

Introducing the



Home Water PlantTM

by Aquametrics



Our website has all the technical and scientific information you need to understand water quality problems and treatment.

Clean, drinkable water for the whole family



The countless benefits of the Home Water Plant:



Protects Your Plumbing

Removes existing limescale and prevents new scaling.



Quit Buying Bottled Water

Bottled water quality from every faucet in your home.



Removes Contaminants

Removes heavy metals, chlorine, chloramines, tannins, and many others.



Extends the Life of Your Appliances

Greatly extends the lives of water heaters and dishwashers.



Green Technology Water Treatment System

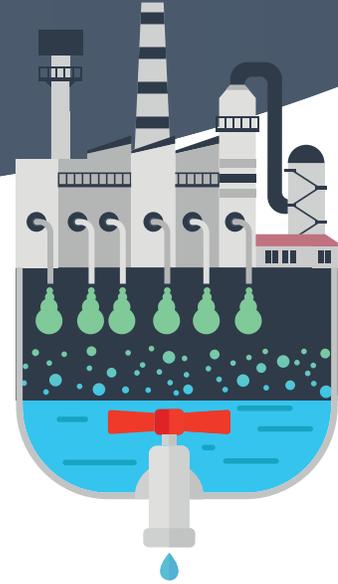
No lugging 40 lb. bags of backwashing salt. No more salt going into the aquifer.



Your Water

The Modern Answer to an Age Old Problem: Hard Water!

Our water treatment system employs patent pending technology to **eliminate the problems caused by hard water:**



Water Spots

Water spots and stains on dishes, silver and glassware.



Staining

Staining on toilets, shower doors & walls, cars and other surfaces touched by water.



Skin & Hair

Dry itching skin, dull and unmanageable hair.



Slippery Water

Caused by traditional water softeners that use salt to regenerate.



Harsh chemicals

Stop using harsh detergents for washing clothes, dishes, cars.

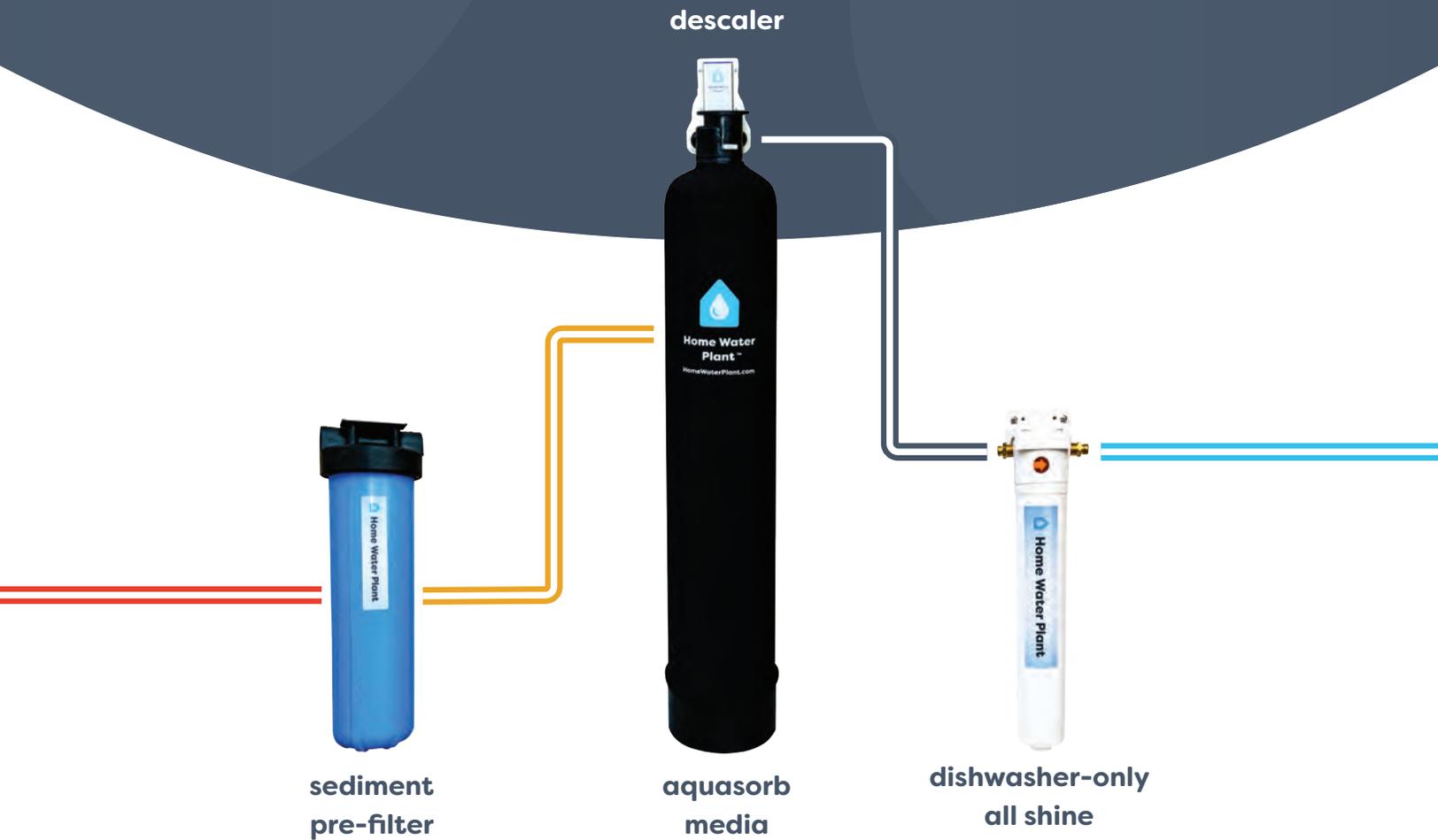


Low Water Flow

Caused by minerals in your water clogging pipes and shower heads.



How Does It Work?



There are four phases to Home Water Plant treatment.





