Guideline for the Safe Use and Handling of Styrene-Based Resins in Cured-in-Place Pipe

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This Styrene Guideline is maintained and updated by NASSCO's:
Health & Safety Committee
CIPP Safety Workgroup
Technical Advisory Council (TAC)

NASSCO.org

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Contents

Executive Summary

Styrene-based resin systems properly used in cured-in-place pipe (CIPP) produce a safe and environmentally sound solution to the challenges in restoring the nation's failing infrastructure. This Guideline discusses styrene and other volatile organic compounds (VOCs) and how to use styrene-based resins in a manner that is safe to workers and residents in an environmentally friendly manner.

Although styrene occurs naturally in many foods such as cinnamon, coffee, and strawberries, styrene derived from petroleum and natural gas by-products has raised many questions about whether its usage in polyester and vinyl ester resin systems, commonly used in CIPP to rehabilitate piping systems, has the potential to adversely affect human health and/or the environment.

Because styrene odor can be detected at concentrations as low as 0.16 ppm or even lower[17], or as low as 0.1 ppm[16], depending on one's ability to detect odors, styrene's odor can be a nuisance to those not accustomed to working around it. To minimize odor concerns during the installation of CIPP, residents/homeowners should be informed of the CIPP installation schedule and what to expect. They should also be advised to ensure that their sewer traps are filled with water and are in a proper state of repair. In cases of damaged, dry, or non-existent traps, the areas or rooms where floor drains or access to traps are located should be ventilated, if possible, by leaving doors or windows open to the outside during the CIPP installation process. The resident/homeowner should be further advised that non-repair of a defective trap may cause hazardous sewer gases to enter the home.

During the installation process, contractors should practice good housekeeping and protect the environment and human health by preventing any accidental resin spillage as well as ensuring proper clean up and disposal. Given the nature of these resin systems to resist movement once placed in the tube's fiber matrix, only very small quantities, such as minor dripping or droplets, should be anticipated on a properly managed jobsite.

Industry standard practice when rehabilitating sanitary sewers with hot water cured CIPP is to discharge the cure water to the immediate downstream sanitary sewer manhole. The impact of styrene in the cure water when discharged directly to a sanitary sewer is typically insignificant if proper discharge procedures are utilized including cooling the cure water to at least 100 F prior to high volume discharges. Although every situation is different and dependent upon site conditions, the receiving downstream collection system should have adequate flow to properly dilute the discharged cure water. This minimizes odors from gases escaping downstream manholes and significantly reduces the risk of harm to wastewater treatment plants or the plants' discharge quality from either styrene or the temperature of the cure water/wastewater mix. Special precautions may need to be taken when discharging CIPP cure water into a sanitary sewer located immediately upstream from a wastewater treatment plant. Depending on the circumstances, these precautions may include making certain the cure water is properly cooled and possibly pretreated to reduce the styrene concentration to an acceptable level.

Studies by Purdue University and others[16] (see CUIRE-UTA Phase 1 Study for list) raised the question of possible hazards to workers and the public from styrene releases from steam cured CIPP job sites. These studies also found a number of other VOCs in the exhaust discharge. Little evidence was produced regarding the health effects of the exhaust discharge on either workers or the public, indicating a need for more studies.

Responding to the industry need for more research into the safety of styrene and other VOCs discharged into the atmosphere at steam cured CIPP job sites, in late 2017 NASSCO commissioned a two-phase study. Phase 1, by the Center for Underground Infrastructure Research and Education (CUIRE) at The University of Texas at Arlington (UTA), focused on the review of published literature pertaining to air emissions during CIPP installations using styrene-based resins. The work, completed in April 2018, found that prior studies did not adequately capture exposures or levels in surrounding areas to which workers or the public may be exposed. Also, the studies lacked information on the effect of different meteorological conditions. Based on information gathered from the literature review, CUIRE developed a scope for Phase 2 of the study. Results of the Phase 1 investigation were presented in the report "Evaluation of Potential Release of Organic Chemicals in the Steam Exhaust and Other Release Points during Pipe Rehabilitation Using the Trenchless Cured-In-Place Pipe (CIPP) Method"[16] (available for review at www.nassco.org).

