

# Evaluation of Volatile Organic Compounds During CIPP Process: The Critical Role of Resin Liners and Curing Methods

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CIVIL ENGINEERING

**March 4, 2025**



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# Introduction

- **CIPP** is the most common pipeline renewal method.
- **CIPP** offers a fast and efficient repair solution.
- **CIPP** provides durability, forming a strong, seamless liner that withstands pressures and stresses within existing pipelines.
- **CIPP** enhances flow with its smooth inner surface, helping to improve flow characteristics and reduce future blockage risks.



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# Introduction (Cont.)

☹️ CIPP installations may release volatile organic compounds (VOCs) into the air.

☠️ VOCs are linked to both short- and long-term health effects.



Source: CUIRE



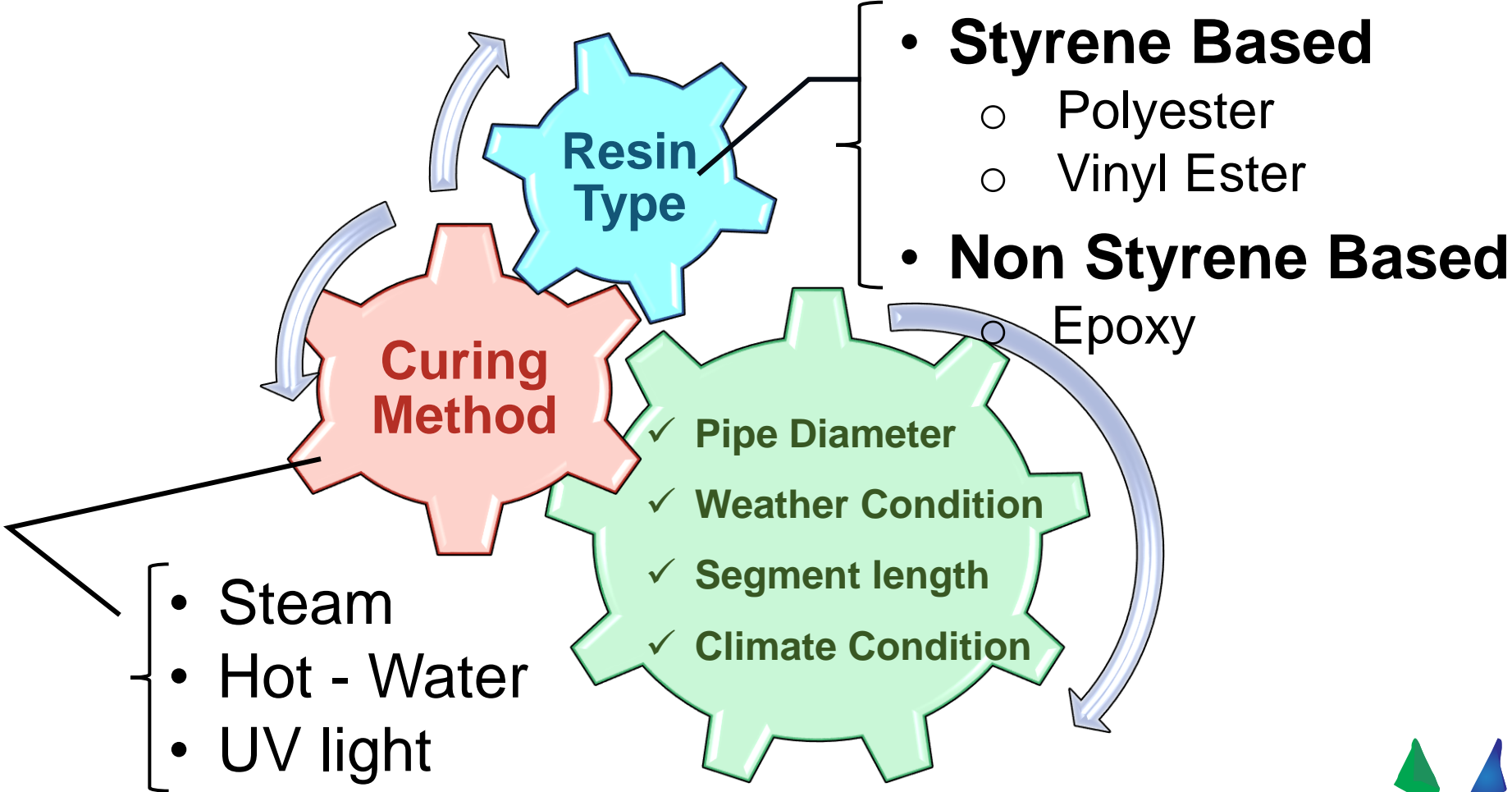
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# CIPP Volatile Organic Compounds (VOC) Emissions



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# Volatile Organic Compounds (VOC) Compliance Levels

Table 1. USEPA Acute Exposure Guidance Level 1

Chemical of Interest	Exposure limits USEPA (ppm)					Odor Threshold ppm
	10 min	30 min	1 hour	4 hour	8 hour	
Styrene	20	20	20	20	20	0.54
Cumene	50	50	50	50	50	0.008 – 0.132
Acetophenone	10	10	10	10	10	0.36 – 0.6

☺ Level 1: non-disabling

☹ Level 2: Disabling

☠ Level 3: Lethal



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# VOCs Compliance Levels (Cont.)