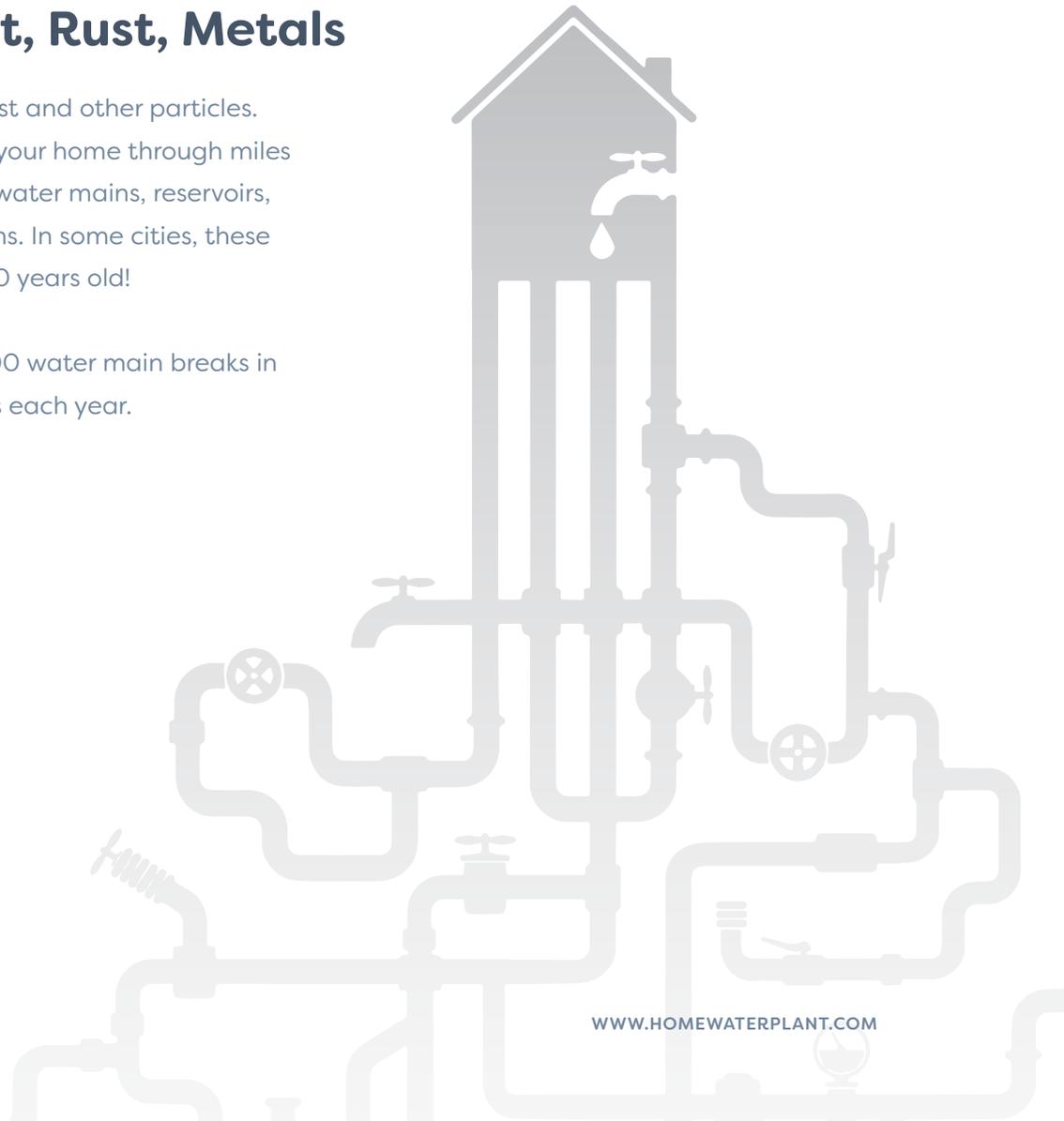
Phase One

Sediment & Turbidity Filtration

Sediment, Rust, Metals

Dirt, sand, grit, rust and other particles. Sediment enters your home through miles and miles of city water mains, reservoirs, and pump stations. In some cities, these pipes are over 100 years old!

There are 240,000 water main breaks in the United States each year.





Phase Two

Eliminates Bad Taste, Odor, and a Broad Spectrum of Contaminants

Taste & Odor

Our enhanced catalytic carbon, Aquasorb, has been developed to effectively reduce or eliminate the following from your tap water:



Suspended Solids

Sediment, silt, dirt, rust, and sand. Further reduction to one micron.



Humic Substances

Organic matter from city water mains and reservoirs.



Tannins & Lignin

Humic and fulvic acid, brownish stains.



Chlorine

City water plant purification, swimming pool smell.



Chloramines

Increasingly used for city water plant disinfection but with hazardous by-products.



Heavy Metals

Inorganics harmful to your family's health.



Phase Three

Elimination of Hard Water Problems

Electrochemical Scale Removal & Prevention



The descaler changes the molecular structure of the minerals (calcium and magnesium) that make up hardness. The process allows these healthy minerals to remain in your water without sticking to the sides of your pipes and appliance heating elements.

Our descaler removes existing limescale from pipes and the heating elements of hot water heaters, dishwashers and other appliances and prevents new limescale. Appliance lives are lengthened. Water flow from fixtures like showerheads increases.



Phase Four

Dishwasher-Only Treatment

Sparkling Dishes

Our food grade polyphosphate media assures that your dishes, silver and glassware emerge from the dishwasher without the addition of hard water spotting.





Home Water Plant + (Silica Treatment)

Resolving Silica Scale

85% of the US suffers from lime scale problems caused by calcium and magnesium in hard water. The Home Water Plant cures these problems.

Some localities also suffer from an excess of silica (SiO_2) (think sand, sulfates or chlorides) in their municipal water supply. Excess silica, though chemically different, also scales pipes, appliance heating elements and fixtures like shower heads.

The Home Water Plant + (silica treatment) adds a second, silica treatment tank and specialized media to the system. In those locations where excess silica, sand, sulfate, or chloride problems exist, the augmented system should be employed.



