An Assessment of

Long-Term Performance of Non-Water (Waterfree) Urinals

in Relation to Drain Line Buildup

Falcon Waterfree Technologies and

Sloan Valve Company

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Abstract

A current initiative in the United States Environmental Protection Agency (EPA) WaterSense program is to develop a specification for high-efficiency urinals (HEU), which includes non-water (waterfree) urinals. The EPA has requested information and data from manufacturers of non-water urinals to better understand concerns about drain line clogging as it relates to the use of non-water urinals. This paper provides the EPA with technical information as to what occurs in drain lines for non-water urinals in comparison to drain lines for water-flushing urinals.

When water-flushing urinals are utilized, hard material bonds to drain pipe walls and must be mechanically routed out. This basic fact of drain line clogging is evidenced by several businesses in the plumbing service industry offering products that keep flush urinals from clogging including Roto Rooter and Ready Rooter; not to mention the plethora of other products that are commercially available for the same use. Unlike water-flushing urinals, a substrate from non-water urinals (explained in detail in this report) is easily and readily washed away as a result of routine, proper product maintenance.

Non-water urinals have been in use in the United States for over 15 years. Each year, an increasing number of water utilities and commercial customers are utilizing non-water urinals to preserve natural resources, improve restroom hygiene, save money, and realize improved product performance. The WaterSense Specification for HEUs should now be developed as there is no diminution of drain line carry or performance from use of these safe, sanitary, hygienic non-water urinal plumbing fixtures.

Introduction

The use of non-water urinals does not require any special changes to the plumbing system to which they are installed. Proper slope, installation, and maintenance are required in much the same manner as all other plumbing fixtures. In all water-flushing plumbing fixtures such as toilets, sinks, showers, and urinals, the drain, waste, and vent (DWV) portions of plumbing systems can clog. This is also true for non-water urinals.

The water-flushing urinal installations included in this report range from 21 months to ten years of continuous operation, while all of the non-water urinal installations that are included in this report were installed and remain in continuous operation for 4 to 6 years. There are over 100,000 non-water urinals installed domestically, comprised of Falcon Waterfree, Sloan Waterfree, and other brands.

Non-water urinals are becoming increasingly common and can be found in every type and size of commercial application, from single urinals in small cafes to over 900 in large stadiums, and from single-story service stations to the tallest LEED rated building in the world (the Bank of America Tower in New York City). All of the non-water urinals that are installed save valuable and limited water resources, save money, and provide for a safe restroom environment.

In response to the EPA request for information on the long-term performance of non-water urinals in relation to drain-line issues, this paper presents facts and figures on both water-flushing urinals and non-water urinals.

Plumbing Fixtures and Plumbing System Design Technical Overview

In order to provide a complete assessment of the use of safe, sanitary, hygienic non-water urinals and their impact on drain lines, it is important to first understand the purpose of Plumbing Codes and Standards as they relate to both plumbing fixtures and plumbing systems.

Section 101.3 of the International Plumbing Code spells out very clearly the intent of the entire code: "*The purpose of this code is to provide minimum standards to safeguard life or limb, health, property and public welfare by regulating and controlling the design construction, installation, quality of materials, location, operation and maintenance or use of plumbing equipment and systems*." It is critical to recognize that both installation and maintenance are included within the general scope of the Plumbing Code.

The Plumbing Code is then organized into various sections including definitions, fixtures, water supply and distribution, sanitary drainage, and traps and interceptors. All sections of the Plumbing Code, taken in sum, lay out the types of equipment and systems that are permitted for use.

For non-water urinals, there are two ANSI approved, nationally recognized standards- ANSI/IAPMO Z124.9 for plastic urinals and ANSI/ASME A112.19.19 for vitreous china urinals. The development, adoption, publishing, and renewal of these standards follows a rigorous consensus processes as required by ANSI. These standards provide the necessary

requirements and testing criteria to ensure that these plumbing fixtures are safe, sanitary and adequate for use in any properly installed plumbing system.

In a manner similar to the product fixture standards, Plumbing Code is also developed, adopted, and renewed utilizing consensus processes. All three model plumbing codes in the United States currently or are planned to reference the product standards for non-water urinals. Plumbing codes provide specific requirements for the design and installation of proper sanitary drainage, which includes the requirement that horizontal drain lines with a diameter of 3 inches or less have a minimum of 1/4 inch or 2 percent downhill slope (*International Plumbing Code 704.1 and Uniform Plumbing Code 708.0*).

The nationally recognized consensus standards for non-water plumbing fixtures ensure that they are safe, sanitary, and hygienic. All three model plumbing codes in the Unites States allow the use of waterfree urinals and reference the appropriate product standard(s) or are in the process of permitting them. Falcon/Sloan Waterfree urinals meet or exceed all of these standards.

This report demonstrates that when properly installed and maintained, Falcon/Sloan Waterfree (non-water) urinals do not create long-term drain-line buildup or clogging. For comparison, this report also provides numerous instances of flushing urinals that have created long-term drain line clogging or build-up.

Facts and Figures

Purpose and Requirement of Water-flushing Urinal Clean-out Plugs

All drainage systems are subject to blockage and must be periodically cleaned. Drain line blockage is an important and large enough of an issue that it has been addressed by model plumbing codes and capitalized upon by independent businesses that offer preventative and remediation services.

Clean-out plugs (see Figure 1) are common, commercially available drainage system components that provide access for removal of drain line blockage, minimizing the need for invasive remediation that could include demolition of walls and replacement of drain pipes. Plumbing code officials have demonstrated foresight with regards to the potential detriments of blocked drainage systems by establishing codes that require the installation of clean-out access throughout sanitary systems, which allow for periodic cleaning and clog removal. In addition, plumbing codes also require placement of clean-out plugs in specific, strategic locations where frequent clogging is known to occur, such as at urinal fixtures (see Table 1).

Figure 1. Drain pipe fitting with a clean-out plug.

Table 1.

Uniform Plumbing Code (UPC) Chapter 7
SANITARY DRAINAGE 707.0 Clean-outs
707.4

Each horizontal drainage pipe shall be provided with a clean-out at its upper terminal, and each run of piping, that is more than one-hundred (100) feet (30,480 mm) in total developed length, shall be provided with a clean-out for each one-hundred (100) feet (30,480 mm), or fraction thereof, in length of such piping. An additional clean-out shall be provided in a drainage line for each aggregate horizontal change of direction exceeding 135 degrees (2.36 rad).

Exceptions:
(1) Clean-outs shall be permitted to be omitted on a horizontal drain line less than five (5) feet (1,524 mm) in length unless such line is serving sinks or urinals.

The Uniform Plumbing Code (UPC) is developed and governed by the International Association of Plumbing and Mechanical Officials (IAPMO), which utilizes an open consensus process that is accredited by the American National Standards Institute (ANSI). Before the addition or revision of UPC content, the open consensus process must validate the necessity for the addition or revision. The code section cited in Table 1 is based upon the consensus on common clogging in drain lines that serve urinals.

Clean-out plugs on water-flushing urinal drain lines are usually visible on restroom walls where plumbing chases are not accessible (see Figures 2-6).

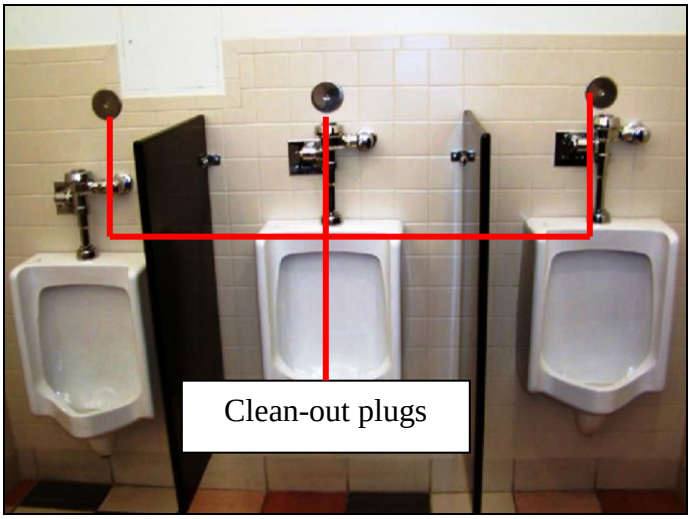

Figure 2. Clean-out plug examples.