Table 2. Averaging Period 8 hours- TWA Exposure Levels

<b>Chemical of Interest</b>	<b>OSHA PEL (ppm)</b>	<b>CAL/OSHA PEL (ppm)</b>	<b>NIOSH REL (ppm)</b>	<b>ACGIH TLV (ppm)</b>
Styrene	100	50	50	10
Cumene	50	50	50	50
Acetophenone	N/A	10	N/A	10



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# Project Overview

Table 3. Projects Characteristics

Site	Segment Length (L.F)	Pipe Diameter (in)	Liner Thick (mm)	Curing Method	Cooking Temp °F	Curing Duration (hr.)	Resin Liner Type
1	154	18	5	Hot-Water	180	6	Vinyl Ester Styrene Free
2	350	10	5	UV	160	2.5	Vinyl Ester Styrene Free
3	1091	48.5	18	Hot-Water	180	9	Polyester Styrene-based
4	464	12	6	Hot-Water	180	6	Vinyl Ester Styrene-based



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# Weather Condition

Table 4. Weather Condition

Site	Environment	Temp(°F)		Wind speed	Wind Direction
		Min	Max	mph	
1	Residential	42.2	56	4	NE
2	Residential	44.1	77	5.5	SW-S
3	Residential	68	92	2.8	SW
4	Residential	49	74	2.8	E-ESE



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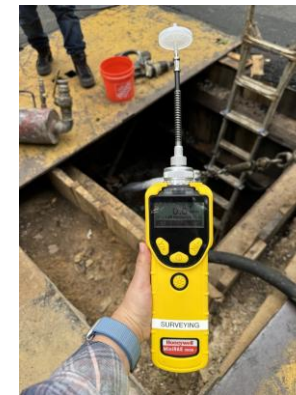
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# Sampling Methods and Equipment

- **Real-time Monitoring**
  - Photoionization Detectors (PIDs)
- **Laboratory Analysis**
  - Suma Canisters



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# Real-Time Monitoring (PIDs)

- **Testing Method**

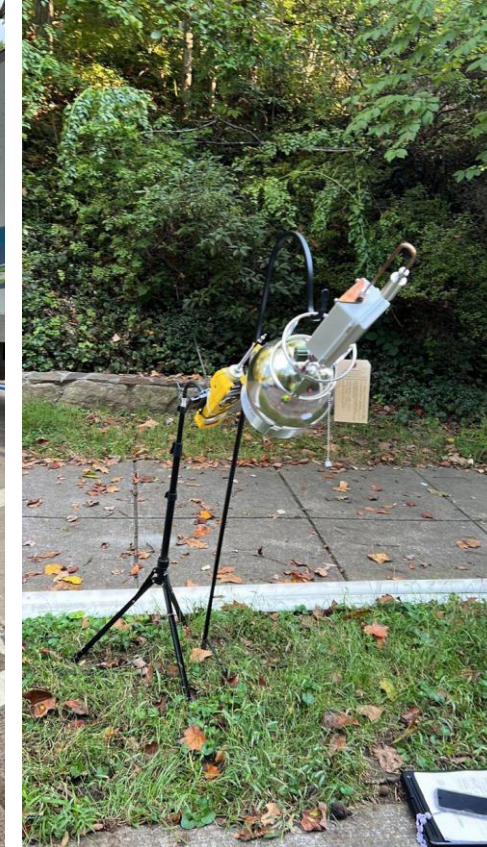
- Continuous 15-minute TVOC average concentrations.
- Hand-held instantaneous TVOC measurements.

- **Locations**

- Upwind of Insertion MH
- Downwind of Insertion MH
- Hand-held PID (every 30 minutes, different locations)



*TVOC Measurement Using Hand-held PID*



*Continuous TVOC Measurement Using PID Positioned Upwind and Downwind of the Insertion Manhole*



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# Laboratory Analysis (Suma Canisters)

- **Baseline Measurements:**

- Upwind of Insertion manhole (1-4 hours period).
- Downwind of Insertion manhole (1-4 hours period).
- Downwind of terminal discharge manhole (1-4 hours period).

- **Measurements during liner installation:**

- Upwind of Insertion manhole (8-12 hours period).
- Downwind of Insertion manhole (8-12 hours period).
- Downwind of terminal discharge manhole (8-12 hours period).