As a result, the Phase 2 study, conducted by the Trenchless Technology Center (TTC) at Louisiana Tech, began in July 2019 and consisted of measuring emissions from steam cured CIPP job sites representing sewers of different lengths, diameters and in varying geographical locations. In all, nine CIPP job sites were visited. Measurements were taken before, during and after installation in various locations on the site as well as locations in the surrounding area and inside nearby buildings connected to the subject sewer. Worker exposure was also measured by personal monitors. In addition, dispersion modeling was conducted primarily to evaluate the emissions concentrations for possible worst-case scenarios over a range of weather conditions to determine best practice recommendations. Measured and modeled emission concentrations were compared to appropriate health-based criteria to determine if any potential health risks exist for workers or the nearby residents.

Phase 2 work was completed in late 2019 with the results presented via a webinar by TTC in December 2019 and in the report "NASSCO CIPP Emissions Phase 2: Evaluation of Air Emissions from Polyester Resin CIPP with Steam Cure"[17] (available for review at www.nassco.org).

During the Phase 2 study, of all the chemicals found both in CIPP steam cured CIPP emissions and on the EPA's TO-15 list, styrene was the only VOC to exceed regulatory thresholds for a portion of the measurements taken. Because of this important finding, only styrene was evaluated for health risks. Two situations were found to require safety precautions to protect workers: 1) upon initial opening of the transport truck/storage unit door and entering the transport truck/storage unit and 2) in the vicinity of the exhaust stack during the cure phase. Safety recommendations for in the vicinity of the exhaust stack are presented in the Steam Cure section of this Guideline.

In addition to the two situations found to require safety precautions to protect workers in the Phase 2 study, a subsequent study was recommended to better understand the concentrations and dispersion of styrene related to refrigerated storage units. As a result, the Phase 3 study conducted by TTC at Louisiana Tech, began in August 2021, focused on the VOC (styrene) emissions associated with various CIPP coatings and concentrations in refrigerated storage units.

Three tasks were identified as the project approach: 1) Styrene breakthrough analysis of various coatings in a laboratory setting utilizing gas chromatography (GC) to develop a mathematical model of styrene breakthrough concentrations over time, 2) Evaluate the GC model by simulating field conditions in a lab using a modified chest freezer to collect VOC (styrene) emissions and 3) Field validation of laboratory results in refrigerated storage units to conduct breakthrough analysis utilizing photoionization detectors (PIDs).

Phase 3 work was completed in early 2023 with results available in the report "NASSCO CIPP Emissions Phase 3: Evaluation of Styrene Emissions Associated with Various CIPP Coatings in Refrigerated Storage"[20] (available for review at www.nassco.org).

During the Phase 3 study, the laboratory breakthrough analysis curve was not replicated during field analysis, and developing a mathematical model of styrene breakthrough concentrations over time was not achieved. Recommendations for improving refrigerated storage unit safety on CIPP project sites are presented in the Water Cure and Steam Cure sections of this Guideline.

Introduction

Styrene is the ideal monomer used for cross-linking polyester and vinyl ester resins. Although alternative monomers have been extensively investigated and are currently in use in the CIPP industry, none of those monomers have matched the overall performance or cost of styrene. However, the use of styrene-free vinyl ester resins has increased principally because of publicity about styrene and styrene's distinctive odor and low threshold level of detection by humans.