Figure 3. Clean-out plug example.

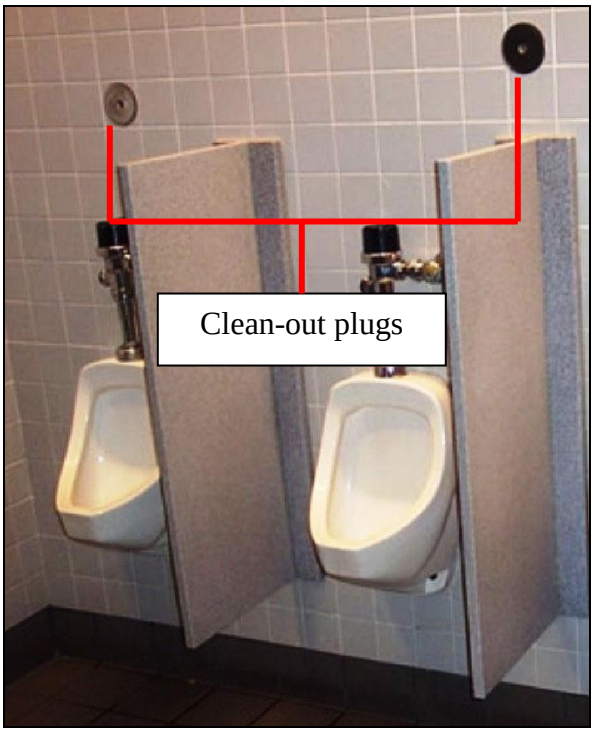

Figure 4. Clean-out plug examples.

Figure 5. Clean-out plug example.

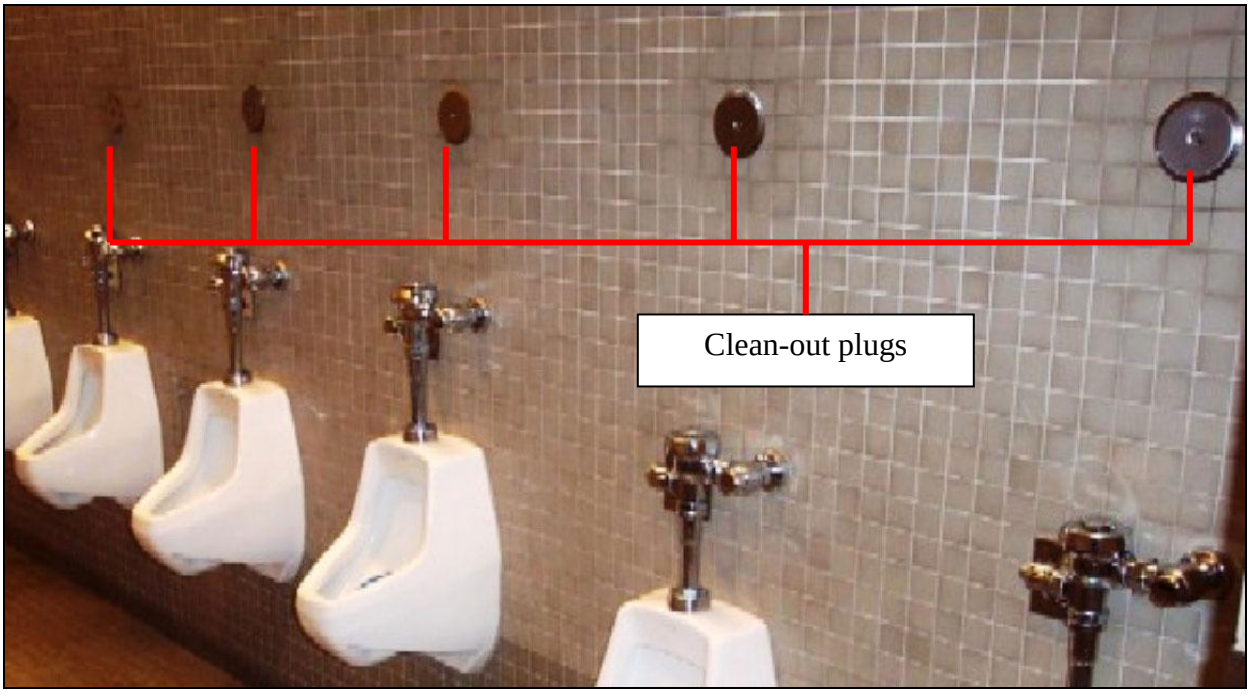

Figure 6. Clean-out plug examples.

Urine Composition

Human urine is comprised of approximately 96 percent water and 4 percent other constituents, which include 1.8 percent urea, 1.2 percent mineral salts, 0.06 percent creatinine, 0.03 percent uric acid, and 0.91 percent additional biological constituents[1].

Urine contains organic and inorganic constituents, with organic constituents representing 58 percent and inorganic constituents represent 42 percent of the total 4 percent volume. The principal organic constituent in urine is urea, representing 99 percent of the organic volume. The principle inorganic constituent in urine is sodium chloride, representing 50 percent of the inorganic volume.

What Happens in Drain Pipes of Water-flushing Urinals?

Mineral Constituents Found in Water-Flushing Urinal Drain pipes

The inorganic mineral sediments found in water-flushing urinal plumbing drain pipes were identified using X-Ray Diffraction (XRD) and were found to be comprised primarily of calcite (CaCO3). Other inorganic mineral sediments were found, such as Hydroxyapatite Ca5(PO4)3(OH) and Struvite (MgNH4PO4.6H2O) but at much lower concentrations. Note: Hydroxyapatite, also known as Hydroxylapatite or HAP, is a form of calcium apatite with the

[1] Putnam, D. (1971, July). *Composition and Concentrative Properties of Human Urine*. Retrieved August 29, 2008, from http://ntrs.nasa.gov/archive/nasa/casi.ntrs.nasa.gov/.

formula Ca5(PO4)3(OH) but is usually written Ca10(PO4)6(OH)2 to denote that the crystal unit cell comprises two molecules.

Water-Flushing Urinal Drain pipe Buildup and Maintenance

Water-flushing urinals produce calcite buildup in the urinal bowl and drain pipes. Calcite buildup is solid in consistency, bonds to the pipe wall, and can only be removed by accessing the drain pipe through a clean-out plug using a drain machine (see Figure 7) with cutter heads to remove the hard deposits.

Figure 7. Drain machine.

If no clean-out plug exists, the urinal must be removed from the wall for access to any portion the drain pipe. In most cases the urinal must be removed from the wall to clean the horizontal connection nipple because the nipple cannot be accessed through cleanouts. In some instances, buildup can become so severe that pipes may need to be replaced.

The cause for this hard buildup in water-flushing urinals is due to mineral ions in flushing water combining with the sediment in urine. A chemical bond is formed between the flushing water minerals and the urine sediment to form a hard calcite buildup inside the drain pipe. The addition of flushing water to urine sediment is similar to adding a catalyst or hardener to a resin or glue.

Examples of drain pipes sections that served water-flushing urinals are shown on the following pages (see Figures 8-15).

Figure 8. Drain pipe for water-flushing urinal at Fort Bliss in El Paso County, Texas, removed after 8 years of service.

Figure 9. Drain pipe for water-flushing urinal at Fort Bliss in El Paso County, Texas, removed after 8 years of service.

Figure 10. Drain pipe for water-flushing urinal at Fort Bliss in El Paso County, Texas, removed after 8 years of service.