- **Measurements during Curing:**

- 4 inches above the center of the Insertion Manhole (4-8 hours period).
- 4 inches above the center of the terminal discharge manhole (4-8 hours period).



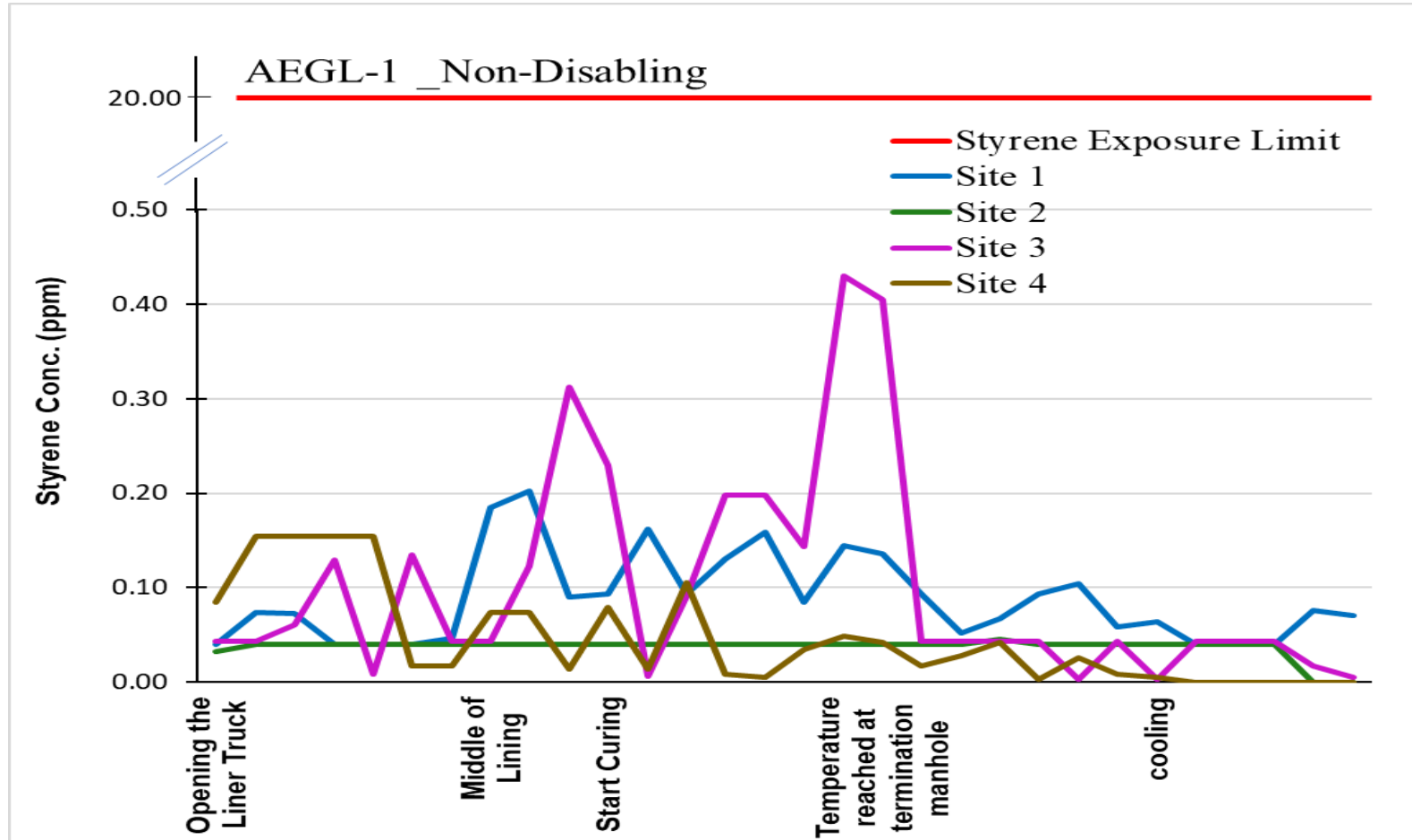
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# Styrene Concentration Upwind of Insertion Manhole (15-Minute Average)



