)
 - Respiratory hazards and diseases
 - Fatality
 - October 2017 in Streamwood, IL



Background CIPP

- Liner
 - Felt
 - Fiberglass reinforce
- Resin
 - Styrene
 - Non-styrene
 - Epoxy
- Curing
 - Hot water
 - Steam
 - Ultra-violet



Background

- Employer request in 2018 to evaluate current practices for controlling exposure to styrene during installation
- Sewer and stormwater drain repairs with liner cured by ultra-violet light





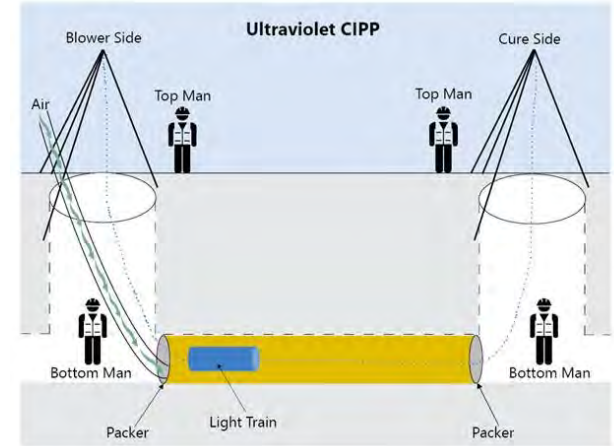
Styrene

- Major component of resin system
- Inhalation and dermal exposure routes
- Health effects
 - Tiredness, changes in color vision, slowed reaction time, concentration problems, balance problems, feeling drunk, or hearing loss
 - Probable carcinogen (IARC Group 2A)
 - Non-malignant respiratory diseases (for example, asthma and obliterative bronchiolitis)
- NIOSH exposure limits
 - Short-term exposure limit (STEL): 100 ppm for 15 minutes



Process

- Installation crew consists of 3 to 5 employees
- Liner shipped to installation site
- Pipe cleaned
- Liner pulled through the pipe
- Liner cut to length and ends taped
- Light train inserted and packers attached at each end
- Liner inflated and cured
- Cured liner cut with grinder
- Inspected and laterals cut





Current Practices to Control Exposures

- Immediately bag excess liner and contaminated gloves
- Company suggested the use of a ventilation blower fan





Methods

- Process and worksite assessment
- Task-based styrene exposures
- Source air sampling
- Real-time air sampling
 - Photo-ionization detector (PID)
 - Fourier transform infrared spectrometer (FTIR)
- Temperature and relative humidity
- Bulk headspace and emission testing



Task-based Styrene Exposures

- Sorbent tube placed in breathing zone of employee
- Air pumped at 50 milliliters/min for the duration of the task



Source Air Sampling

- Evacuated canisters
 - NMAM 3900 <https://www.cdc.gov/niosh/nmam/pdf/3900.pdf>



Real-time Air Sampling

- PID
 - 10.6 eV lamp
 - Non-selective
 - Response factor
 - Humidity effects
- FTIR
 - Infrared absorption
 - Selective
 - No humidity effects
(for styrene)