Figure 11. Horizontal fixture run, directly beneath water-flushing urinal at Aquinas College in Grand Rapids, Michigan, removed in 2005 after 12 years of service.

Figure 12. Vertical stack drain pipe for water-flushing urinal at Lackland Air Force Base in San Antonio, Texas, removed after 24 months of service.

Figure 13. Vertical stack drain pipe for water-flushing urinal at Lackland Air Force Base in San Antonio, Texas, removed after 24 months of service.

Figure 14. Urinal outlet for water-flushing urinal at Los Angeles County Beaches, removed after 3 years of service.

Figure 15. Horizontal pipe nipple/drain connection in 2005 after removing a water flushing urinal that had been in operation for less than five years at CPR in Grand Rapids, Michigan.

What Happens in Non-Water Urinal Drain Pipes?

Mineral Constituents Found in Non-Water Urinal Drain Pipes

The inorganic mineral sediments found in non-water urinal plumbing drain pipes were identified using X-Ray Diffraction (XRD) and found to be comprised primarily of struvite (MgNH4PO4.6H2O) Magnesium Ammonium Phosphate Hexahydrate, also known as MAP. Other inorganic mineral sediments were found, such as Hydroxyapatite Ca5(PO4)3(OH) and Calcite (CaCO3) but at much lower concentrations.

Non-water Urinal Drain Pipe Buildup and Maintenance

Falcon/Sloan Waterfree urinals have a sealed cartridge trap that acts as a sediment catch, reducing the amount of sediment entering the drain pipe. These non-water urinals are also installed with a unique drain line connection system (see Figure 16), which provides an internal 2% slope in compliance with the plumbing codes. This slope ensures that the liquid waste will be properly discharged in the drainage system.

The sealed cartridge trap of a non-water urinal acts as a sediment catch, reducing the amount of sediment entering the drain pipe. Manufacturer specified maintenance procedures for cartridge replacement include pouring a bucket of water (see Figure 17) into the system, which removes loose and soft sediment from the pipes. Sediment from undiluted urine in the drain pipe remains soft and does not form hard buildup like water-flushing urinals. This is because there is no

addition of flush water to the sediment. Without the use of flush water as a catalyst or hardener, the sediment remains soft and is rinsed away by flushing water through the empty cartridge housing into the drain pipe. Without hard buildup in the drain pipe, there is no need to open a clean-out plug or remove the urinal from the wall. Non-water urinal drain pipes can be rinsed clean by the action of flowing water.

Figures and details of non-water urinal drain pipes are shown in pages 38-52 of this report.

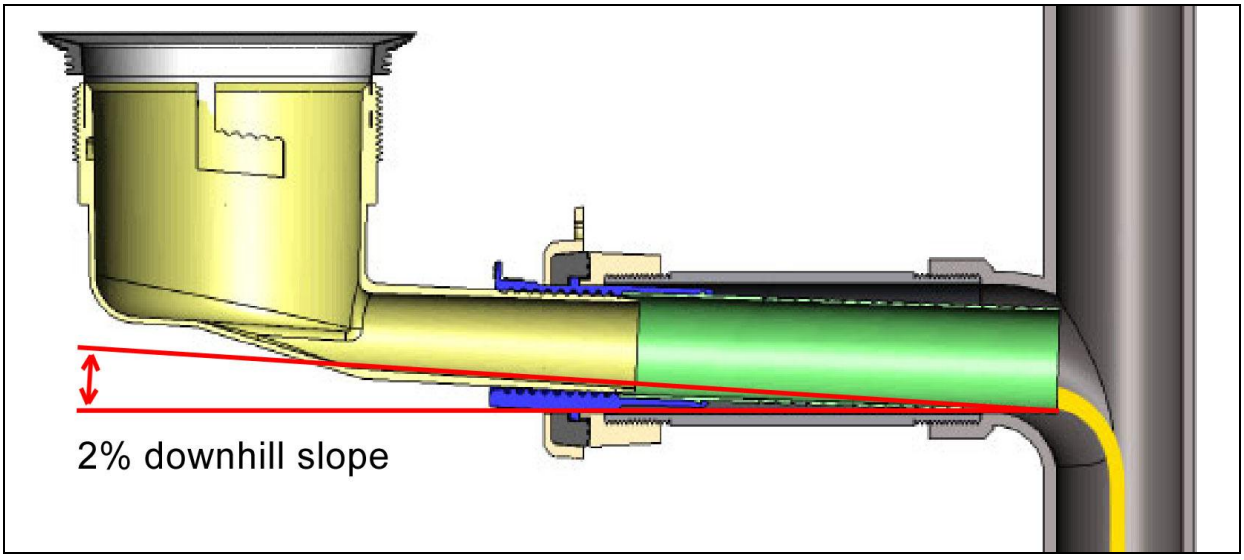

Figure 16. Falcon/Sloan Waterfree drain line connection system.

Figure 17. Pouring water into a non-water urinal system to clean drain pipes.

Summary of Calcite Versus Struvite in Urinal Drain Pipes

Calcite, found in water-flushing urinal drain pipes, is formed by the precipitation of minerals found in the mixture of flush water and urine. The process of nucleation and crystallization forms a solid, rock hard buildup that is cohesive and strongly adheres to the inner wall of drain pipes. The addition of flush water to urine is similar to adding a catalyst or hardener to a resin or glue. Mineral ions in flush water combine with urine constituents and form a chemical bond producing a hard calcite buildup. Calcite is not soluble in water as a solvent and will not undergo the dissolution process to reform into an aqueous solution upon contact with water. It can only be

removed by using mechanical means such as a drain machine auger with cutting heads to chisel away the rock hard buildup.

Struvite, found in non-water urinals, is formed solely by the precipitation of the constituents in urine. Without the addition of flush water, it does not undergo the same nucleation and crystallization process as water flushing urinals. Therefore struvite remains a soft and mildly cohesive compound that weakly adheres to the inner wall of drain pipes. Struvite is soluble in water as a solvent and will undergo the dissolution process to reform into an aqueous solution upon contact with water. It can easily be removed by simply flushing water through the drain pipe until it is clean.

The Drain Cleaning Industry Precedes Non-Water Urinals

Clogged drain pipes have been an issue far longer than non-water urinals have been marketed in the United States. The service and equipment industry for clearing clogged drains has been a viable, growing business since the early 1900's. Waterless Company began selling non-water urinals in the United States in 1991 and Falcon Waterfree began in 2000.

The following examples characterize a small portion of the entire drain cleaning industry:

- Roto-Rooter was established in 1935 and revenue in 2007 was $344.6 million.
- Ten (10) different United States manufacturers, with more than 40 brand names of drain cleaning equipment are listed in ThomasNet (www.thomasnet.com). The largest of which is General Pipe Cleaners with 35 brands of drain cleaning equipment.

- 90 percent of plumbing services ads in telephone yellow page books prominently list drain cleaning services, and several list “emergency” drain cleaning services.
- Roto-Rooter has introduced Urinal Block product (see Figures 18a and 18b), stating that it “eliminates the calcium build-up inside drain lines.” Based upon the discounted price of $5 per Urinal Block, 500 uses per block, and an average of 25,000 uses per urinal per year, the added cost to keep drain pipes clear of hard buildup is $250 per urinal per year.
- Hercules Sizzle (see Figures 19a and 19b.) is a specialized product for professional use that uses a chemical reaction to dissolve calcite and other deposits from drain pipes. Besides numerous cautionary measures listed on the product sheet, such as protecting from contacts and fumes, one of the warnings states “never add water to Sizzle, as a violent reaction will occur,” which raises the question of safety when the product is poured into a urinal trap that contains water, or if the product is flushed into a septic drain field or waterway.