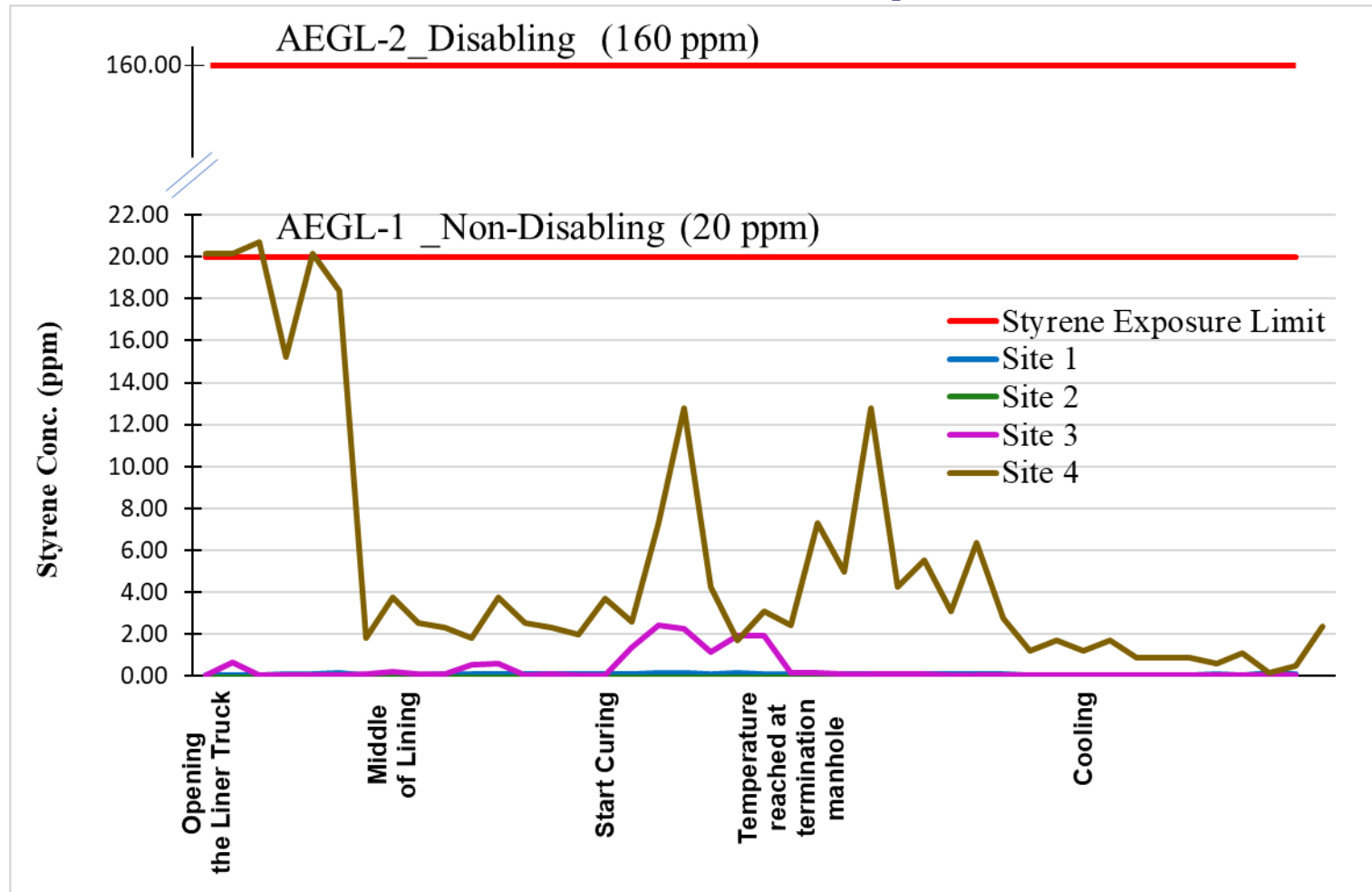
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# Styrene Concentration Downwind of Insertion Manhole (15-Minute Average)