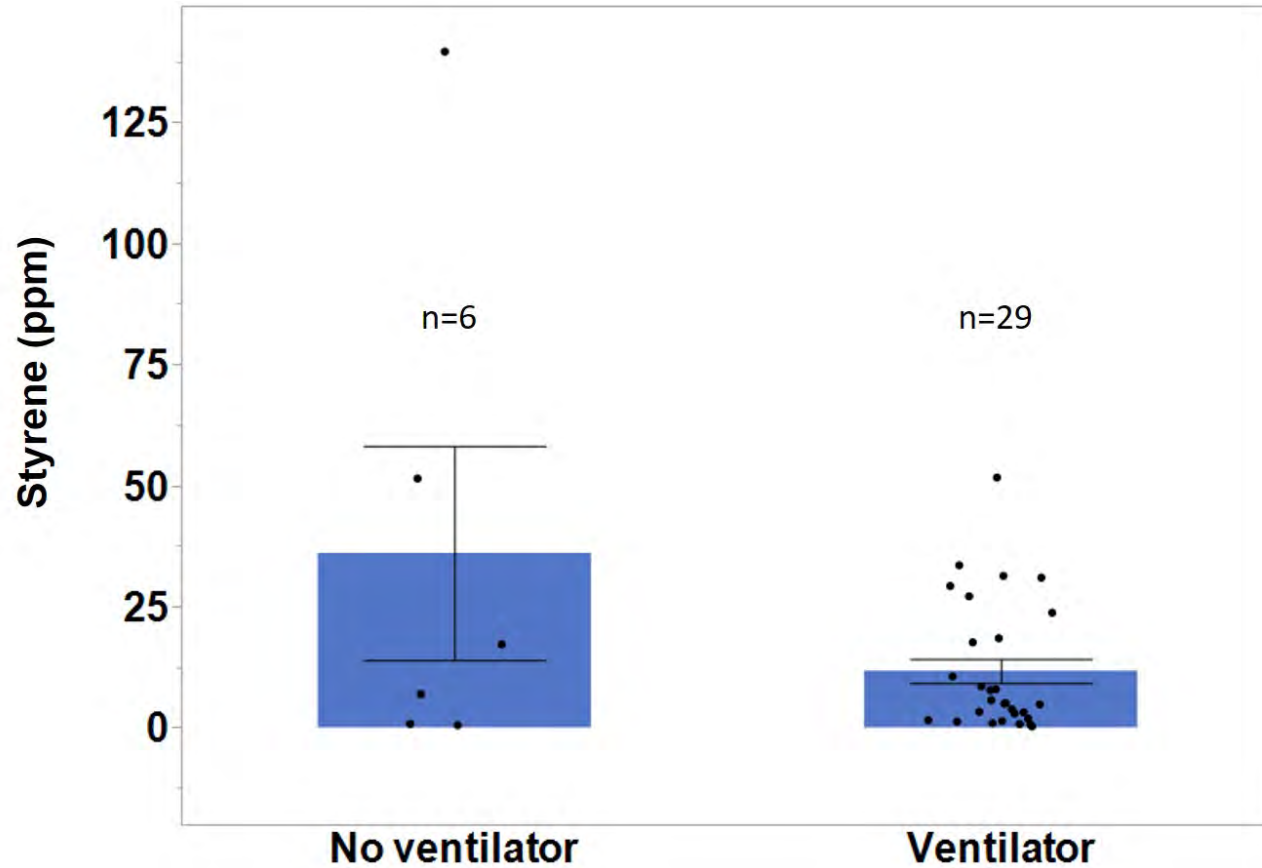
Bulk Headspace and Emissions Testing

- Collected bulk sample of cured liner
- Headspace
 - Potential for material to emit chemicals
 - One gram of cured liner in 40 mL vial
 - Measured styrene concentration
- Emissions
 - Rate at which material emits chemicals
 - One gram of cured liner in chamber
 - Air humidified to 54%
 - Measure styrene at outlet



