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How Tempe Controls Manhole Odors

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The adjacent cities of Tempe and Mesa, Arizona, rely on a combined wastewater collection system comprising 434 miles of sanitary sewer lines and more than 6,000 manholes. The 40-mgd system serves a total metropolitan population of nearly 450,000.

Turbulent flows at the force main discharges and other areas of the sewer system cause considerable hydrogen sulfide off-gassing and resultant odor emissions through nearby manhole covers. In addition, low sewage volume, typically a problem in newly developing suburban communities, causes the liquid waste stream to become stagnant and highly odorous.

The influence of stream volume and velocity is further compounded by the high temperatures experienced in this semiarid area of the country. During summer months, wastewater temperature in the pipes frequently exceeds 90°F. Extremely warm temperatures encourage the rapid growth of bacteria which, in turn, hastens the formation of volatile, odor causing sulfide compounds that may easily escape into the air through manhole covers.

Tempe's Water & Wastewater Division investigated several remedial treatment schemes over the past six years. City personnel and consultants have concluded that a combination of caustic soda and adsorption with activated carbon works best to solve sewer system odor problems.

The author holds a carbon canister as he inspects a Sweet Street installation.

Odor Abatement Program

Tempe began a formalized odor abatement program in 1983. Initially, the program included the logging of all citizen odor complaints, with a description of the type of odor; the most common odor was the characteristic rotten eggs smell of hydrogen sulfide.

For the first few years, odor studies basically consisted of instrument confirmation of complaints by citizens. Using a special gas detector instrument, Tempe's staff would insert a probe into closed manhole covers and take odor readings. Hundreds of manholes were investigated in this manner. The overall goal was to identify and isolate geographic areas that consistently generated odor complaints, rather than just seeking to locate individual problem manholes.

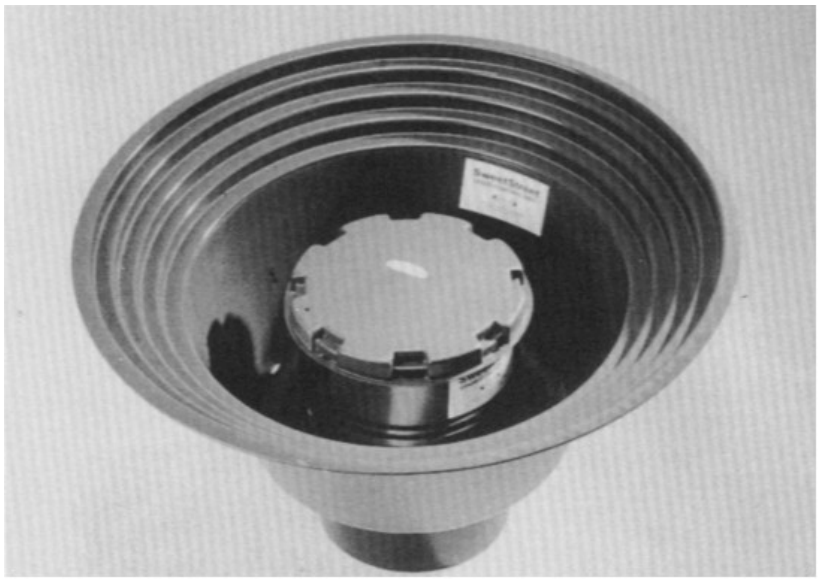
In addition to odor monitoring, the early odor abatement program involved the use of a hydraulic power cleaner to remove the bacterial slime layer clinging to the side of the pipe. Where a stretch of line was clearly identified as an odor problem, Tempe added a liquid deodorizer or an odor block to mask future odors and seal the manhole. These efforts were only partially successful and sulfide odors usually returned quickly after line cleaning.

In 1986, Tempe began using more sophisticated electronic as detection equipment. The city also hired a consultant to assimilate previously collected data, start a computerized analysis of the complete wastewater system, and make recommendations for improved control of nuisance odors emanating from manhole covers.

Based on computerized analysis of slope, pipe diameter, flow, effective BOD, and temperature of the wastewater, the consultant developed a model that led to investigation of "suspected" odor-causing areas that could not be confirmed with previous testing techniques and equipment. Also, the computerized analysis predicted future tracts of city land that would have high odor potential.