Struvite-based buildup that may occur in non-water urinal systems is effectively managed with routine maintenance, preventing clogs from occurring. In the event that a non-water urinal drain pipe clogs, due to improper maintenance, struvite can be removed without requiring any specialized tools, chemicals, or services that exist for remediation of hard buildup in flushing urinal drain pipes. It can be removed by flushing water through the drain pipe until it is clean.

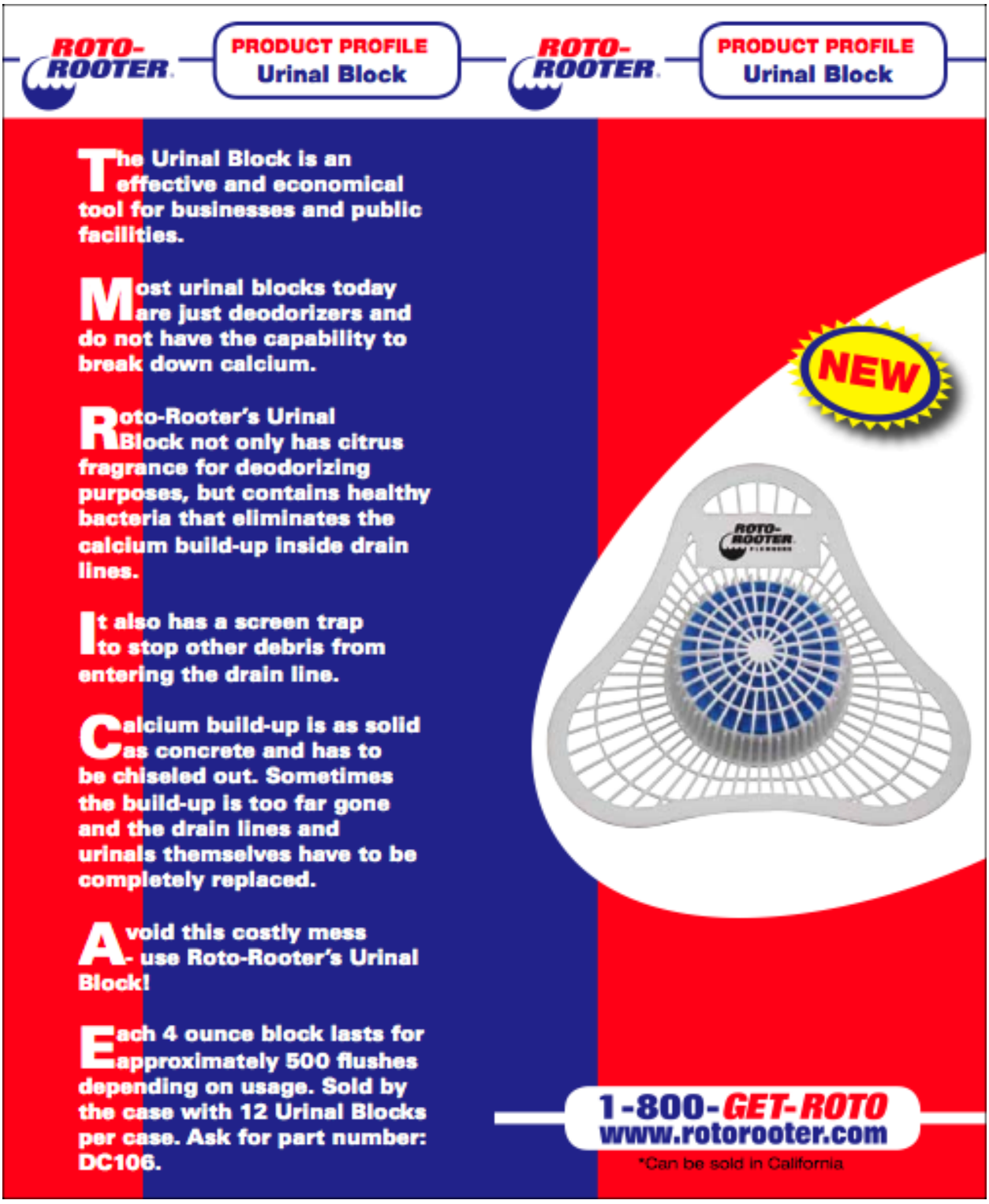

Figure 18a. Roto-Rooter Urinal Block, product information sheet page 1.

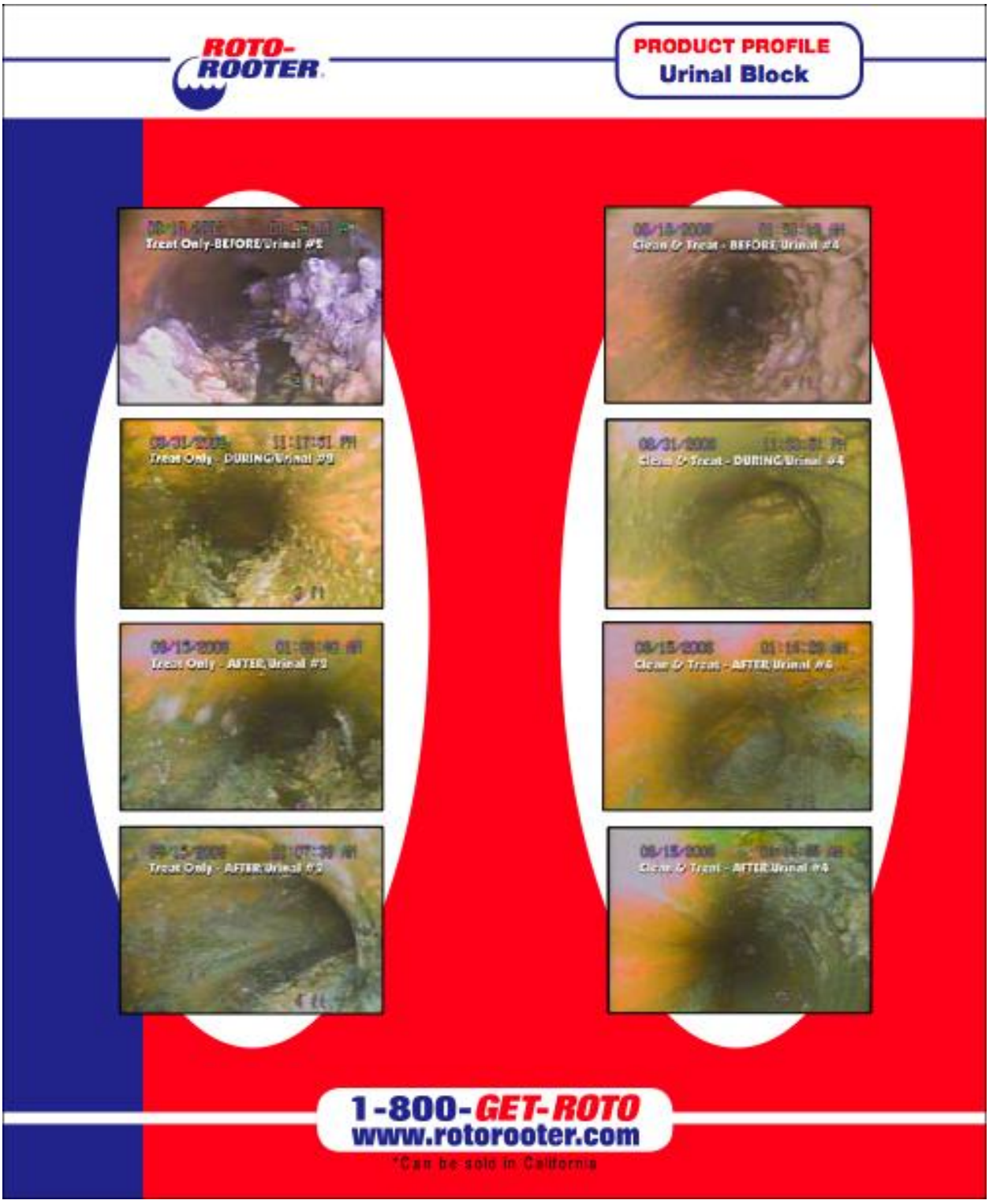

Figure 18b. Roto-Rooter Urinal Block, product information sheet page 2.