The increasing awareness of the need to limit the effects of styrene exposure has led the polyester resin processing industry to pursue strategies to reduce exposure in the manufacturing and processing plant environment. Most of the studies undertaken to date have centered on these producers' and users' environments which are dramatically different than the work environment of the CIPP installation contractor. Given the desire to address the rehabilitation industry's need for standards in the proper safe use and handling of styrene-based resins for CIPP, in 2008 NASSCO created a styrene task force to review the technical information available from these studies and current CIPP installation practices to produce this Styrene Guideline. This guideline was updated in 2009, 2017, 2020 and now in 2023 based on the findings of the Phase 3 study referenced in the Executive Summary. In addition to this Guideline, NASSCO has prepared an Inspector Training and Certification Program (ITCP) for CIPP to properly equip owners, project engineers and inspectors with the necessary knowledge to ensure that a proper installation is achieved which minimizes the potential for release of styrene to the environment. An extensive revision of the ITCP training materials was completed in 2017, and further revisions are currently ongoing with an expected release date later in 2023. .

Polyester and vinyl ester resin systems have been used successfully for over 50 years in CIPP. Potential hazards are mitigated when proper confined space and other health and safety procedures are followed. Styrene vapors are heavier than air and will migrate to the bottom of confined spaces. Unfortunately, when proper health and safety protocols are not followed, hazards can occur. For example, there has been at least one reported incident involving worker safety where the effects of styrene gas may have contributed to the incapacitation of a worker who may not have been following proper confined space procedures resulting in loss of life due to drowning.

There have also been reports where styrene gas has entered buildings and caused the residents to evacuate. This is understandable because those not familiar with the smell of styrene may notice an unusual, chemical smell and become concerned. Although a small percent of the population may be affected by inhaling styrene from CIPP projects, such as experiencing upper respiratory tract issues, most people in these situations simply need to move to a well-ventilated area. As no definitive document for these resin systems used in the CIPP industry existed prior to 2008, the unknown gave rise to speculation as to their safety with respect to the workers involved, the general public, especially when the odors enter the structures connected to the piping under rehabilitation and the surrounding environment from where the work is taking place.

Styrene is a common chemical compound found where we live and work. Indoor sources of styrene emissions include off-gassing of building materials and consumer products and tobacco smoke. For example, styrene is emitted from carpet, floor waxes and polishes, paints, adhesives, putty, etc.

Styrene is expected to exist solely as a vapor in the ambient atmosphere[19]. In its vapor phase it is expected to react rapidly with hydroxyl radicals and with ozone. Half-lives have been estimated to range from 7 to 16 hours[18]. Atmospheric washout (the removal from the atmosphere of gases and sometimes particles by their solution in or attachment to raindrops as they fall) is not expected to be an important process because of these rapid reaction rates and styrene's low vapor pressure. Outdoor air monitoring by the EPA for 259 monitoring sites involving some 8,072 observations in 2007 showed that the mean concentrations for these sites were very low and ranged from 0.028 to 5.74 parts per billion (ppb). The primary sources of styrene in outdoor air include emissions from industrial processes involving styrene and its polymers and copolymers, vehicle emissions, and other combustion processes.

Published scientific journal articles agree that styrene biodegrades rapidly in most environments. Fu and Alexander[4] concluded that styrene will be rapidly destroyed by biodegradation in most environments having oxygen, although the rates may be slow in environments with low pH. Fu, Mayton and Alexander[5] concluded that being broken down by microbes is a major fate mechanism by which styrene is destroyed in soils. Cushman[6] concluded that styrene's potential impact on aquatic and soil environments is significantly mitigated by the rapid rate at which it evaporates and biodegrades in the environment. Alexander[7] concluded transport of styrene in nature is very limited because of its volatility from soils and surface waters, its rapid destruction in air and its biodegradation in soils and surface and ground waters.