Safer, Drinkable Water Your Family Deserves



Transform your tap water into crystal clear, safe drinkable water that leaves your dishes sparkling clean.

Call or Email Us Today

(888) 963-6178

info@homewaterplant.com

For specifications, a more detailed description of the Home Water Plant, and application of these certifications and scientific research papers, please visit our website at www.homewaterplant.com



**PATENT
PENDING**



Manufactured by Aquametrics, distributed through its sales affiliate Aquatronx 1320 26th St NW #7 Auburn, WA 98001

DESIGNED, PROGRAMMED AND ASSEMBLED IN THE US

Frequently Asked Questions

Click on a question below to bring up its answer.



Don't See Your Question?

[Call Us Today \(888\) 963-6178](#)

info@homewaterplant.com

1. Who are we?

The Home Water Plant is designed and manufactured by Aquametrics LLC, a Seattle area company formed in 2006. Aquametrics key employees aggregate almost 100 years of water quality treatment experience in residential, commercial and industrial applications. The Home Water Plant and other Aquametrics manufactured water treatment systems that include scale prevention and removal technology are sold through an Aquametrics sales-affiliate, Aquatronx, part of an intellectual property, patent protection arrangement.

2. What is our experience?

If you call us, these are some of the people you will be talking to: Larry Meek, CEO, 19 years in the water quality industry; Scott Borough, COO, 20 years in the industry; Laren Meek, VP, Research & Development, 19 years in the industry; Richard Scheu, 35 years in the industry. All have residential, commercial and industrial water quality treatment experience.

3. What certifications does the Home Water Plant have?

Certifications vary, depending upon treatment phase. The phase 1 sediments removal filter is certified by NSF International to NSF/ANSI standard 42 for material requirements only. Phase 2 enhanced catalytic carbon is certified to NSF/ANSI standard 61. The Phase 3 scale removal and prevention power supply is UL & CE approved. Phase 3 electronics have passed FCC Part 15 A (commercial), Part 15 B (residential) and Part 18 (laboratory) environments requirements. Phase 4, the dishwasher-only sequestering media, is certified to NSF/ANSI standard 42 for material requirements only and certified by NSF to NSF/ANSI standard 60, drinking water treatment chemicals-health effects.

4. Our water comes from a city water plant. Why should we buy a Home Water Plant?

Your city water plant and the Home Water Plant perform different, but complementary functions.

Cities source water from surface waters, lakes, rivers, and underground aquifers. City water plant treatment may include screening, coagulation with ferric chloride or alum,

sedimentation and filtration of particulates, then disinfection with chlorine and/or chloramines, and often the addition of fluoride. Great Britain began disinfecting water in the early 20th century and saw a sharp decline in typhoid deaths. Shortly after, disinfection was introduced into the United States. The result has been virtual elimination of waterborne diseases such as cholera, typhoid, dysentery and hepatitis A. Public health, generally, is the city water plants' concern.

Leaving the city's plant, water flows through reservoirs, pump stations, and miles and miles of pipe (Phoenix, e.g., has about 10,000 miles of pipeline). Some city pipe is really old, or cracked, or scum lined, and there are about 240,000 city water main breaks in the US each year. The American Society of Civil Engineers gave the nations' drinking water infrastructure a D grade for aging pipes in 2013. Then, there is piping from the city's main into your home.

City water still contains a host of contaminants, most of which are of aesthetic concern—color, taste, odor, and hardness. Other contaminants are of a more serious safety concern. The job of the Home Water Plant is to take over where the city leaves off: to further ameliorate safety concerns and to make your city water clean tasting, clean smelling, clear, and pleasurable to bathe in.

5. Your brochure and website description of Home Water Plant treatment phases is brief. Where do I get a more detailed description of each phase's treatment?

The Technical Information section of this website contains specifications and detailed scientific and technological information with respect to each treatment phase, in a series of PDF white papers.

6. What is in my city water that I should be concerned about?

Of course it varies, city to city, and within any city from one time to another depending, e.g., on sourcing changes, storms, drought and other factors. A few concerns are: Eastern seaboard storms flooding livestock farms, causing widespread fecal contamination of drinking water. California droughts producing high nitrate concentrations. Lead leaching into pipes, e.g., Flint, Michigan, Tacoma, Washington Sebring, Ohio (where authorities had to mandate drinking bottled water). What is known as “bio-fouling” occurs when a homeowners' water pipes scale because of hard water and biologic viruses or the like grow on the deposited limescale. The Environmental Working Group website alleges that 81% of US water systems discharge water with contaminants linked to cancer, that 7 million Americans are drinking water with unsafe levels of nitrates, that 250 million Americans' drinking water contains hexavalent chromium and that 19,000 US water systems discharge water in which lead was detected at levels harmful to children.

Water plants are required by EPA to issue annual “Water Quality Reports.” Those reports note whether regulated contaminants exceed permitted levels — but the reported numbers are only averages; in some neighborhoods and at some times permitted contaminant levels are regularly exceeded.

The Environmental Working Group alleges on its website that there are more than 160 unregulated contaminants, contaminants for which no limits have yet been established.

7. Chloramines: does my city water plant use chloramines? Why should I be concerned about chloramines?

Your city water utility's annual EPA Water Quality Report will disclose whether chloramines are used in its water plant. Your water quality treatment local dealer will also be able to tell you.

Chloramines are increasingly used as an alternative or supplement to chlorine purification by city water plants. Chloramines have a host of “disinfection by-products;” they are largely unregulated (one of the reasons cities use them). Chloramines are reported to adversely affect human respiratory and dermatological systems (the bathing hazard may be worse than the drinking hazard). See, e.g., Miranda, Marie Lynn, et al,

Changes in Blood Lead Levels Associated with Use of Chloramines in Water Treatment Systems, Environmental Science & Technology, Vol 41, No 2, February, 2007; Richardson, S. D., *New Disinfection By-Product Issues: Emerging DPBs and Alternative Routes of Exposure*, Global NEST Journal, Vol. 17, No. 1 (2005).