Sizzle®

Spec Sheet #S00017
December 2000

Drain and Waste System Cleaner

HERCULES®

specifications

Sizzle®

FOR PROFESSIONAL USE ONLY
NOT FOR SALE TO OR USE BY CONSUMERS

DESCRIPTION

A chemically-reactive product which effectively removes deposits of carbonates, sulfates, phosphates, oxides, urinary salts and other mineral deposits. Triple action formula of virgin hydrochloric acid blended with selected corrosion inhibitors and a strong foam suppressant, **Sizzle** dissolves inorganic deposits that restrict flow of water and waste. Removal of these deposits restores heat transfer efficiency to boilers, radiators, and water heaters. **Sizzle** can be safely used with iron, steel, copper, brass, bronze and lead fixtures to quickly dissolve scale and mineral build-up from water, waste, heating, processing and air conditioning systems. Clears plaster, grout and concrete obstructions from new and old construction. **Sizzle's** SAF-T-POR Spout is provided free with each 1 gallon jug, permitting safe, easy, pinpoint application of **Sizzle** without hazardous splashing.

SIZES AND PACKING

STOCK NO.	SIZE	PACKING	WEIGHT/CASE
20-305	1 qt.	12	32.4 lbs.
20-310	1 gal.	4	42.3 lbs.

Figure 19a. Sizzle Lime, Rust, and Scale Remover, product information sheet page 1.

Sizzle®
Drain and Waste System Cleaner

SPEC SHEET #S00017

APPROVALS AND LISTINGS

Not applicable.

SPECIFIC USES

Sizzle uses a chemical reaction to safely and effectively dissolve hard water and other deposits of carbonates, sulfates, phosphates, oxides, urinary salts and other mineral deposits from piping and equipment.

SPECIFIC APPLICATIONS*

Removes scale, salts, mineralized deposits, slime, and corrosion to clean heating, cooling, plumbing equipment and tools. Does not contain phosphates.

PHYSICAL PROPERTIES

Boiling Point:	181°F
Solubility in water:	Complete
Appearance/color/odor:	Light yellow liquid; acid odor.

WARNINGS OR CAUTIONS

- DO NOT use or mix **Sizzle** with any other chemicals especially before, during, or after products containing chlorine bleach, caustic, or lye.
- **Keep out of reach of children.**
- Read all cautions and directions carefully before using this product.
- Use only in a ventilated area and avoid breathing fumes.
- Protect skin and eyes from liquid or vapor.
- Use goggles, face shield and rubber gloves to prevent burns.
- Generates profuse foaming when removing lime or scale. Add slowly to minimize foam and fuming.
- **Sizzle** should not be used to remove organic stoppages, to clean out septic tanks or grease traps, or to clear root blockages.
- **Sizzle is for PROFESSIONAL USE ONLY.** Not for sale to or use by non-professionals.
- DO NOT store near foodstuffs.
- Store away from other chemicals and away from copper or chrome plated objects including bare steel shelving/objects.
- DO NOT take internally.
- DO NOT wear contact lenses when using this product.
- DO NOT use on aluminum or magnesium. These metals as well as tin, nickel, zinc, chrome, galvanized and enameled surfaces, nylon, concrete, marble and terrazzo are attacked by this product. In case of contact wipe clean and flush with cold water.
- Prevent spillage onto skin, clothing, floors, lawns, or any other surfaces attacked by acid.
- The dissolving action of **Sizzle** may open up holes which had been plugged with rust and scale, particularly on old equipment. If this occurs, leakage should be immediately diluted with cold water and flushed away or mopped up while observing all necessary personal precautions. After spent solution of **Sizzle** has been discharged into drains or sewer lines, these lines should be flushed with plenty of water to further dilute the product.
- Safe for use in plastic and rubber plumbing. Pumps used to circulate **Sizzle** through a system must be acid resistant. **Sizzle** will damage nylon components occasionally used in centrifugal pumps.
- Never add water to **Sizzle**, as violent reaction will occur.
- Not for use in garbage disposals, dishwashers, clothes washers.
- Store in a cool, dry, well ventilated area. Replace cap tightly and secure after use.
- Store only in this container. DO NOT reuse empty container. When container is completely empty, rinse carefully with cold water before discarding or recycling to prevent accidental burns.

DIRECTIONS FOR USE

WEAR GOGGLES OR FACE SHIELD AND RUBBER GLOVES. HOLD PRODUCT AT ARM'S LENGTH. USE ONLY COLD WATER WHEN DILUTING **Sizzle**. The sizzling action of **Sizzle** may often be used as a guide to determine when the line is clear or when the solution is spent. While this sizzling action occurs with carbonate deposits, it does not occur when deposits consist of sulfate, phosphate and other insoluble salts. Therefore, sizzling action may be used as a guide, but when it does not occur, Hercules pH Test Papers should be used to determine active acid content of spent solution.

GAS WATER HEATERS: 1) Turn off heat source. **2)** Drain all hot water and run until water is cold. **3)** Shut off water supply to heater. **4)** Break unions of inlet and outlet water lines and drain tank. **5)** For a 30-gallon tank, add 4 gallons of cold water then 1 gallon of **Sizzle**. Allow solution to work 1 to 2 hours. **6)** Flush out Sizzle solution to a drain, not to the floor. **7)** Keep draincock open, connect up cold water line and flush thoroughly. **8)** Close draincock, fill tank with cold water then drain. Repeat twice more. **9)** Reconnect hot water side, fill tank and turn on heat source.

HOT WATER COILS: 1) Close the cold water feed valve to the tank or coil. **2)** Break the nearest union on the cold water feed line to the unit. **3)** Connect a standpipe into the cold water feed line to unit. Inlet must be at least 6" higher than hot water outlet line. **4)** Break nearest union on hot water outlet line. **5)** Make a solution of 1 quart **Sizzle** and 2 parts water and add to standpipe until solution runs out the hot water outlet. Hot water outlet should be at least 1" higher than coils. **6)** Leave solution in unit until foaming stops. Unit is clean if adding more **Sizzle** solution does not produce more foaming. **7)** Thoroughly back flush to remove residue and remaining acid solution by removing the standpipe and inserting water hose into hot water outlet of unit. Back flush through and out cold water inlet for at least 5 minutes after all foam or residue is removed.

COOLING TOWERS, EVAPORATIVE CONDENSERS and HEAT EXCHANGERS: 1) Drain sump, flush out, or remove all loose sludge and dirt to reduce **Sizzle** consumption. **2)** Close bleed line and refill sump with clean water and start circulating pump. **3)** Add 1 gallon **Sizzle** every 5 minutes up to 1 gallon for each 15 gallons of system capacity. **4)** Circulate solution through equipment. Check pH every 10 minutes with a meter or test paper. Add **Sizzle** as necessary to maintain pH between 4 and 6 or lower for faster cleaning. Do not add more than 2 additional gallons of **Sizzle** per 15 gallons of system capacity without draining and flushing. **5)** Cleaning is complete when little or no increase in pH occurs between measurements. **6)** Drain and thoroughly flush twice before returning to service.

UNIT HEATERS: Fill steam/water coils with a solution of 2 parts water and 1 part **Sizzle**. If a recirculating unit is used, use 5 parts water to 1 part Sizzle. Allow solution to work until foaming stops, then flush.

BOILERS: Depending on scale build-up apply 10 to 15 parts of COLD water to 1 part **Sizzle**. After at least 12 hours, flush boiler thoroughly.

TOILETS/URINALS: 1) Flush to remove any other cleaning chemicals which might be present. **2)** Add 1 to 1 1/2 pints **Sizzle**. Add 2 quarts for flush tanks. **3)** Cover urinals to minimize fumes then allow **Sizzle** to work 15 to 30 minutes. **4)** Brush and flush.

