



1900 Arch Street Philadelphia, PA 19103-1498 (215) 564-3484  
Fax: (215) 564-2175 Email: [tsa@fernley.com](mailto:tsa@fernley.com) [www.tinstabilizers.org](http://www.tinstabilizers.org)

## ***Tin Stabilizers Safely Enhance the Performance of PVC Water Pipe Applications***

### **OVERVIEW**

PVC pipe is one of the most effective materials for delivering clean water and carrying waste to treatment facilities. In fact, PVC (polyvinyl chloride, commonly known as vinyl) is the predominant material used in drain, waste and vent applications and is used in cold-water delivery systems. Another formulation, CPVC (post-chlorinated polyvinyl chloride) is used in both hot and cold-water delivery systems.

PVC/CPVC pipe has been manufactured with tin stabilizers for more than 40 years and has a long history of safe and effective use with outstanding performance characteristics:

- ✍ **It is easy to install.** PVC pipe is lighter in weight than other piping systems, and can be assembled using simple tools and techniques.
- ✍ **PVC pipe will not corrode**, from the outside or the inside, which gives it a **long service life**. This means it won't react with the water carried through the pipe. It also is impervious to corrosive soil conditions, a known cause of damage to buried water mains made of metal.
- ✍ No corrosion also means **excellent water quality and excellent water flow**. With other materials, corroded particles can contaminate water being sent through the pipe. Because the interior walls of PVC pipe are smooth, **flow rates remain high** for the life of the system.
- ✍ **PVC pipe is durable**, resists leaks and performs to specifications over a long lifetime. This also means that, once installed, the piping system is **reliable** and requires less costly maintenance than other piping systems.
- ✍ **Because of its relative flexibility, PVC pipe is resilient.** This allows it to withstand pressure without breaking. This was perhaps best illustrated by a 1994 earthquake near Los Angeles, in which about half of the water main system was made up of PVC pipe, which did not fail. (The rest of the system, made up of cement and steel pipe, suffered hundreds of main line breaks, according to a spokesman for the Valencia Water Company, which services the area.) He attributed the excellent seismic performance of PVC to its flexibility.

### **TIN STABILIZERS AND THE PERFORMANCE OF PVC PIPE**

Tins have long been the most commonly used stabilizers for PVC pipe manufactured in North America. They are a key contributor to the overall outstanding performance of PVC pipe, including the color of the finished article and durability. Tin stabilizers also improve output rates during the extrusion manufacturing process. These elements improve the long-term performance of the pipe, and allow PVC pipe to meet certification standards for water safety.

Much of North America's potable water infrastructure was built with cast iron, and is now aging to the point where water main breaks have become all too common. The US Environmental

Protection Agency (EPA) estimates that 54,000 drinking water systems will require a \$150.9 billion investment during the next 20 years just to ensure safe drinking water. The American Water Works Association (AWWA) puts the number at \$250 billion over 30 years to replace worn-out drinking water pipes, valves and fittings. That figure is extrapolated from an analysis of 20 utilities.

A study by the National Research Council Canada evaluated five different pipe materials and found that cast iron failed most often, while PVC pipe had the lowest failure rate. Many municipalities are replacing significant portions of their water distribution systems due to failure, and turning to PVC pipe for its durability and overall cost performance. In fact, according to trade organization Uni-Bell, PVC pipe – virtually all manufactured with tin stabilizers – now accounts for about 70 percent of the new buried water distribution pipes being installed throughout the United States and Canada.

### **CERTIFICATION AND REGULATION**

As with all other pipe for potable water, PVC pipe must pass an exacting certification process that covers the manufacturing process as well as the materials used to make the pipe, including tin stabilizers. In 1985, the EPA contracted with a consortium led by NSF International (NSF) to develop health effects standards and a product certification program for components of the drinking water system, as well as treatment chemicals. NSF International is a third party, independent, not-for-profit organization dedicated to public health, safety and protection of the environment. The consortium also included AWWA and its research foundation, AWWRF, and the Association of State Drinking Water Administrators (ASDWA).

NSF developed the standards, which were approved by the American National Standards Institute (ANSI) in 1989. EPA recognizes these standards as the criteria for determining that the materials or products used to convey potable water meet EPA Drinking Water Standards for safety and health. (EPA does not directly regulate the use of tin stabilizers in PVC.)