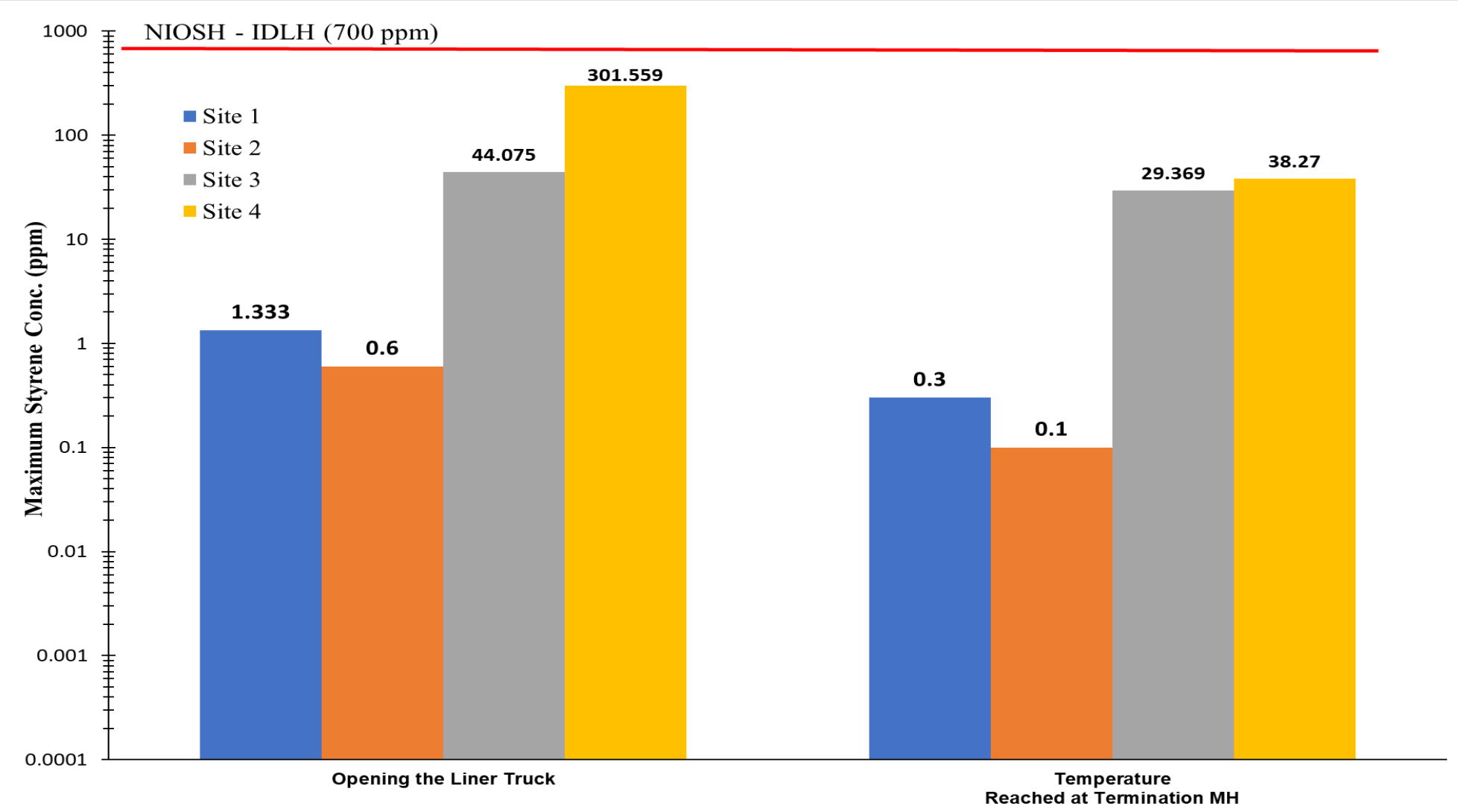
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# Maximum Styrene Concentration \_ Instantaneous Observation



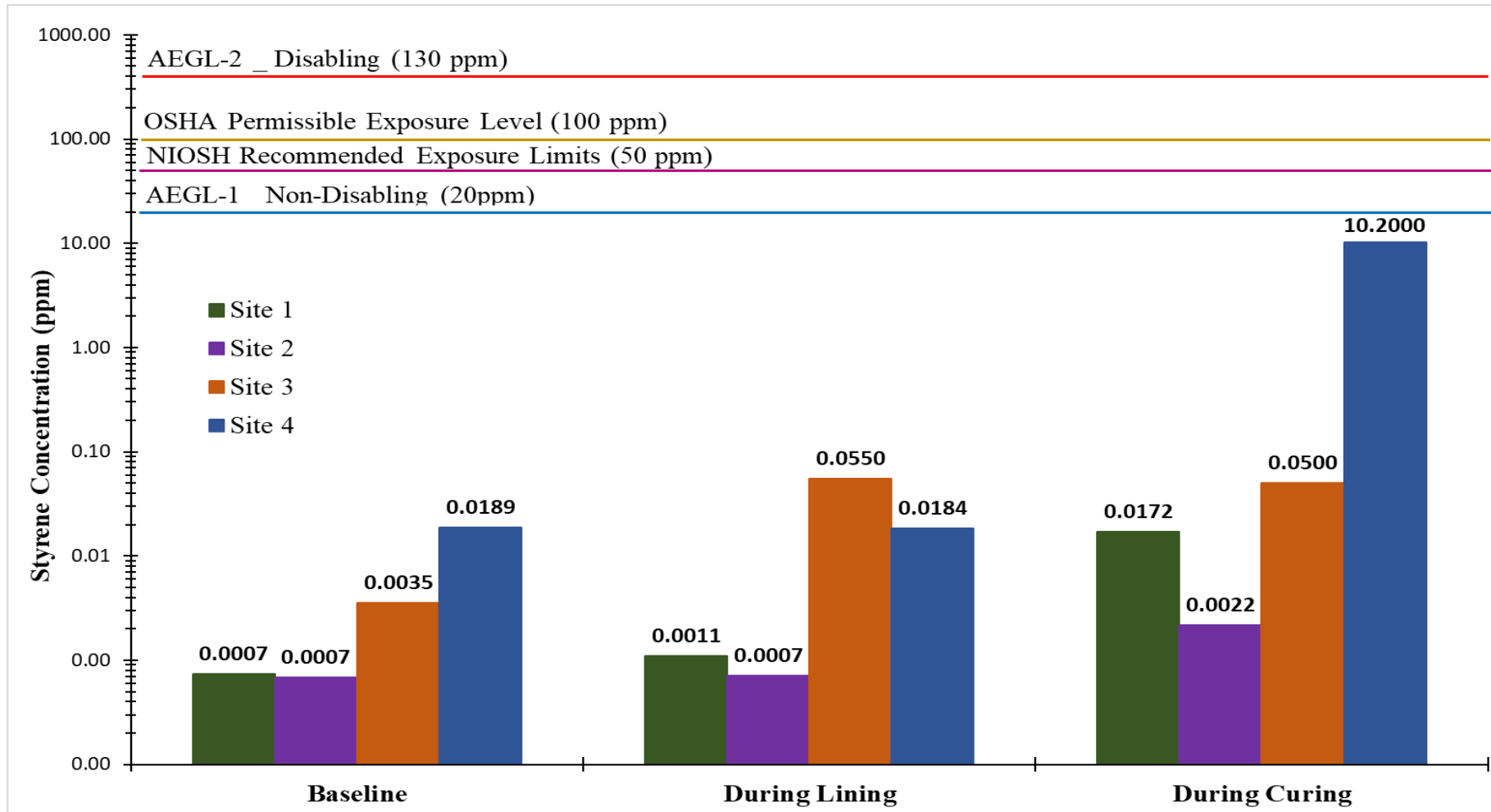
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# Time Weighted Average (TWA) Styrene Concentration Upwind of Insertion Manhole