8. Trihalomethanes: what are they, and why should I be concerned about them?

Trihalomethanes are combinations of chlorine and organic matter. They are what is known as “disinfection by-products.” A few trihalomethanes have established EPA limits, e.g., chloroform. Many more trihalomethanes are simply unregulated. According to the Environmental Working Group, scientists suspect trihalomethanes in drinking water may cause thousands of cases of bladder cancer every year. Trihalomethanes have also been linked to colon and rectal cancer, birth defects, low birth weight and miscarriage. Sharp, et al, *Water Treatment Contaminants: Forgotten Toxics in American Water*, EWG website, February 27, 2013.

9. Is the Home Water Plant appropriate for well, community well, lake, river or stream source treatment?

No.

The Home Water Plant is designed to treat water already treated at a city water plant.

10. If my water is not treated by municipal/city water utility, where should I look for appropriate water treatment products?

Aquametrics, manufacturer of the Home Water Plant, also manufactures water quality treatment systems appropriate for individual well or community well, lake, river or stream sources, including chlorine and reverse osmosis treatments. See aquametricsusa.com.

11. How does the Home Water Plant compare with water softening systems?

Apples and oranges. (There is a lot wrong with water softening, but see FAQ 12 for that discussion.)

Both the Home Water Plant and water softening systems resolve hard water problems. Water softening systems generally prevent limescale; however, they are not successful removing limescale already in place. The Home Water Plant scale removal and prevention technology not only prevents scaling, but removes existing scale (and any associated bio-fouling).

And the Home Water Plant does much more: Phase 1 removes sediments and eliminates turbidity; Phase 2 removes a host of contaminants and resolves color, taste and odor issues; Phase 4 prevents dish, silverware and glassware spotting and etching. These treatments (with the qualified exception of spotting) are not addressed at all by water softening systems.

The Home Water Plant eliminates the slippery feeling commonly associated with artificially softened water.

12. Why are water softening systems the wrong solution?

Most importantly, water softening systems are an environmental disaster.

“Using a self-regenerating softener for a month is basically the same as taking a 40-pound bag of salt and dumping it directly into the [Santa Clara] River.” Ann Heil, Senior

Engineer, Sanitation Districts of Los Angeles County.

As a result, water softening systems are increasingly banned, e.g., cities in Los Angeles, San Diego, Orange, San Bernardino, Riverside, Kern, Ventura, Santa Barbara, San Marcos and Tulare counties in Southern California. In the Santa Clarita Valley, homeowners are prohibited from replacing existing water softeners and strongly encouraged to stop using their existing units. Residents who violate the no-replacement ordinance are subject to a fine of up to \$1000 and/or jail not to exceed 30 days.

Water softening systems are labor-intensive, requiring regular backwashing and lugging around 40 pounds bags of salt.

Water softening systems are expensive, not only in themselves, but because drainage for backwashing brine often needs to be dug and piped to install the system and regeneration is a never-ending expense.

Then, after bathing in softened water, the homeowner emerges with slippery, soapy-like skin, feeling like it was just not possible to thoroughly rinse.

13. Should I buy a Home Water Plant + Silica Removal system or a Home Water Plant?

You should buy a + system if your water has problematic levels of silica, sulfates or chlorides. Otherwise, the Home Water Plant will provide entirely adequate water quality treatment.

14. What if my city utility treated water has quality problems above and beyond the typical problems result by the Home Water Plant?

Aquametrics, the manufacturer of the Home Water Plant, also manufactures water quality treatment products appropriate for non-city water and a range of unusual water chemistries (including, e.g., the water purification system in STAR™, a hurricane and other disasters emergency shelter system, capable of turning severely contaminated into potable water).

15. What maintenance is appropriate for the Home Water Plant?

Annual maintenance by a local dealer is highly recommended. Home Water Plant Aquasorb and + (Silica Treatment) media are not replaced during maintenance; they are simply regenerated by adding a package of desorption media and running a hose bib or bathtub faucet for 20-30 minutes. During annual maintenance the Phase 1 and Phase 4 canisters are replaced. The scale removal and prevention electronics are simply checked to verify proper operation.

16. What is the Home Water Plant warranty?

Given annual dealer maintenance the tanks, valves and Aquasorb media are warranted for 10 years. The electronics are warranted for three years. The Phase 1 and 4 canisters are warranted for one year and should be replaced annually. Without annual dealer maintenance, tanks, valves and Aquasorb media are warranted for three years.

Home Water Plant

PHASE 2 TREATMENT
ENHANCED CATALYTIC CARBON FILTRATION
SPECIFICATIONS
SCIENCE AND TECHNOLOGY

CONTAMINANTS REMOVAL

The second phase of home water plant water treatment is contaminants removal via filtering through Aquasorb, *The Home Water Plant* enhanced catalytic carbon proprietary media.

The contaminants listed below are commonly found, in greater or lesser amounts, in treated water released from municipal water plants and entering your home. The city has done its job, purification. Your job, the job of *The Home Water Plant*, is ensuring in-home water quality: enhanced safety, and drinking, bathing, and dishes, silver, glassware, and clothing aesthetics.

Aquasorb effectively reduces or eliminates these contaminants:

Suspended solids, silt, sand and dirt, greater than 10 μm^1

Humic substances (organic matter)

Tannins and lignin (humic and fulvic acid) brownish colors (disinfection byproducts)

Hydrogen sulfide (rotten egg odor)

Chlorine (city water plant purification, swimming pool smell)

Chloramines (with dangerous, largely unregulated, disinfection byproducts)

Trihalomethanes (THM's) city water plant chlorine disinfection byproducts

Phenols and p-nitro phenol (industrial chemicals from surface waters or the aquifer)

Heavy metals (inorganics)



¹ A μm , a micron, equals 39 millionths of an inch; a red blood cell is 6-8 μm .



certified to ANSI/NSF standard 61

CARBON FILTERING IN GENERAL

Carbon has been used to rid water of contaminants for hundreds of years. In the days of long passages under sail, water barrels were charred to keep water fresher, longer. (Carbon is also used in air filtration, industrial gas processing, respirator masks, and other applications.) Carbon filtering media are made from a variety of carbon sources: bituminous coal, wood, coconut shell, and others. Wood carbons have macro-pores, mostly suitable for de-colorization and removal of large organics. Bituminous coal has an intermediate pore size. Coconut shell carbons have micro-pores; in addition to the capabilities of the other carbons, coconut shell carbons can remove smaller organics and disinfection byproducts.