CONCRETE, GROUT OR PLASTER BLOCKAGES IN LINES OR DRAINS: Remove as much standing water as possible. Add **Sizzle** full strength. When sizzling stops or solution is spent, flush thoroughly with COLD water. Repeat treatment, if necessary.

MATERIAL SAFETY INFORMATION

FOR MORE INFORMATION ON THIS PRODUCT, REQUEST MATERIAL SAFETY DATA SHEET (MSDS) #17.

For Delivery by Fax	Call 1-800-942-4636
Internet	See MSDS section of **www.herchem.com**
Mail	Contact Hercules at address below or any Hercules representative

HMIS Hazard Warning 3-0-2-H

INGREDIENTS	CAS#
Hydrochloric Acid	7647-01-0

- For special applications which may not be covered on this or other Hercules literature, please contact Hercules Technical Services Department by phone at 1-800-221-9330 or send a fax to 1-800-333-3456.

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http://www.herchem.com
HERCULES®

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AN EMPLOYEE OWNERSHIP CORPORATION

Figure 19b. Sizzle Lime, Rust, and Scale Remover, product information sheet page two.

Response to Two Published Reports Referenced by the EPA

In developing the appropriate parameters for a voluntarily labeling program for non-water urinals through the EPA WaterSense Program, WaterSense evaluated only two publicly available studies that discuss drain line issues: A report by Mete Demeriz at the Gelsenkirchen University of Applied Sciences and a pictorial presentation labeled as a "study" by Roger Van Gelder at the University of Washington. Following is a response from Falcon Waterfree and Sloan Valve.

Mete Demiriz, Gelsenkirchen University of Applied Sciences, Gelsenkirchen, Germany

The Demeriz report was based on a total of six non-water urinals, over a two-year period, in the cafeteria restroom of the Gelsenkirchen University of Applied Sciences in Germany. Two Urimat brand urinals and two Sphinx brand urinals that use mechanical traps were used. This type of mechanical trap is not allowed under United States plumbing codes. Two Duravit brand urinals with integral liquid trap-ways were also used.

Mechanical trap urinals do not contain a liquid trap seal or sealant liquid and the manufacturers do not recommend periodic flushing as part of their standard maintenance procedure. All liquid seal trap urinals recommend periodic flushing as part of their standard maintenance procedure.

Duravit recommends periodic flushing as part of the standard maintenance procedure for Duravit non-water urinals. Due to the fact that the Duravit urinal has an integral trap-way with no service access, the fixture can only be flushed through 3 drain holes that measure approximately 1/4 inch

diameter (see Figure 20). The small drain holes do not allow flushing sufficient enough to clear the trap-way or drain pipes.

Figure 20. Drain holes in the bottom of the bowl in a Duravit non-water urinal.

Non-water urinals that use removable cartridges provide a large opening for efficient and effective flushing of the system during routine maintenance (see Figure 17).

While the buildup described in the report may be an accurate representation of mechanical trap urinals for which flushing is not recommended and urinals with insufficient drain size, it is not consistent or represent the conditions found by Falcon Waterfree and Sloan Waterfree in non-water urinals in the United States.

In addition, the report notes that the urinals were not maintained according the manufacturers guidelines. If product performance is effected by maintenance, the performance and results cited in the report is invalid

The report also states that a “Window Cleaner with Alcohol” was used to clean the urinals. The Duravit sealant liquid (Hexydecanol) is an oil derived from coconut, palm, and vegetables, and reacts to alcohol-based cleaners by breaking down and dissipating into the drain pipes. Over time, the emulsified Duravit sealant liquid accumulates in the drain pipe, exacerbating buildup.

The addition of sealant oil to the Duravit fixtures is noted in the report, but no mention is made of Duravit’s recommended maintenance procedure of flushing with 5 gallons of water each month. Even if flushing did take place, the small drain holes in the Duravit fixtures do not allow adequate flushing and soft buildup is allowed to accumulate and eventually clog the drain pipe.

In addition, “Window Cleaner with Alcohol” has a high pH, which dramatically increases the hydrolysis of urea, causing rapid precipitation of sediment and buildup. Mild organic acid or neutral cleaners are the recommended cleaners for non-water urinals. The use of alcohol-based cleaner negatively skews the results of the study.

It should be noted that Falcon and Sloan Waterfree urinals use an alcohol-based sealant liquid and not an oil. Two ounces of Falcon/Sloan sealant liquid is used and stays inside the urinal cartridge for its entire life cycle. It is not deposited into the drain pipe as with the Duravit system.

The drain pipe system was cited in the study as having 1 percent pitch (downhill slope), which by common laws of physics cannot allow liquid waste to flow away as efficiently as in a pipe with correct pitch. The 2 inch drain in the subject system is half the minimum amount required in drain pipes in the United States. Plumbing codes in the United States require a 2 percent grade or 1/4 inch fall per linear foot (*International Plumbing Code 704.1 and Uniform Plumbing Code 708.0*). Improper slope increases the sedimentary buildup in the drain pipes, which negatively skewed the results of the report.

Incorrect venting is another condition in the plumbing system in the report. A combination waste and vent System were used, which is not compliant with United States plumbing codes. Without proper venting, the environment inside the pipe becomes alkaline (high pH), which increases the hydrolysis of urea and increases sedimentary buildup.

Following is a summary of additional incorrect aspects of the system that is depicted in the report, as evident by visual reference to the photos in the report. The following aspects affect system performance and the conclusions of the report:

- Fixture overload: Six urinals on the same drain line. United States plumbing codes allow only one (1) fixture on this type of drain/waste/vent (DWV) system.
- Urinals and water closets are prohibited from this type of DWV system under United States plumbing codes.

- Wrong pipe size: Two-inch pipe was used where 3-inch pipe is the minimum required by code for combination systems. Use of larger pipes is necessary because the pipe serves both as a drain line and vent line in this type of DWV.
- System drain pipe is too long: The maximum length for a combination waste and vent system is 15 feet. The pipe in the subject system is 25 feet.
- Dead end system: As previously described, there is no air circulation in a combination waste and vent system, and the condition is exacerbated by the system also being undersized and over length.
- Pipe fitting gaps: The glass tube fittings used in the test installation create gaps or crevices between the connecting tubes, which serve as a collection point for sediment. These sediment collection points do not exist in standard seamless fittings.

University of Washington Pictorial Presentation by Roger Van Gelder

The PowerPoint presentation from Mr. Van Gelder is not accompanied by any research report or analysis so it is referred to in this report as a Pictorial Presentation and not a study.

In July 2007, two urinals with the greatest amount of use on each floor of a seven-story dormitory building at the University of Washington were removed and reinstalled with new waste lines and a new vertical drainage section. Mr. Van Gelder's presentation doesn't confirm or deny that urinals were reinstalled according to the recommendations of the specific manufacturer, but the photograph on page 17 of his presentation shows a mismatch of a current Falcon rubber bushing combined with older, incompatible coupling hardware. The result of not

using all the new installation components and following directions provided with the new Falcon Waterfree urinal is a distorted bushing and flow path, causing buildup that would otherwise not exist in a proper installation. It is also critical in the case of the Falcon/Sloan non-water urinal that installation includes the pipe-in-pipe unicoupler that is provided with each urinal and detailed in the urinal installation instructions to ensure that proper slope. While Falcon supplied Mr. Van Gelder and the University of Washington with two new urinals, the older, outdated fixtures were incorrectly reinstalled and Mr. Van Gelder discarded the new fixtures. An offer for technical assistance from trained Falcon personnel to assist with the reinstallation was declined. Equally important, Mr. Van Gelder's pictures are accompanied by a full disclosure that the urinals were not maintained according to manufacturer's documented procedures that were included with the urinals, and also provided in duplicate.