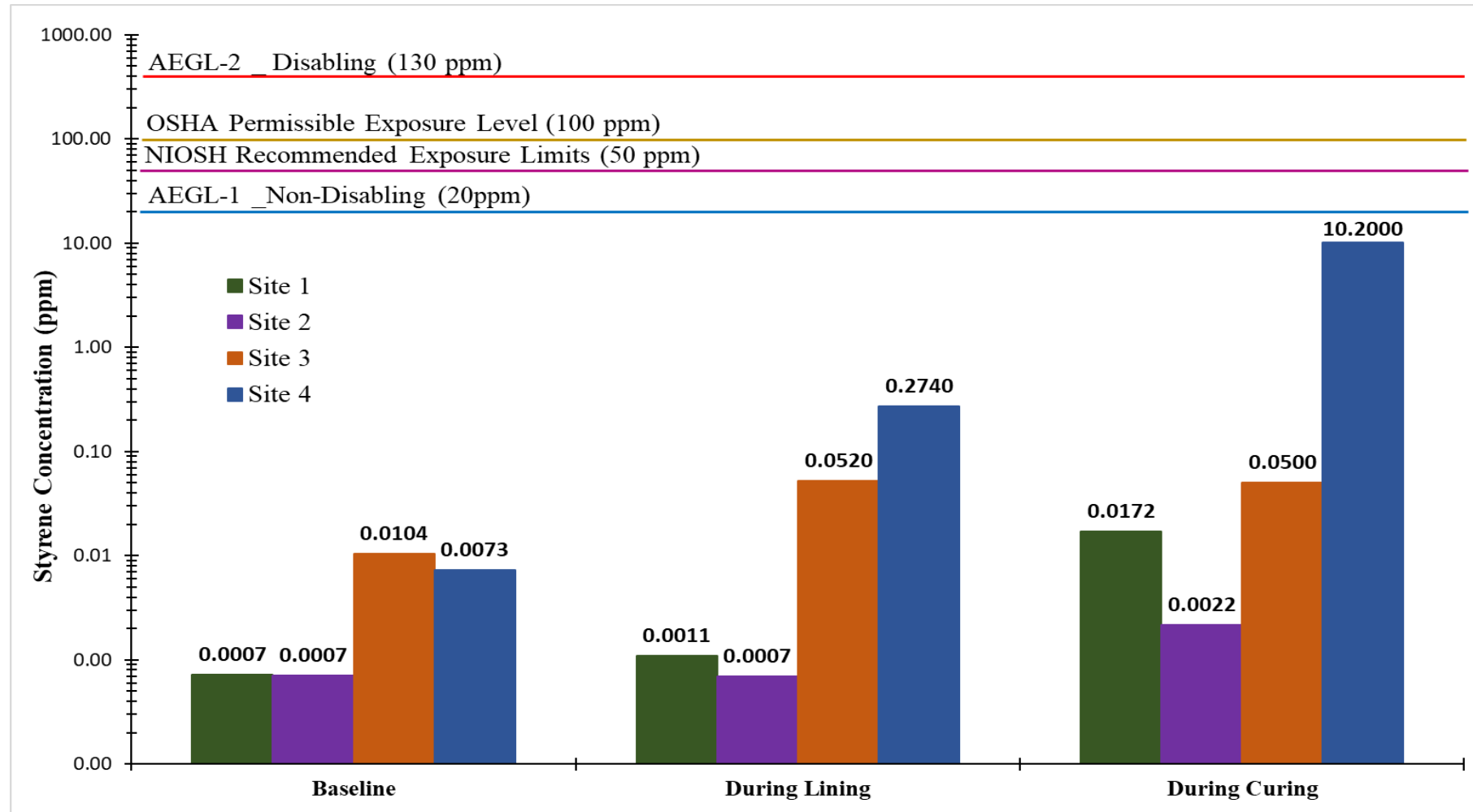
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# Time Weighted Average (TWA) Styrene Concentration Downwind of Insertion Manhole