Nowadays, virtually all carbon filtration uses at least “activated carbon,” made by thermal activation of the charcoal media, which improves pore volume, surface area and carbon structure. Activated carbon has a slight electro-positive charge, making it attractive to negatively-charged chemicals and impurities. Activated carbon works in two ways to remove impurities. First, it removes organic compounds by adsorption, i.e., adhesion of the impurities to the carbon surface. The second way is catalytic reduction: negatively charged impurities are attracted to the positively charged activated carbon. Impurities of significant concern, such as chlorine and chloramines, are negatively charged — but the ability of simple activated carbon to eliminate chlorine and, particularly, chloramines is limited.

The two types of activated carbon generally sold in the United States are granular activated carbon, known as GAC, and carbon block, also known as powdered carbon block. GAC is generally loaded into tanks on top of a bed of gravel. Carbon block is made by compressing powdered carbon into a dense block, enclosed in a mesh. Carbon block has a larger ratio of activated carbon surface area to the water, and the block form is denser than GAC, so water travels through it more slowly. Due to additional processing, carbon block is more expensive than GAC.

Generally, the two keys to effective filtration are the media surface area ratio to the quantity of water being treated and contact time, i.e., the amount of time the water being treated is effectively in contact with the media.

A significant step above simple activated carbon, either GAC or block, is what is known as “catalytic carbon”: activated carbon with modified surfaces, creating more sites on the carbon surface for decomposition of impurities. Chloramines, generally chlorine combined with ammonia, are removed by catalytic carbon far more efficiently than by simple activated carbon. (This paper discusses chloramines in quite a bit more detail below; they constitute a major,

emerging health hazard.) The potential of a specific carbon filter to remove chloramines can be tested by measuring its ability to catalyze the decomposition of hydrogen peroxide. Catalytic carbon has been shown far superior to simple activated carbon in this test. 1 gram of catalytic coconut shell activated carbon powder will reduce hydrogen peroxide concentration by 95% in 10 minutes, compared to a 25% reduction for 1 gram of standard coconut shell activated carbon.

THE HOME WATER PLANT AQUASORB MEDIA

Aquasorb is an enhanced catalytic coconut shell carbon. Aquasorb's macro-pores increase surface area (think of the coastline length difference between a straight coastline and one featuring bays and estuaries). Aquasorb has a surface area of 2000 – 2500 m²/g — uniquely high.

Aquasorb is treated with a ferric hydroxide coating 20-50 μm (microns) thick. This coating covers both the outsides and the insides of the media micro-pores (not only the straight coastline but the bays and estuaries), imparting a particularly strong positive charge and especially adhering chloramines and THMs.

In addition to adsorption, catalytic carbon eliminates contaminants by hydrophilic action, the attraction of contaminant molecules to the media surface and subsequent dissolving (as distinguished from adsorption). The amount of oxygen on media surfaces is key to hydrophilic reactions, and the ferric hydroxide (oxygen containing) coating on Aquasorb and greater surface area facilitate this reaction.

The Home Water Plant contains 30 pounds of Aquasorb.

THE PHASE 2 TREATMENT TANK

Most water treatment tanks are down flow: water enters the top of the tank, flows downward through packed media then exits the bottom of the tank and up through a tube to a top outlet. At the bottom of the tank there lies packed media or packed media on top of gravel (the gravel is intended to hinder the media from consolidating too tightly).

One of the keys to effective water treatment is contact time: the amount of time water molecules are effectively in contact with treatment media. In the *Home Water Plant* tank, water to be treated flows upward (see figure 1). This upward flow maximizes contact time.

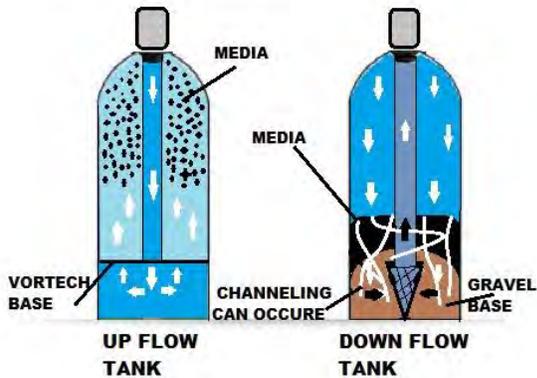


Figure 1

Upward flow also avoids channelization, not uncommon in competing technologies, and a serious impediment to contact time.

CHLORAMINES AND TRIHALOMETHANES

The Home Water Plant first second removes a broad spectrum of contaminants. Among these are chloramines and trihalomethanes. City water plant chlorine purification generates a host of disinfection byproducts, mostly combinations of chlorine and organic matter, called trihalomethanes. These are carcinogenic. As a result, they are increasingly regulated by the EPA. In part to get around these regulations, city water utilities increasingly disinfect their source water with chloramines, a combination of chlorine and ammonia. Chloramines also have the advantage, from the utilities' point of view, of persisting longer in the municipal piping system than chlorine. Unfortunately, chloramines also generate disinfection byproducts, and these are not only dangerous but, as yet, largely unregulated.

Chlorine → Chloramines → THM's → Cancer

The Home Water Plant's Aquasorb is specifically tailored to remove chloramines and trihalomethanes. Just by way of example, a leading carbon media seller claims to treat 500,000

gallons of water before media replacement or re-bedding. But the capacity of that system to adsorb chloramines is exhausted at about 17,000 gallons; their media will continue to adsorb other contaminants, but after 17,000 gallons chloramines simply pass through, into your drinking and bathing water. Chloramines are much harder to treat than chlorine — *The Home Water Plant* has been specifically designed to attack these dangers head on.