Material Facts

Styrene Monomer

Property		Value
Auto-ignition Temperature (in air):		$914^{o}F$
Boiling Point:	@14.7 psi (Atmospheric Pressure)	$293^{o}F$
Color:		Colorless
Corrosivity:		Non-corrosive to metals except copper and alloys of copper
Density:	$32^{o}F$	7.71 lbs./US Gallon
	$68^{o}F$	7.55 lbs./US Gallon
Solubility: Styrene in Water:		
	$32^{o}F$	0.018 gms/100 gmsH_20
	$104^{o}F$	0.040 gms/100 gmsH_20
	$176^{o}F$	0.062 gms/100 gmsH_20
Upper (UEL) and Lower (LEL) Explosive Limits:		
	UEL	6.1%
	LEL	1.1%
	By Volume of Air @ $68^{o}F$ & Atmospheric Pressure	
2011 Health and Human Services Ruling:		Reasonably anticipated carcinogen

CIPP Installation Practices

Good Housekeeping. Many environmental and safety issues can be prevented when good housekeeping is practiced on CIPP installation job sites. One definition of good housekeeping is the general care, cleanliness, orderliness and maintenance of a business or property. That definition certainly applies to CIPP job sites.

Resins, catalysts and other chemicals must be handled with care to promote a safe working environment and prevent spills. This also applies to other liquids on the job site such as gasoline, diesel fuel, various oils, anti-freeze and other liquids common on construction sites. Spills on the ground, a street, sidewalk or on personal property must be addressed immediately. However, an additional level of concern must be raised when a spill enters a sanitary sewer, storm sewer, culvert or surface water.

Excess resin and CIPP trimmings in a sanitary sewer must be trapped and collected and properly disposed of during the installation process and at the conclusion of the project. Disposal may be as simple as collecting the waste liquid polymer in a container and initiating it with the same initiators used for cure. When the material has polymerized, depending on State or Provincial and local regulations, it may be disposed of as industrial waste.

When rehabilitating storm sewers or culverts, additional measures must be taken to prevent excess resin, resin residues or other liquids and debris from cutting and trimming the CIPP from entering a downstream storm sewer or receiving stream. Floating dikes or other devices should be used at the downstream end of a culvert to prevent excess resin from entering the stream. These devices must be maintained throughout the installation process until the installation is complete, including end trimming. Shavings from cutting devices can cause problems in surface waters, and if the floating dikes are removed prior to trimming the ends of the CIPP, these shavings can enter the water.

Provisions must be made by the contractor in advance for containing any accidental spillage of the resin, and these provisions should be included in the project Safety Plan. Further, if more than 2500 pounds of neat (unfilled) resin (approximately 1000 pounds of styrene) is spilled, the spill must be reported to the appropriate local pollution control authorities. For spills less than this "reportable quantity", check with Federal, State or Provincial and local disposal requirements. Absorption with an inert material and placing in an appropriate waste disposal container is the industry standard for handling small spills on the ground. Some absorbing agents, such as untreated clays and micas, will cause an exothermic reaction which might ignite the styrene monomer. For this reason, absorbing agents should always be approved by the resin manufacturer or tested for their effect on the polymerization of the monomer before they are used on larger spills.

It is recommended that the contractor continually clean the installation site of construction debris and keep tools in their designated storage location. The same is true for equipment items that have been used and are no longer needed to provide for a safe jobsite.

Water Cure

For CIPP installations using hot water to cure the resin, the cure water must be disposed of once the curing cycle is complete. For most sanitary sewer projects, this usually involves slowly discharging the cure water to the sanitary sewer once the cool down cycle has begun. Styrene readily dissipates through volatilization and degradation. In order to ensure that the cured CIPP remains tight fitting and dimensionally stable with the release of the cure water, the standard in the industry is to require that the cool down be continued until the temperature of the CIPP is no more than 100^{o}F. During the cool down process, a small hole is typically made in the downstream end to release hot water as cold water is introduced at the other end of the installation. For high volume discharges, the cure water should be cooled to 90 – 100 F for safety concerns downstream, to reduce the styrene concentration in the cure water, to protect downstream treatment facilities and to produce a higher quality CIPP product. In this case, releasing of the cure water directly to the sewer is not a concern due to the benefits of dilution in the downstream wastewater. When large volumes of process water are discharged to an existing, low capacity, smaller sewer, the flow must be regulated or limited by the contractor to provide for sufficient dilution of the cure water. The contractor should survey and/or notify the downstream homeowners of potential odors from residual styrene contained in the cure water.