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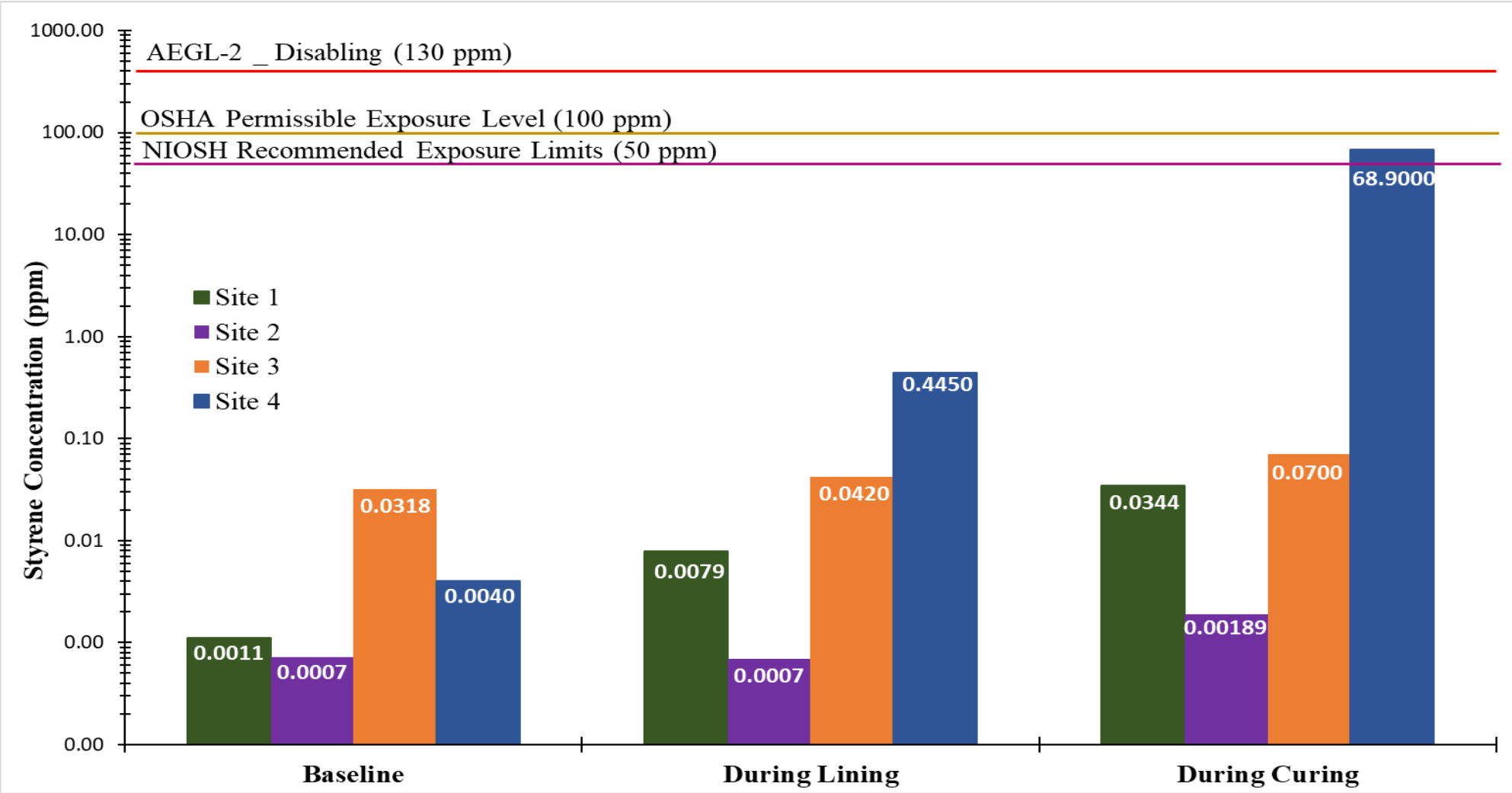
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# Time Weighted Average (TWA) Styrene Concentration Termination Manhole