REGENERATION

Most carbon treatment, tank systems require periodic media replacement or re-bedding, or entire tank replacement. At the least, this requires backwashing into utility room floor drains (if the homeowner actually has them); it is a mess, and time-consuming and expensive. *The Home Water Plant* avoids all this mess, time and water wastage, and expense.

Home Water Plant media is easily regenerated to 99% of its original effectiveness by annually depositing a packet of desorption media into an aperture on the tank valve. Harmless effluent is run, say, from a hose bib or bathtub faucet for 15 or 20 minutes. If desorption is performed by a *Home Water Plant* dealer as part of annual maintenance, Aquasorb is warranted for 10 years.

TECHNICAL SPECIFICATIONS

Tank

Dimensions — 9" x 48"
Effective Flow Rate (gpm) — 8
Max/Min Pressure — 100 psi/30 psi
pH level — 6.0-9.5
Plumbing Inlet/Outlet Size — 1"

Media

Appearance — coarse granule
Particle Size — 0.6-2.4 mm
Surface Area (BET) — 2000-2500 m²/g
Moisture Content — 5% (max.)
Ball Pan Hardness — 98% (min.)
Bulk density — 630-640 kg/m³
pH — 9.5 (max)
Multiple Regeneration



THE ELECTRONICS OF HOME WATER PLANT™ SCALE REMOVAL & PREVENTION ¹

INTRODUCTION

Electronic descaling technology has been around for a long time.² It has been a mixture of successes, failures, and mysteries. It was a significant challenge to separate the real science of electronic descaling from the pseudo-science and market hype permeating the Industry. Frequently, an electronic descaler works in one house but not in the house next door, and no one has seemed to know why. Understanding these problems was a big part of the Home Water Plant descaler project.

The basic technology of electronic descaling has been shown to work. But user complaints are common. Interviewing users and testing competitors uncovered three basic, industrywide deficiencies:

- Descalers often do not work.
- If a descaler works at all, it takes too long for visible results.
- The user never knows if the descaler is working or not.

The Home Water Plant descaler was designed to overcome these problems.

IDENTIFYING INDUSTRY PROBLEMS

Research more specifically identified three key technological problems:

1. Many descaling devices simply proved not to deliver enough power to be effective, at least within any customer's perception of a reasonable time. Descaling signals rapidly decrease in size as they travel through the water. Most descaling devices have small descaling signals to start with. As these small signals rapidly decrease in size, they become ineffective after a short piping distance. Their descaling effect is limited to a small segment of the water system. This deficiency is particularly true of magnetic descalers. One descaler user's manual states not to expect visible results for "three months."

2. Electronic devices sold in the USA must pass FCC regulatory standards.³ The FCC regulates electronic devices to avoid interference with communications equipment, e.g.,

¹ © Joseph F. Walsh, 2018.

² The first patent issued in 1903.

³ Other parts of the world impose CE standards.

AM/FM radio bands, Wi-Fi, TV, etc. These FCC regulations are particularly difficult to pass for devices with electric signal outputs, such as descalers. Most descalers avoid interference with communications equipment by limiting their descaling signals to very low power levels. While avoiding FCC noncompliance, these descalers are so low power that they may take many months to see results, or never see results at all.

3. Many descalers do not work at all in some installations, but do work in others. There has been no way to tell, at the time of installation, whether a descaler will work in a given installation or not.

In addition to these major deficiencies, two others were identified:

4. Coil wrap descaling devices were difficult and frustrating to install. It is particularly difficult to install coils on pipe mounted to walls or ceilings. Magnetic clamp devices seemed fragile.

5. No descaling device advised the user whether the descaler was actually functioning, or had at some point stopped working.

ADDRESSING THE DEFICIENCIES

Greater power means a more effective and faster acting descaler. But designing a descaler with greater power, yet passing FCC standards, was a challenge.

Ultimately, a pure⁴, powerful, and effective descaling signal was engineered that passed FCC tests. This pure signal (nearly free of radio noise) passed FCC Part B, (residential) Part 15 A (commercial and industrial)⁵ and Part 18 (scientific and laboratory) requirements⁶ an industry first. Further interference protection (shielding) was provided by the Home Water Plant descaler's aluminum housing. Plastic enclosures used by the rest of the industry are not suited to providing the shielding desirable for the descaler's larger signal to pass FCC standards.

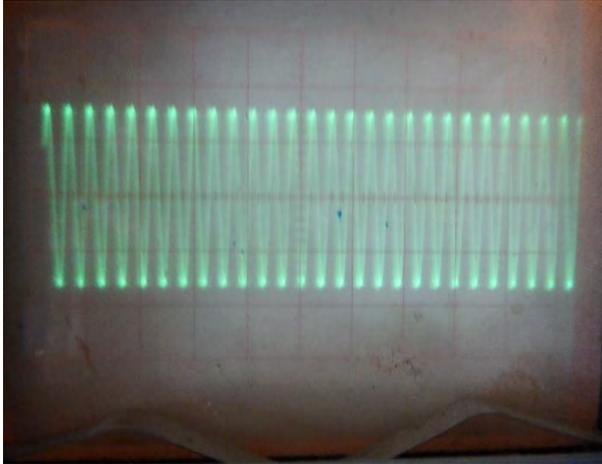
Immediately following are oscilloscope descaling signal strength readings of the Home Water Plant descaler and its most powerful competitor. The Home Water Plant descaler, over the same time, is delivering many times more descaling energy.⁷

⁴ Free of the harmonic distortions that cause FCC noncompliance.

⁵ 47 CFR §§ 15.107 and 15.109 (class A devices).