As a result of this process, two standards regulate the industry: ANSI/NSF Standard 14, which is a nationally and internationally recognized pipe performance standard, and ANSI/NSF Standard 61, which covers health effects and safety standards for pipe. Standard 61 contains well-established procedures for setting safe levels of contaminants based on a full assessment by professionals.

In the process of certifying pipe under these standards, NSF tests the materials used to make the pipe, and conducts periodic audits and inspections of manufacturing facilities and quality control programs at those facilities. Pipe and fittings that meet these standards are marked accordingly. NSF has concluded that, based upon the ANSI/NSF standard, the evaluation of PVC/CPVC pipe is protective of human health. The presence of any tin in potable water due to its use as a heat stabilizer is well below the safe limits imposed by the NSF, and does not present a human health risk.

Actual testing predates these standards. Since 1965, NSF has been developing standards for the testing and certification of plastic plumbing components. NSF began collecting extraction data on PVC and CPVC pipe in the 1970s.

Based on a thorough review of the data collected, NSF has concluded that tin stabilizers used in potable water pipe (mono- and di-methyltin and butyltin compounds) do not pose a risk to human health.

Another third-party certifying agency, Underwriters Laboratories (UL), also has set standards for piping and pipe materials used in potable water pipe, including those made of PVC and CPVC.

### **TESTING OF WATER SYSTEMS**

A number of studies have been conducted in North America on the presence of tin stabilizer compounds in water from new and existing PVC and CPVC pipe installations. These studies show that, while organotins have been detected, the levels are too low to cause a concern for effects on human health. In fact, the amounts detected are well below the safe Short Term Exposure Levels (STEL) and Maximum Allowable Levels (MAL) established by Standard 61. For example, single time point testing results for organotin extraction from PVC and CPVC pipe, fittings and materials under Standard 61 showed average levels in CPVC at 11 ppb, and in PVC at 6.4 ppb – well below levels that would present a human health risk. Further, more than 99 percent of PVC pipe tested with a multiple time point analysis met the criteria for exposure as defined under Standard 61, Appendix A.

When tin stabilizers are detected in the water, it is usually just after new pipes have been installed. This is because residues of some of the materials used in the pipe formulation may be left on the pipe wall after manufacturing, and these residues – which may include tin – are quickly washed away into the water as it flows through the pipes. Most importantly, after the residues are washed off, the levels of tin decline dramatically and, as studies show, are negligible after about 12 hours. Since newly installed pipe systems are routinely flushed before consumer use, most of these residues are removed and the resulting low concentrations of tin in drinking water do not present any potential risk. In fact, after just a few liters of water pass through the system, levels drop to the parts per trillion range – well below established safe levels.

### **OTHER CONSIDERATIONS**

Presently, EPA's recommended water quality criteria, developed in response to the federal Clean Water Act, is based only on the total amount of tin from all sources. However, organotin compounds, which are present in tin stabilizers, are currently among 50 chemical substances on the EPA's Drinking Water Contaminant Candidate List (CCL). The inclusion of organotins on the CCL does not necessarily mean that they will be regulated. It simply means that they warrant further investigation. The tin stabilizer industry is voluntarily working to fill data gaps identified by the EPA.

Occasionally, regulators, customers and environmental organizations have expressed some concerns about tin stabilizers because they mistakenly equate these products with tributyltin (TBT) biocides.

TBT is used primarily in marine antifoulant paints and is a registered pesticide in the US and Canada. Many countries have regulated its usage and application. TBT is never used as a stabilizer, and tin stabilizers do not have biocidal properties.

Concern over TBT in the environment has raised concern about all organotin compounds. This concern is misplaced, as tin stabilizers have been safely used in vinyl products for many years without cause for concern.

It is important, therefore, to clearly distinguish between TBT and tin stabilizers on issues related to environmental and human health effects.

## **CONCLUSIONS**

Tin stabilizers are key components in the overall outstanding performance of PVC and CPVC pipe, and have been safely used for several decades. PVC pipe has demonstrated its value and is now preferred over traditional piping materials because of its performance and longevity.

To ensure continued safety, tin stabilized PVC/CPVC pipe is tested to rigid standards and certified for use by NSF. Regular reviews support the continued safe use of tin stabilizers in PVC/CPVC. As part of its ongoing commitment to Responsible Care<sup>®</sup> and Product Stewardship initiatives, the PVC/CPVC pipe industry, in conjunction with the tin stabilizer industry, continues to monitor and provide new information on materials used in manufacturing to assure the safety of their products.

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