In cases where an interceptor is rehabilitated immediately upstream of a wastewater treatment plant, the customer may request additional measures to lower the styrene content of the cure water. Carbon filters and aeration have been used to lower cure water styrene content. When discharging cure water to either a sanitary sewer or directly to a wastewater treatment plant, the temperature of the cure water may be of greater concern than the styrene content. Thousands of gallons of high temperature water discharged directly to a wastewater treatment plant could have a disruptive effect on biological treatment processes. Properly cooling the cure water is especially important in this case.

Cure water disposal is an important element in the safe installation of CIPP in all types of pipeline systems. When rehabilitating storm sewers and culverts, cure water disposal requires more attention. Cure water should not be discharged to the environment; it should be properly discharged to an adjacent sanitary sewer or hauled to a sanitary sewer manhole or wastewater treatment plant for disposal. Permission should be obtained, in writing, from the sewer or plant owner before discharging. Steam cure, which has only a small amount of steam condensate to manage, is a good installation alternative for storm sewers and culverts, where possible.

Following are NASSCO's recommendations for protecting workers and the public in and around CIPP water cured job sites.

1. All contractors must operate in a safe manner as well as review State or Provincial and local requirements regarding a site-specific safety plan before the start of any work on the project.
2. OSHA confined spaces in construction 1926.1203 shall always be followed.
3. All workers must have proper personal protective equipment (PPE).
4. A work zone perimeter should be maintained around the job site to prevent the public from entering. The limits of the perimeter should be based on distancing from general construction hazards.
5. Current data indicate the public is not at risk during the transfer of liners from the refrigerated storage unit.
6. Job site air monitoring should be conducted and documented for the refrigerated storage unit as installation companies use different types of tube coatings, have various amounts of liner in each storage unit, and follow a variety of installation procedures.
7. The current (April 2023) American Conference of Governmental Industrial Hygienists (ACGIH) has set the threshold limit value time weighted average (TLV-TWA) for styrene at 10 ppm and 20 ppm for the threshold limit value short term exposure limit (TLV-STEL). In addition, notations of ototoxicant and A3 carcinogen ("confirmed animal carcinogen with unknown relevance to humans") were also adopted for styrene.
8. Testing to determine the styrene level in the refrigerated storage unit is recommended when workers must enter. Typical testing instruments are photoionization detectors (PIDs) and detector tubes.
9. When using a PID, if levels are above the 20 ppm TLV- STEL when entering the refrigerated storage unit, the PID should alarm, and the employee should leave the storage unit.
10. Use of impervious coatings and ventilation will reduce the levels of styrene in the refrigerated storage unit and are recommended as first options to reduce styrene levels. Respiratory protection is recommended if these options are not available, and styrene levels exceed the TLV-STEL of 20 ppm.
11. Always define and maintain good housekeeping practices throughout the project period.
12. Discharge properly cooled cure water to a sanitary sewer with adequate flow for dilution.
13. Always keep the public informed and address their questions and concerns. Typically, a minimum 24-hour notification is made with a door-hanger. See NASSCO's 'What's that odor?' brochure and nassco.org for up-to-date information.

Following are TTC's recommendations regarding the refrigerated storage unit as stated in the Phase 3 Study recommendations:

1. From TTC Phase 3: Once storage unit or truck doors are opened and styrene thresholds reduce to below regulatory agencies' limits for the planned exposure time of workers, the truck can safely be entered for that amount of time with minimal PPE. Please refer to the latest exposure guidelines for styrene for full guidance.
2. From TTC Phase 3: If durations for exposure times must be exceeded, manufacturers could consider using thicker coatings, more impermeable coatings, wrapping the liners with impermeable materials to reduce the release of styrene in the refrigerated storage units, additional PPE appropriate for the higher styrene thresholds, etc.