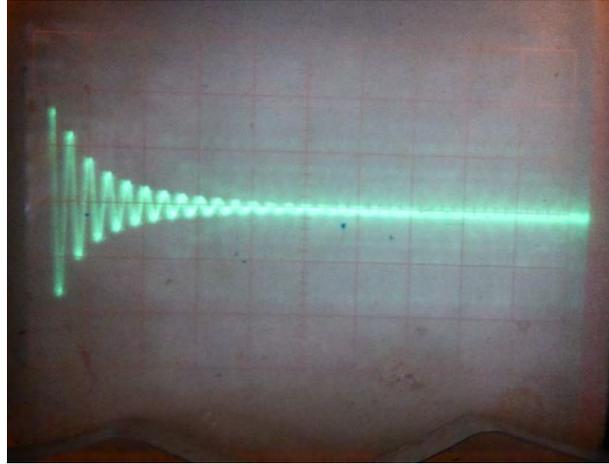
⁶ 47 CFR §§18.305 and 18.307. Although FCC compliant for medical establishments, the Turbo Descaler has not been field tested in medical environments and should not be installed in them.

⁷ The Home Water Plant descaler and other descaling devices were connected to the cold water pipe input of a 70-gallon hot water heater. The pictured signals were oscilloscope measured on the hot water pipe output of the same hot water heater. (The descaling signals traveled through the water in the hot water heater before being measured.) Other co competitors tested displayed far weaker signals, many too small to be recorded.



Home Water Plant Descaler

Every cycle has same high potential for descaling.



Nearest Competitor

It has a good peak, but the signal rapidly decays. Each cycle has progressively less potential for descaling. Note the long time between signal bursts with no descaling activity taking place.

The industry problem of descalers working in some installations but not others was found to be caused by descaling signals being diverted to electrically grounded pipe rather than propagating into the water to be treated. The industry standard has been to display a “power on” light indicating that a descaler was working. But these lights showed only that descaler power was on; they did not indicate if the descaling signal was being delivered into the water, or was just sent to ground, where it was useless.

The Home Water Plant descaler was designed with a built-in optimum installation site. It has a built-in section of metal pipe to which the descaler connects. This signal connection pipe is built-in insulated from ground by two dielectric unions. Thus, the Home Water Plant descaling signal is never shunted to to ground, solving the industry’s largest problem.

The Home Water Plant descaler has well over 100 electronic components, including a microprocessor. To assure that electronics are consistent, unit to unit, each descaler is tested and calibrated prior to shipment. Calibration parameters are retained in non-volatile long-term microprocessor memory.

The installation and durability issues characteristic of coil wrap and magnetic devices were resolved by designing a direct clamp-on descaler connection to the piping system — quick and easy, requiring only a screwdriver. Direct electrical connection assures that the maximum descaling signal reaches the water, for maximum descaling.

Repair, remodeling, or appliance replacement may change the conductivity of a home’s piping systems, which may in turn affect a descaler. A descaler’s initial placement may no

longer be satisfactory. Previously, the industry had no way of alerting customers to this problem. This issue was resolved by the Home Water Plant descaler's built-in computer and front panel lights. The descaler retests installation suitability about every ten seconds for as long as it is in place. Should a problem occur, the descaler's front panel lights alert the user.

A more powerful descaler signal generates more heat. The relatively large cooling surface of the aluminum enclosure allows the Home Water Plant descaler to deliver a larger descaling signal, with just a few degrees of temperature rise (pleasantly warm to the touch).

The few degrees temperature rise of the Home Water Plant descaler keeps moisture from condensing on the electrical circuits inside. This enables the descaler to be installed in higher moisture environments such as restaurants. Restaurants especially need devices with powerful descaling signals, to keep up with high usage hot water heaters and dishwashers.

ABSTRACT

The electronic descaling field has been characterized by several deficiencies. Many devices simply emit insufficient descaling signal strength, so as not to violate FCC regulatory standards. Designing a much more powerful descaling signal, yet also passing FCC standards, was a significant challenge. A powerful, but pure and consistent signal frequency plus an aluminum enclosure proved to be the answer. Many descalers work in some installations, but not in others, and no one could say why. The key to successful installations was found to be selection of an installation site where the maximum amount of the descaling signal entered the water, not shunted to ground, where it is useless. The Home Water Plant descaler was designed with a built-in, optimum installation site.

The Home Water Plant descaler is directly wired to the water piping, maximizing the amount of the descaling signal entering the water. This design also eliminates the frustrating aspects of coil wrap and magnetic descaling devices.

The Home Water Plant descaler has built-in computer diagnostics, calibration, and continuous self-testing, to assure uniform unit-to-unit performance and confirmation of successful performance over the years.

AUTHOR

Joseph F. Walsh

Sequim, WA, 2016

Abbreviated Curriculum Vitae

Education:

B.S.E.E. Electrical Engineering University of Connecticut

2 years graduate work electrical engineering at the University of Washington

Work History:

20 years industry experience as design engineer and principal engineer for John Fluke Instrumentation Co., and others

25 years independent design engineer

Patents: USA Issued Patents, named inventor:

- 8 patents on the Smart Phone
- 2 patents on measuring time at the speed of light
- 1 patent on computer interconnections
- 1 patent on secret-less security codes used on US passports
- + 1 patent pending on the Smart Descaler

THE SCIENCE OF LIMESCALE FORMATION and HOME WATER PLANT™ SCALE REMOVAL & PREVENTION ¹

It All Starts with Hard Water

Hard water is created by the chemical weathering or dissolving of rocks in lakes, rivers, reservoirs, and wells. This process begins with carbon dioxide from the atmosphere dissolving in surface waters. Atmospheric carbon dioxide reacts with water in solution to form a weak acid, carbonic acid. (Carbonic acid is harmless; it is more popularly known as soda water, which adds carbonation to soft drinks.) This weak carbonic acid reacts with carbonates² in rocks and silicates³ to form soluble calcium, magnesium and manganese ions⁴ and other minerals, the components of hard water. As the water runs over and through cracks in these rocks (for example, limestone), these soluble ions get into the water supply.

Other weak acids, such as acid rain, get into the water supply and dissolve rocks further contributing to the creation of hard water.