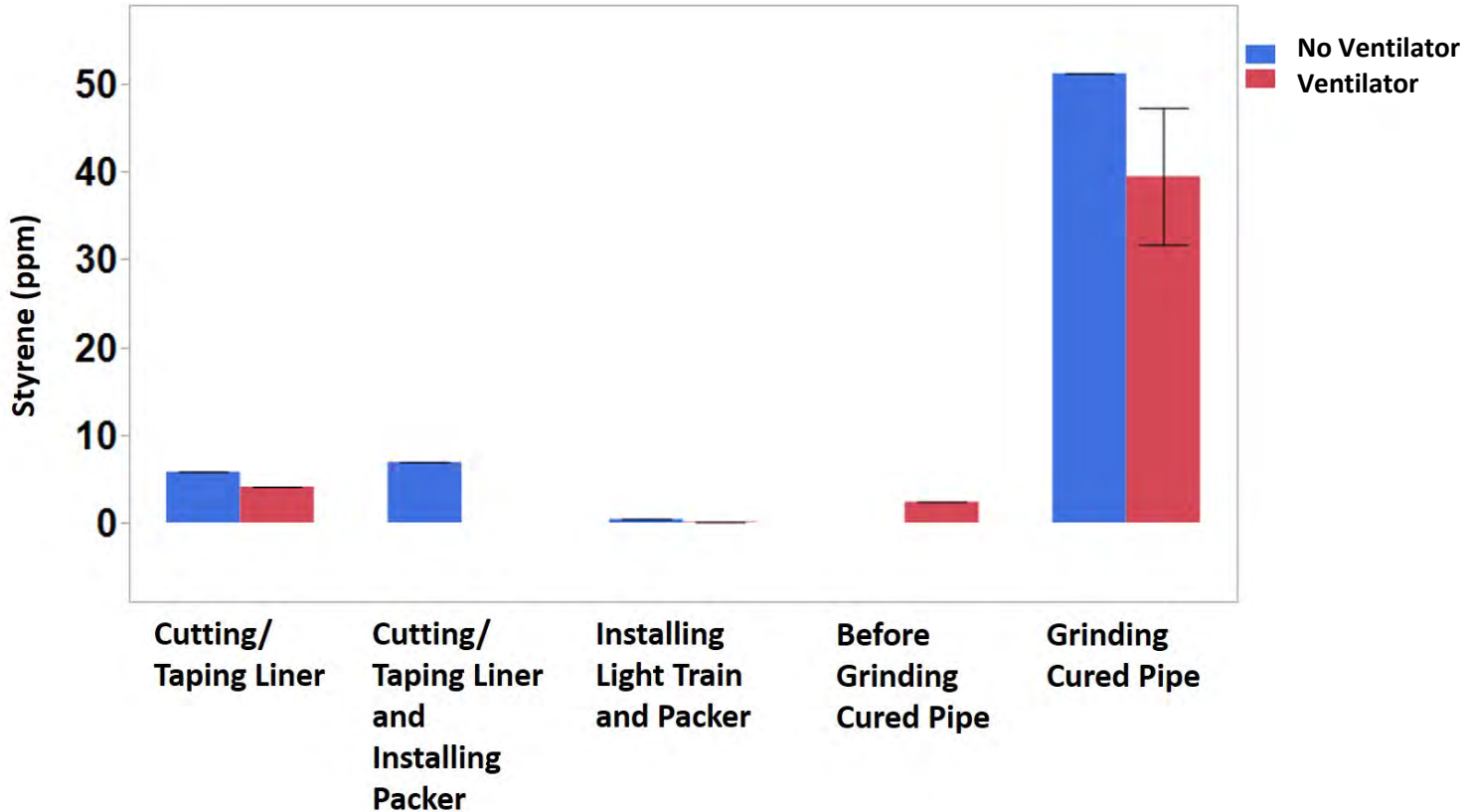


Bottom men task-based personal exposures

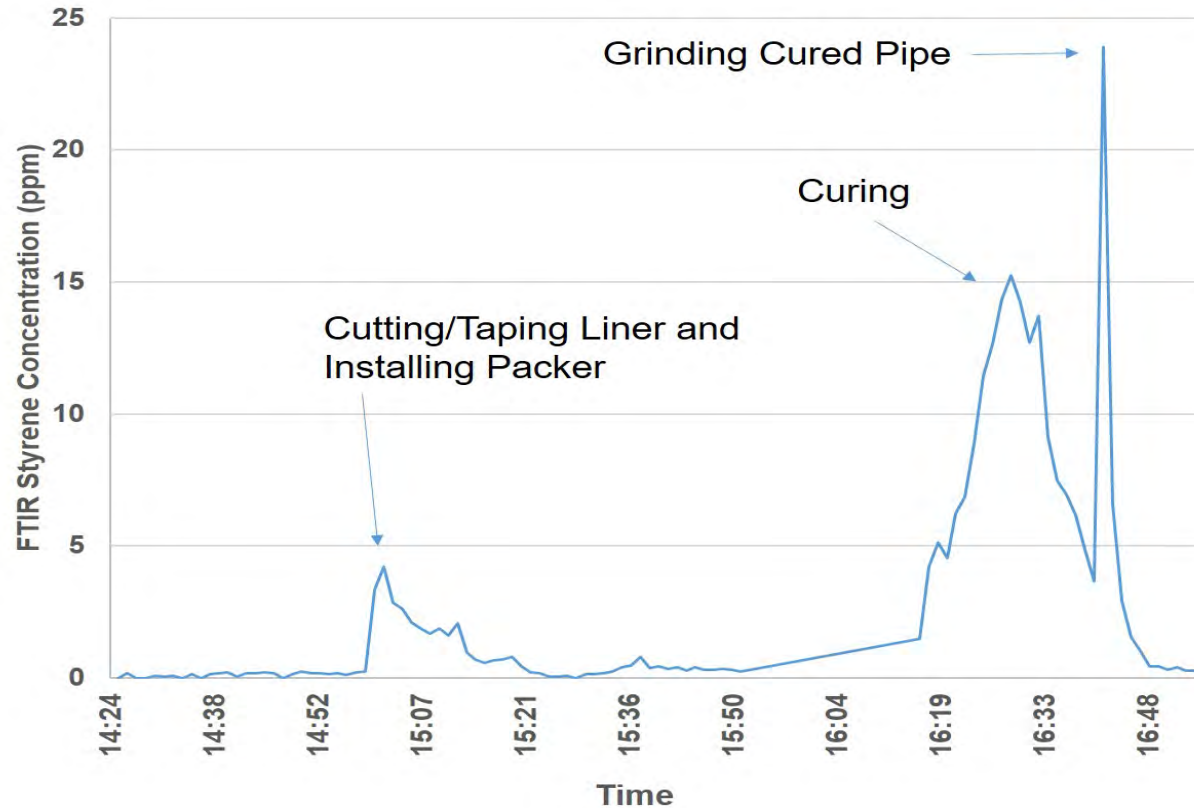




Canister air sampling at manhole opening

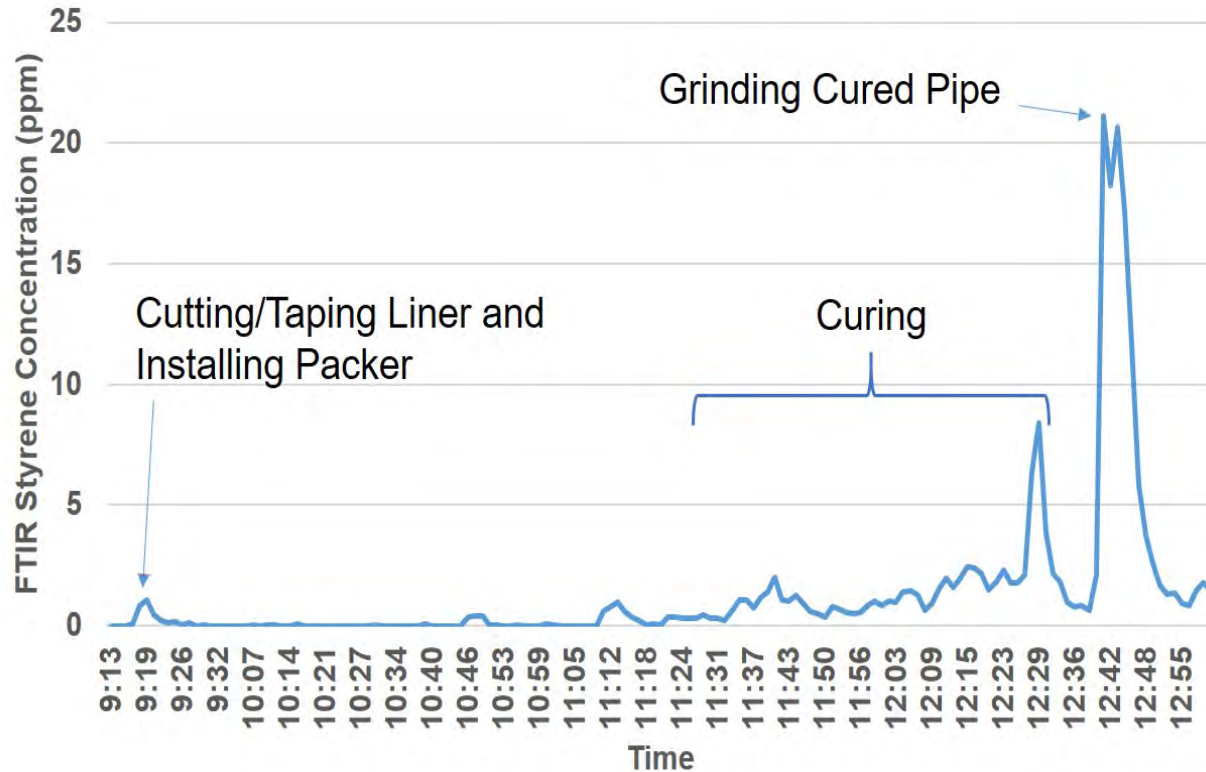


Styrene air concentrations at manhole face on blower side with **NO ventilator**



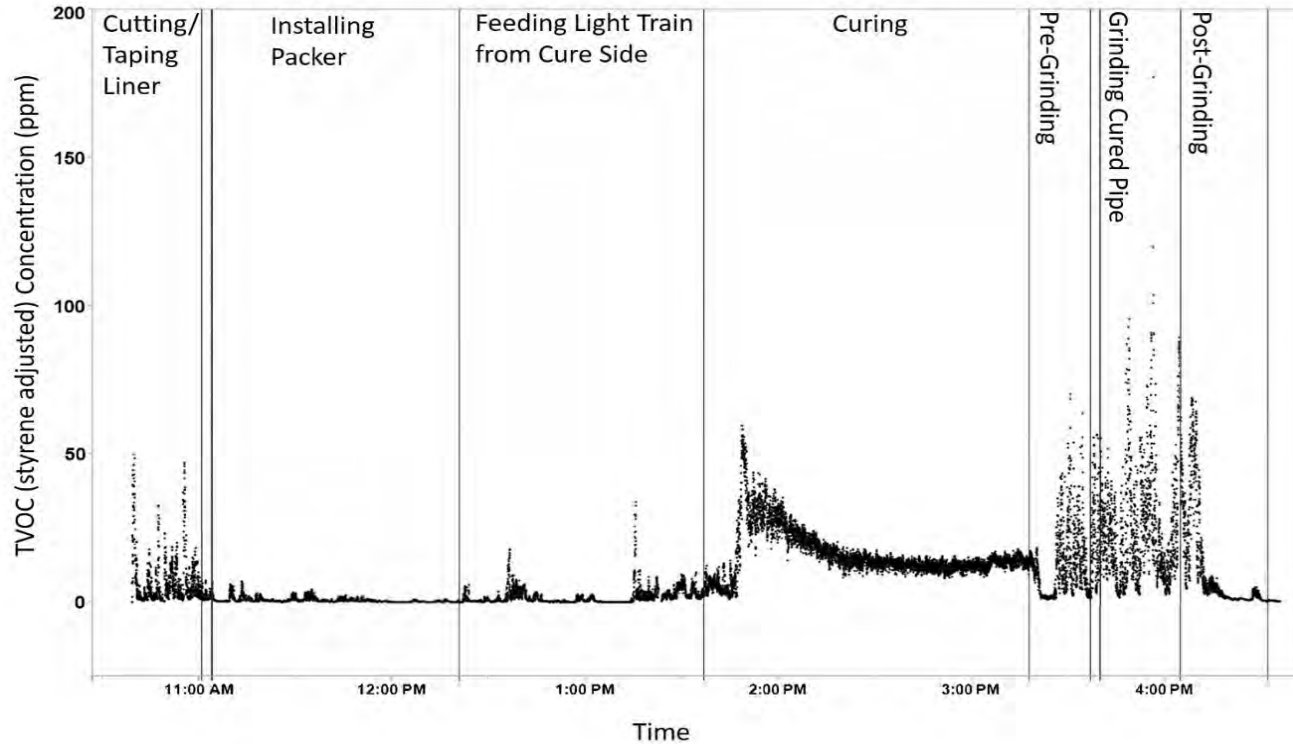


Styrene air concentrations at manhole face on blower side with ventilator



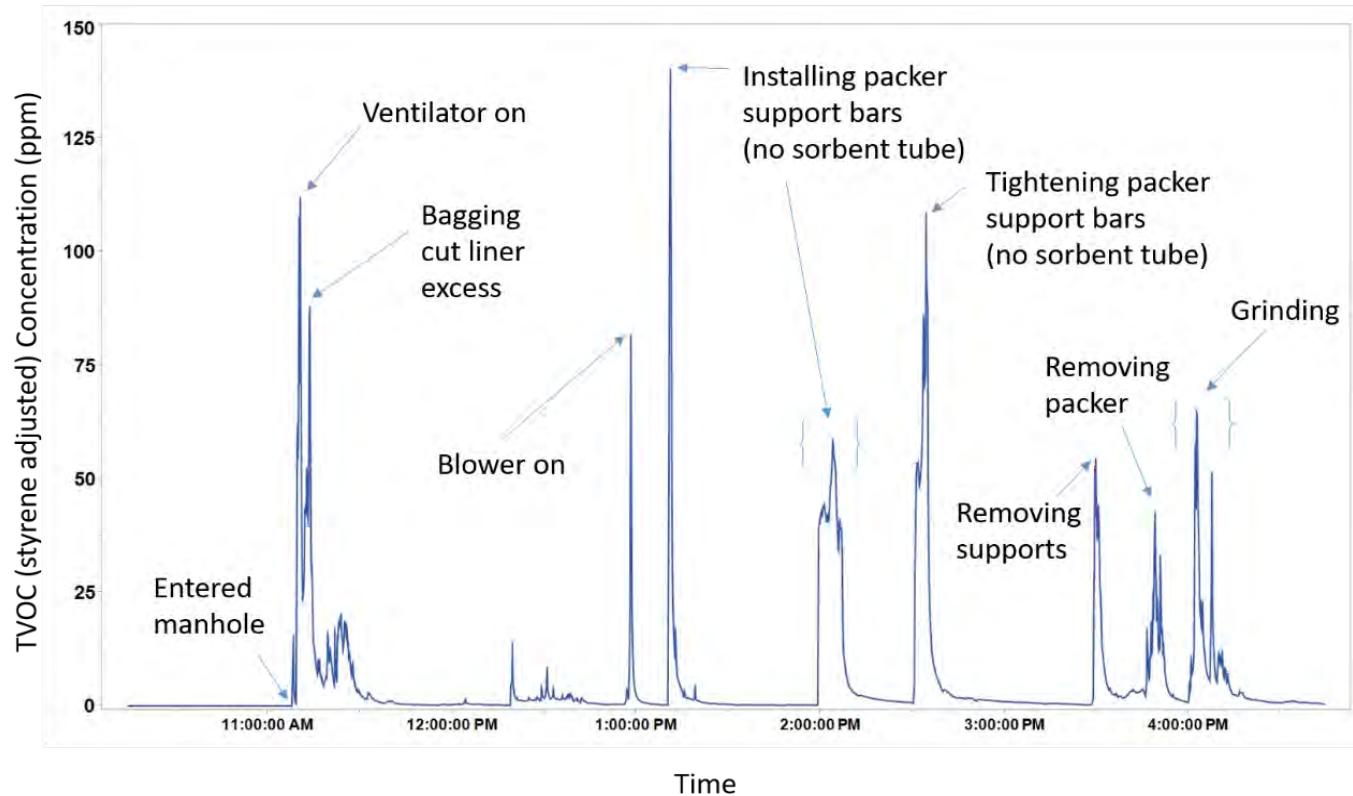


PID Air Concentrations at manhole face with ventilator





Bottom men personal air concentrations with ventilator





Emissions Testing of Cured Pipe Liner

- Styrene headspace in 40 ml vial
 - 1,300 ppm/gram
 - 5,100 ppm/gram
 - Not indicative of actual worker exposure

- Styrene emission factors
 - 500 mg/(kg·h) and 750 mg/(kg·h)
 - 850 mg/(kg·h)



Conclusions

- Installation of CIPP emitted styrene
- Work tasks associated with higher exposures
 - Cutting and taping liner
 - Installing packer
 - Installing light train
 - Grinding cured pipe
- Ventilator fans might have some effect at reducing exposures



Specific Recommendations

- Continue to ventilate manholes
 - make sure the ventilator duct only has one 90° bend
- Continue to remove and contain excess liner and change gloves regularly
- Encourage bottom men to take fresh-air breaks
- Consider respirators with organic vapor cartridges, if necessary

Limitations

- Individual worksite and process differences don't allow for industry-wide generalizations to be made concerning recommendations
 - Funding received to investigate different cure processes at multiple sites.

Thank you!

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For more information, contact CDC
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov

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