Steam Cure

On steam cured CIPP projects, steam is introduced into the pressurized air flow on one end of the installation, and a mixture of mostly hot water vapor, styrene and other chemical byproducts are exhausted at the other end. Steam curing potentially reduces the amount of styrene that can be released into the environment because the quick cross-linking of the resin effectively binds up the styrene to a high degree. Also, large amounts of cure water do not have to be disposed. A small amount of steam condensate is produced, and this amount can be minimized by maximizing the flow of air through the curing CIPP for the site-specific conditions. This condensate should be cooled and discharged to a sanitary sewer. For storm sewer and culvert projects, the steam condensate should be handled in a similar manner as cure water; steam condensate should be collected and discharged to a sanitary sewer.

The TTC Phase 2 Study found that much of the styrene released using the steam cure method is in the vapor form, principally from the steam exhaust. Although higher levels of styrene can be measured directly in the steam exhaust at the end of the discharge hose, the Phase 2 study found that the styrene concentration of the vapor rapidly dissipates as it moves away from the discharge point. The styrene concentration in the air is rapidly diluted by the cube of the distance from the source. Also, higher levels of styrene are found in conjunction with heat, so as the air cools, the styrene level decreases. The styrene level decrease helps to determine the location of the public/worker perimeter to be established.

Following are NASSCO's recommendations for protecting workers and the public in and around CIPP steam cured job sites.

1. All contractors must operate in a safe manner as well as review State or Provincial and local requirements regarding a site-specific safety plan before the start of any work on the project.
2. OSHA confined spaces in construction 1926.1203 shall always be followed. In addition, no worker should enter a job site manhole during steaming operations.
3. All workers must have proper personal protective equipment (PPE).
4. Exhaust stacks should be a minimum of 6 feet in height above the work area.
5. The exhaust stack and manhole should have a 15-foot radius perimeter established around them.
6. Other sources of exhaust discharge (loose connections, glands, etc.) should be minimized and/or properly repaired or adjusted.
7. A work zone perimeter should be maintained around the job site to prevent the public from entering. The limits of the perimeter should be based on general construction hazards as well as proper distancing from exhaust discharge sources. Exhaust discharge sources that conflict with start/stop traffic lanes or pedestrian access areas should be included in the work zone perimeter.

8. Current data indicate the public is not at risk during the transfer of liners from the refrigerated storage unit.
9. Job site air monitoring should be conducted and documented for the refrigerated storage unit as installation companies use different types of tube coatings, have various amounts of liner in each storage unit, and follow a variety of installation procedures.
10. The current (March 2023) American Conference of Governmental Industrial Hygienists (ACGIH) has set the threshold limit value time weighted average (TLV-TWA) for styrene at 10 ppm and 20 ppm for the threshold limit value short term exposure limit (TLV-STEL). In addition, notations of ototoxicant and A3 carcinogen ("confirmed animal carcinogen with unknown relevance to humans") were also adopted for styrene.
11. Testing to determine the styrene level in the refrigerated storage unit is recommended when workers must enter. Typical testing instruments are photoionization detectors (PIDs) and detector tubes.
12. When using a PID, if levels are above the 20 ppm TLV-STEL when entering the refrigerated storage unit, the PID should alarm, and the employee should leave the storage unit.
13. Use of impervious coatings and ventilation will reduce the levels of styrene in the refrigerated storage unit and are recommended as first options to reduce styrene levels. Respiratory protection is recommended if these options are not available, and the styrene levels exceed the TLV-STEL of 20 ppm.
14. Always define and maintain good housekeeping practices throughout the project period.
15. Discharge cooled steam condensate to a sanitary sewer.
16. Always keep the public informed and address their questions and concerns. Typically, a minimum 24-hour notification is made with a door-hanger. See NASSCO's 'What's that odor?' brochure and nassco.org for up-to-date information.