The photos of the vertical and horizontal drain line from the Falcon urinal (as well as the other non-water urinals) are described as "substantial" build-up while the picture from the lower flush volume urinal is described as "significantly less." It is subjective and impossible to determine what Mr. Van Gelder is using as a baseline of information to determine "substantial" build-up. Therefore, the pictures of horizontal and vertical drain lines after six months use are not clear and based on other examples in this Falcon/Sloan report, are misleading. Mr. Van Gelder acknowledged during his presentation at the American Water Works Association (AWWA) conference in February 2008 and again confirmed in a telephone conversation on September 8, 2008, that these pictures are not representative of any other non-water location or installation. He further acknowledged when queried that it was unfair to draw any conclusion about non-water urinals that are installed and maintained properly from these images.

Despite explicit offers from Falcon, experts from Falcon have not been allowed to analyze the pipes shown in the pictorial presentation. Based on other scientific data in this Falcon/Sloan report, it is clear that buildup shown in the pictorial presentation is struvite that results from the precipitation of minerals in undiluted urine. Struvite is soft in composition, with a gel-like viscosity and is washed away during the routine and proper maintenance of the non-water urinals. While the Van Gelder's pictorial presentation has no scientific or technical content, it is instructive to note the true composition of the buildup shown in the photos. If Mr. Van Gelder had completed this portion of his pictorial presentation as his last slide indicates, it would have become obvious to him that this material is struvite.

Mr. Van Gelder suggests that no conclusions should be made about non-water urinals based upon his pictures since he acknowledges that the urinals were neither installed nor maintained, as they should have been.

Data Relative to Before & After Non-Water Installations

This report section includes testimony and photographic documentation of drain pipe conditions in non-water urinal systems that have been in continuous operation for various lengths of time. The examples include:

- St. Louis County Health Department, Minnesota
- Hilton Towers Office Building, Pasadena, California
- Fort Huachuca, Arizona
- Lake Avenue Church, Pasadena, California
- Bedford Medical Building, Beverly Hills, California
- Dolphin Stadium, Miami Gardens, Florida
- The Rose Bowl Stadium, Pasadena, California
- Roxbury Public Park, Beverly Hills, California
- Santa Clara University, Santa Clara, California
- Adobe Systems, San Jose, California

St. Louis County Health Department, Minnesota

See figures 21-24.

Figure 21. St. Louis County Health Department, 2003. Drain line after removing water flushing urinal that had been in service for 21 months.

Figure 22. St. Louis County Health Department, 2003. Completing the installation of a Falcon Waterfree urinal, replacing the water-flushing urinal.

Figure 23. St. Louis County Health Department. Removing the Falcon Waterfree urinal to inspect the drain line after one year of continuous operation.

Figure 24. St. Louis County Health Department. Drain line immediately after removing the Falcon Waterfree urinal, after one year of continuous operation. The Falcon Waterfree urinal was reinstalled and continues to be in use at this location.

Figures 21-24 and detail provided by Tom Romundstad, romundstadt@co.st-louis.mn.us, St. Louis County Property Management, 100 North 5th Avenue West, Suite 50, Duluth MN 55802, phone 218-733-2752.

Hilton Towers Office Building, Pasadena, California

See figures 25-27.

Figure 25. Non-water urinal installed as part of city rebate program in 2001. Typical installation on the fourth floor of this 11-story office building.

Figure 26. Non-water urinal removed in August 2008 for drain line inspection.

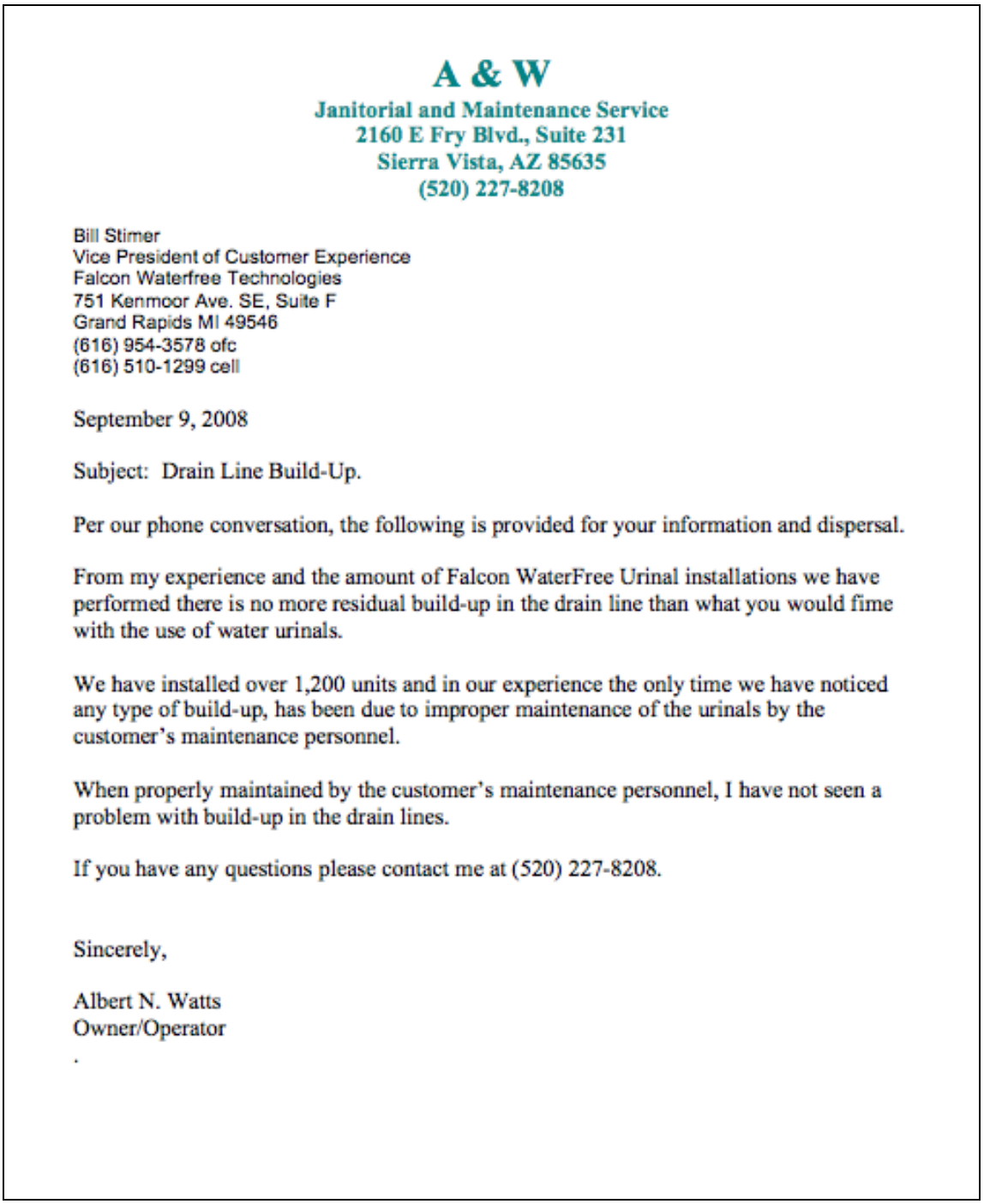
Figure 27. Close-up detail of the horizontal pipe nipple immediately after removing the non-water urinal, after seven years of continuous operation.

Authorization for use of Figures 25-27 and details provided by Jane Raftis, Account Manager, City of Pasadena Water & Power, 626-744-6889.

Fort Huachuca, Arizona

This location has more than 1,200 Falcon Waterfree urinals in operation. See Figure 28.

Reference contact: Al Watts, Owner/Operator, A&W Janitorial and Maintenance Service, 2160 E. Fry Blvd., Suite 231, Sierra Vista, AZ 85635, Phone 520-227-8208.