Three major option for odor control emerged from the consultant's studies. They involved the use of dissolved oxygen, caustic soda, and/or adsorption with granular activated carbon.

In 1986, Tempe started a pilot program through which it fed pure oxygen into the force main. To a limited degree, the dissolved oxygen approach reduced sulfide levels in certain downstream areas of the system. However, Tempe's industrial waste personnel felt that this option would not effectively control odors at the wet well site nor would it control odors in the upstream collection system.



Stepped configuration of the insert adapts to manhole size.

Use of Caustic Soda

Odorous hydrogen sulfide is produced by the slime layer of bacteria attached to sewage pipe walls. Caustic soda (sodium hydroxide) was first used by Tempe in 1986 to shock the bacteria, resulting in inhibition and/or destruction of the bacterial slime layer. This was done while the pH level was raised to 12.5 for 30 minutes.

In March of 1986, the city fed approximately 100 gallons of sodium hydroxide into the wet well and force main. Sulfide levels were reduced to near zero for about 10 days. During the hot summer months of that year, caustic dosing was necessarily increased.

As a result of this initial success, Tempe began using caustic soda as a primary odor abatement method. During the summer of 1987, the city treated two sites on the south end of town and three sites in the center of town. Testing reconfirmed that slime layer regeneration, increases in sulfide production, and resultant odor complaints began to occur approximately seven to ten days after treatment was initiated. Accordingly, Tempe set up a program whereby caustic soda was added to the collection system every six days.

Carbon Adsorption

For more than two decades, granular activated carbon has been used to effectively adsorb and remove odor causing sulfides, mercaptans, and other foul smelling compounds generated at sewage pumping and treatment plants. In 1987, Tempe became aware that Calgon Carbon Corporation had developed a new product, called Sweet Street“, designed specifically to capture odors venting from sewer manholes.

Sweet Street odor control units are compact, modular canisters. Each unit is supplied with 20 pounds of specially impregnated Sweet Street carbon. This carbon has more than twice the capacity for hydrogen sulfide as an equal amount of standard vapor phase carbons and other impregnated adsorbents.

Standard canisters fit existing manholes in sizes ranging from 18- to 37-in. The modular components permit easy assembly and installation into existing manholes. Installation at each manhole in Tempe took less than 30 minutes, including application of roofing cement to assure a good canister seal.

During the July 4, 1987 weekend, the city began to install Sweet Street carbon canisters on portions of a sewer line that historically generated the most odor complaints. Neither caustic soda nor ferric chloride (another chemical sometimes used for treatment) stopped odors in this area.

Specifically, the high odor, high complaint are is located in the heart of town at the six-lane intersection of Priest and Southern Roads. Two sewage lines from Mesa meet underneath this intersection. Due to high sulfide production and high wastewater turbulence, this area had emissions measured at greater than 40 ppm - an excessively high level. However, installation of Sweet Street carbon canisters in strategic manholes instantly reduced the sulfide levels to below 5 ppm measured at the pick hole.

Although inlet gas concentrations were extremely high, the canisters lasted through the summer without need for replacement of the carbon.

Based on this successful experience with Sweet Street, Tempe installed 18 units by the beginning of the summer of 1989. Many of the units are sited in manholes downstream from the Priest/Southern Roads intersection. Others are located at force main and other high turbulence areas of the wastewater collection system. The city anticipates purchase and installation of additional units before the summer of 1990.

During the past six years, Tempe has investigated a variety of methods to control odors from its wastewater collection system. The optimal treatment approach now involves the use of caustic soda for bacterial shock treatment, and the use of activated carbon canisters to capture odors escaping through manhole covers.

In addition to upgrading its treatment, Tempe has also purchased a state-of-the-art hydrogen sulfide testing instrument. The instrument is used to determine specific concentrations of hydrogen sulfide and to indicate when it will be necessary to replace the carbon adsorption media held in the canisters.

Tempe also uses a new recording gas detector instrument that helps detect hydrogen sulfide variations caused by change in sewage flows and other factors. The instrument may be hung in a manhole to record hydrogen sulfide over a period of time; data are continuously recorded into a personal computer for future analysis.

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