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# Conclusion

- Non-styrene-based resins complied with OSHA, NIOSH, and EPA exposure limits, while some styrene-based resins exhibited higher styrene concentrations.
- Instantaneous observations showed that all maximum styrene concentrations remained below the NIOSH -IDLH exposure limit.
- Air monitoring at the termination manhole with vinyl ester styrene-based resin indicated:
  - Styrene levels exceeded the NIOSH-REL threshold.
  - Concentrations remained below OSHA-PEL and AEGL-2 thresholds.
  - Styrene concentrations dissipated rapidly into the atmosphere, showing a significant drop within five feet of the termination manhole.
- Real-time air monitoring is recommended for on-site decision-making and comprehensive emissions assessment during CIPP installations.
- Improving environmental management, establishing safety standards, and conducting further research to refine exposure guidelines are recommended.



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# Thanks for The Opportunity!!!

- CUIRE is ready to conduct more research on CIPP air emissions evaluation.

Resin Types	Steam Cure	Water Cure	UV Cure
Polyester Resin (Styrene Base)	Forney, TX	Garland, TX	
	Washington, DC SLRP-2 (Envirocure)		
	Washington, DC SLRP-2 (Envirocure- Condenser Unit)		
Vinyl Ester Resin (Styrene Base)		Flower Mound, TX	
Vinyl Ester Resin (Non-Styrene Base)		Washington, DC Soapstone	Washington, DC Soapstone
		Washington, DC SLRP- 2	
Epoxy Resin		Washington, DC SDWMR	

 Completed

 Target

## Contact

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# Questions?

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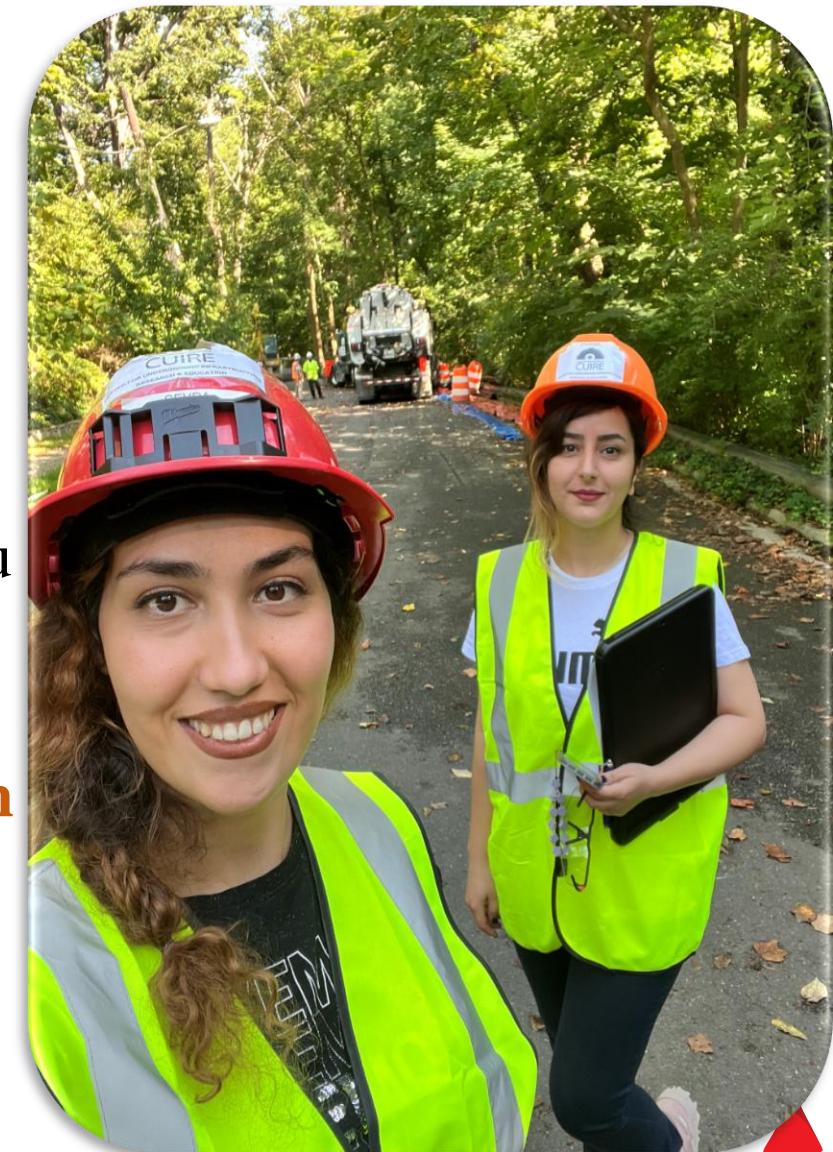
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