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Bill Stimer
Vice President of Customer Experience
Falcon Waterfree Technologies
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(616) 954-3578 ofc
(616) 510-1299 cell

September 9, 2008

Subject: Drain Line Build-Up.

Per our phone conversation, the following is provided for your information and dispersal.

From my experience and the amount of Falcon WaterFree Urinal installations we have performed there is no more residual build-up in the drain line than what you would fime with the use of water urinals.

We have installed over 1,200 units and in our experience the only time we have noticed any type of build-up, has been due to improper maintenance of the urinals by the customer's maintenance personnel.

When properly maintained by the customer's maintenance personnel, I have not seen a problem with build-up in the drain lines.

If you have any questions please contact me at (520) 227-8208.

Sincerely,

Albert N. Watts
Owner/Operator
.

Figure 28. A&W letter regarding Fort Huachuca in Arizona.

Lake Avenue Church, Pasadena, California

See Figures 29-30.

Figure 29. Non-water urinal removed September 2008 for pipe inspection. Retrofit in October 2002.

Figure 30. Close-up detail of the horizontal pipe nipple immediately after removing the non-water urinal, after six years of continuous operation.

Figures 29-30 and detail provided by Levi Heidelberg, Lake Avenue Church, 393 N. Lake Avenue, Pasadena, CA 91101, phone 626-844-4700.

Bedford Medical Building, Beverly Hills, California

See figures 31-32.

Figure 31. Non-water urinal removed September 2008 for drain line inspection. Original installation (retrofit of water-flushing urinal) took place in 2003.

Figure 32. Close-up detail of the horizontal pipe nipple immediately after removing the non-water urinal, after five years of continuous operation.

Authorization for use of Figures 31-32 and details provided by Adrian Fernandez, Building Office Manager, 436 North Bedford, 310-435-4109.

Dolphin Stadium, Miami Gardens, Florida

> "What build-up we experience has been in the housing, not the drain line. We just flush it down the drain line. It's minimal. That's why we like it. It takes a lot of labor out of it compared to flush urinals."

This facility has 220 Falcon Waterfree urinals in operation since 2002.

Reference contact: Frank Everton, Chief Engineer, Dolphin Stadium, 2269 Dan Marino Blvd., Miami Gardens, FL, 33056, Phone 305-623-6150

The Rose Bowl Stadium, Pasadena, California

This facility has 260 Falcon Waterfree urinals in operation since 2002. See Figures 33-36.

Figure 33. Original installation (retrofit of water-flushing urinal) took place in 2002.

Figure 34. Non-water urinal removed September 2008 for drain line inspection.

Figure 35. Close-up detail of the horizontal pipe nipple immediately after removing the non-water urinal, after six years of continuous operation.

Central Services Plumbing

(818) 241-8676

LIC. NO. 788520

September 2008

TO: EPA WATERSENSE

FROM: Daniel Robles Central Services Plumbing

SUBJECT: Drain Line Clogging on Urinals

I understand that you are looking at the issue of drain line clogging with respect to urinals. I am a licensed plumbing contractor in California with over 25 years of experience in the design, installation, and maintenance of plumbing systems. We are also members of the PHCC of Southern California and a lot of our work is in the drain line (rooter) business.

I have personally routed out over 2000 water-fed urinals. My experience is that there is a hard encrustation that results from the urine and the water bonding together, and that it is almost always necessary to completely remove the urinal fixture in order to access and successfully clear the drain line. This occurs almost always between 12-36 months after the water-fed urinals are first installed.

I have also installed different brands of waterfree urinals, including over 260 at the Rose Bowl in Pasadena, CA prior to the start of the 2002 college football season. I have never received a call back or request from the Rose Bowl to route out or snake any of their drain lines. I recently went to the Rose Bowl and removed a waterfree urinal to see for myself if there was any drain line build-up or clogging issue. I believe the attached photo speaks for itself.

Please do not hesitate to contact me if you have any questions on this matter.

Dan Robles

675 South Glenwood Place Burbank, California 91506 Fax (818) 549-0270

Figure 36. Letter from Central Service Plumbing pertaining to the Rose Bowl Stadium.

Authorization for use of Figures 33-36 and details provided by Dan Robles, Central Services Plumbing, 675 South Glenwood Place, Burbank, CA 91506.

Contact for The Rose Bowl Stadium: Jess Waiters, Chief Operations Officer, The Rose Bowl Stadium in Pasadena, California, 626-577-3108.

Roxbury Public Park, Beverly Hills, California

See figures 37-39.

Figure 37. Original installation (retrofit of water-flushing urinal) took place in 2003.

Figure 38. Non-water urinal removed September 2008 for drain line inspection.

Figure 39. Close-up detail of the horizontal pipe nipple immediately after removing the non-water urinal, after five years of continuous operation.

Authorization for use of Figures 37-39 and details provided by Richard Scosnik, Chief Plumbing Inspector, City of Beverly Hills, California, phone 310-285-1000.

Santa Clara University, Santa Clara, California

From an interview with Jeff Charles at Santa Clara University on July 5, 2008.

Q: Have you noticed anything with the drain lines, any kind of buildup?

A: Occasionally, but generally it's when the slope is not enough to prevent urine from standing. In some of the water flush urinals that we took out, in the change out process,

> we found unbelievable amounts of sediment buildup on the inside of the pipe. We're not seeing that in any significant instance now that would cause us to have second thoughts about this (non-water urinal) technology, and I'm the guy paying the bill and I'm the guy maintaining it.

This facility has 213 Falcon Waterfree urinals in operation since 2006.

Reference contact: Jeff Charles, Director of Facilities, Santa Clara University, 500 El Camino Real, Santa Clara, CA, 95053, Phone 408-554-4607.

Adobe Systems, San Jose, California

From an interview with George Denise at Adobe on June 4, 2008

> "At the end of 2003, we were completing new construction of our third tower here in San Jose, and installed both traditional urinals and waterfree urinals. After testing them for a year, we were able to assess how they performed. We pulled those urinals off the wall and sent a micro fiber optic camera down the waste line to see the conditions of the pipes behind the waterfree and traditional urinals, and compare them. We did this with involvement with the San Jose City Building Department. We discovered that the lines behind the Falcon Waterfree urinals were actually cleaner than the ones behind the traditional urinals."

This facility has 78 Falcon Waterfree urinals in operation since 2005.

Reference contact: George Denise, Cushman Wakefield at Adobe Systems, 345 Park Avenue, San Jose, CA, phone 408-536-4426, gdenise@adobe.com.

Conclusion

This report provides the EPA and others with important background information on plumbing fixtures and plumbing design as they relate to drain line issues. A detailed explanation of the differences in physical and chemical composition between the deposits from water-flushing urinals (calcite) and non-water urinals (struvite) has been provided.

The examples of water-flushing urinal installations provided that show hard calcite deposits range from 21 months to over ten years in use. Information from plumbers who routinely work on these types of clogged drains from water-flushing urinals as well as numerous commercial products available to alleviate these problems has also been provided.

As a result, this paper draws three primary conclusions:

1. All drain lines can and will clog, and water-flushing urinals produce some of the worst build-up problems of all plumbing fixtures.

2. Drain line build-up from water-flushing urinals is significantly more costly and problematic to remove than non-water urinals.

3. When installed and maintained properly, non-water urinals will produce less line build-up than water-flushing urinals and can be rinsed clean with water alone.

The examples of non-water urinal installations provided in this report range from 4-6 years of use. The locations and usage patterns at each are varied and include a small office building, a public park, a church with associated community and school services, a mid-rise office building, and a large stadium. These examples show that drain line build-up material, a soft substrate known as struvite, can occur from non-water urinals. But unlike water-flushing urinals, they do not produce a hard encrustation that leads to clogging and failure of the pipe to carry away waste.

Whether short-term or long-term, it is clear that there are no permanent negative effects on drain line performance from properly installed and maintained non-water urinals, and any buildup that should occur can easily be rinsed clean.