Following are TTC's recommendations for protecting workers and the public in and around CIPP steam cured job sites as covered in the Phase 2 Study and also regarding the refrigerated storage unit as stated in the Phase 3 Study recommendations.

17. From TTC Phase 2: Exhaust stacks should be a minimum of 6 feet in height above the work area. This enhances the dispersion of emissions and lessens the likelihood of workers entering the steam plume even when wearing PPE.
18. From TTC Phase 2: The steam exhaust stack and manhole should have a 15-foot radius perimeter established around them. This perimeter can be entered for short amounts of time not exceeding 5 minutes. Longer durations require additional PPE.
19. From TTC Phase 3: Once storage unit or truck doors are opened and styrene thresholds reduce to below regulatory agencies' limits for the planned exposure time of workers, the truck can safely be entered for that amount of time with minimal PPE. Please refer to the latest exposure guidelines for styrene for full guidance.
20. From TTC Phase 3: If durations for exposure times must be exceeded, manufacturers could consider using thicker coatings, more impermeable coatings, wrapping the liners with impermeable materials to reduce the release of styrene in the refrigerated storage units, additional PPE appropriate for the higher styrene thresholds, etc.

Light Cure

Light cure CIPP is installed by pulling or inverting the liner into place and then inflating with air. No end product of water or steam condensate is produced requiring disposal and/or monitoring. Depending on the installation method used, large volumes of air may be pumped through the wet-out tube and exhausted to maintain its inflated condition while the light curing equipment is pulled through for curing. During the light cure process, heat and styrene vapor are released within the CIPP and exhausted at the discharge end.

Following are recommendations for protecting workers and the public in and around CIPP light cured job sites:

1. All contractors must operate in a safe manner as well as review State or Provincial and local requirements regarding a site-specific safety plan before the start of any work on the project.
2. OSHA confined spaces in construction 1926.1203 shall always be followed.
3. All workers must have proper personal protective equipment (PPE).
4. A work zone perimeter should be maintained around the job site to prevent the public from entering. The limits of the perimeter should be based on general construction hazards.
5. Job site air monitoring should be conducted and documented according to regulatory guidelines.
6. Always define and maintain good housekeeping practices throughout the project period.
7. Always keep the public informed and address their questions and concerns. Typically, a minimum 24-hour notification is made with a door-hanger.

General Curing Recommendations

It is imperative that the manufacturer's recommendations be followed no matter which curing method is being used. Properly cured CIPP releases less styrene to the environment over time. Thermocouples and/or continuous monitoring sensor systems placed strategically in the liner/host pipe invert interface are a must for heat cured CIPP. A written cure schedule acknowledging the climatological and site conditions present, resin system proposed, cure times, and cure temperatures will lead to a proper cure, a long CIPP design and service life and minimal environmental impact.

Proper planning is also very important when using styrene-based resins, especially when heavily occupied buildings are connected to the sewer being rehabilitated. In addition, caution around fresh air intakes during CIPP installations must be well managed to prevent styrene from migrating into buildings.

Summary

Following proper procedures when installing and curing CIPP minimizes styrene releases to the environment. CIPP should be installed in accordance with the manufacturer's written instructions and cured following the manufacturer's or resin supplier's written cure schedule. Cure water, exhaust discharges and condensates, air and other discharges to the environment should be properly managed. In addition, contractor good housekeeping on the jobsite is always in order.

Following proper procedures and observing the recommended job site practices discussed in this document attempt to minimize the safety risk to workers and the public, which is NASSCO's key objective in producing this Styrene Guideline. The Contractor's primary responsibility is to provide a safe worksite, including providing a detailed site-specific safety plan as required by State or Provincial and local requirements.

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