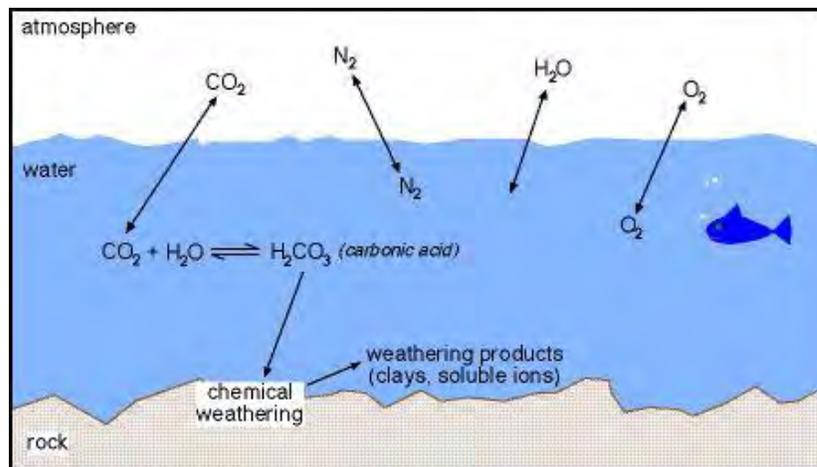


Figure 1⁵

¹ © Sharon Laska, 2018.

² Salts (see footnote 8) composed of metal ions and carbonate ions.

³ Similar to limestone, in that they contain positive calcium or magnesium ions, but different negative ions.

⁴ Atoms which have gained or lost electrons, resulting in either a net positive or negative charge.

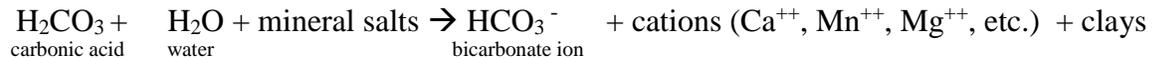
⁵ Picture provided by Columbia University, <http://www.columbia.edu/vjd1/carbon.htm>

The reactions for dissolving rocks (weathering) are these:

Reaction 1: Carbon dioxide is removed from the atmosphere by dissolving in water and forming carbonic acid



Reaction 2: Carbonic acid dissolves (weathers) rocks, yielding soluble bicarbonate ions, other soluble ions, and clays:



Calcium and magnesium are the most common soluble ions in hard water and the amounts of these two ions are measured to determine water hardness. Iron and manganese ions are also found in some water supplies.

How does limescale form in your pipes & appliances?



LIMESCALE IN PIPES



LIMESCALE ON APPLIANCE HEATING ELEMENTS

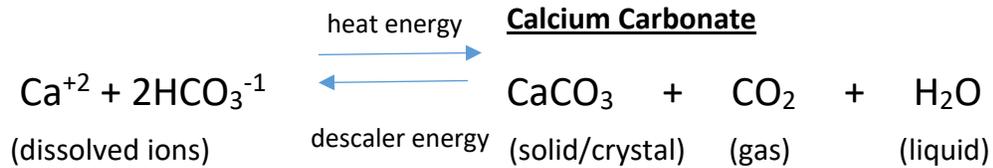


The three carbonates that form from the most common soluble metal ions are calcium carbonate, magnesium carbonate, and manganese carbonate. These three carbonates are very insoluble in water, tend to fall out of solution, and deposit as white to off-white crystals in pipes and on heating elements in hot water heaters, dishwashers, instant hot water heaters, and coffee makers.

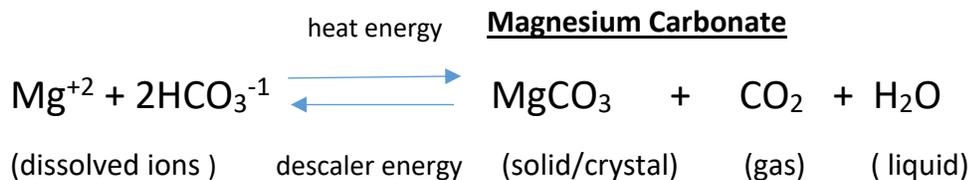
Reactions 3, 4, and 5 show the formation of each carbonate from each soluble metal ion and the bicarbonate ions in water. Carbon dioxide gas is also produced and becomes dissolved in

the water. These three reactions all absorb heat energy. Thus, they all make more solid crystal carbonates at higher temperatures. The “descaler energy” notation for each of these reactions is discussed later in this paper.

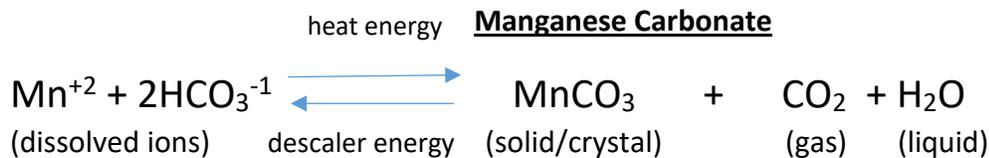
Reaction 3: Formation of calcium carbonate (white solid/crystal) limescale



Reaction 4: Formation magnesium carbonate (white solid crystal) limescale

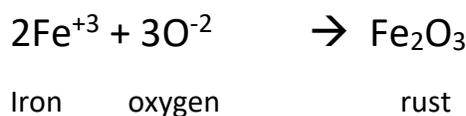


Reaction 5: Formation Manganese Carbonate (white/pink solid crystal) limescale



Reaction 6:

In the presence of oxygen, Fe ions (iron) form rust, which precipitates out of water and combines with the calcium or magnesium or manganese carbonate formations. This may give limescale a reddish-brown color.



How do the different metal ions in hard water affect users?

Calcium, magnesium, manganese, and iron are all needed by the human body. These minerals are found at varying amounts in hard water supplies, as well as in many different foods.

Calcium and magnesium, as the main components in hard water, adversely affect the user by producing limescale build-up in pipes and on dishwasher and hot water heater elements. This limescale causes appliances to work less efficiently and lowers water flow (from reduced interior diameter pipes). Descaling removes the limescale. The freed calcium and magnesium ions pose no health or aesthetic problems to users; the minerals are necessary to health.

Manganese and iron are found less frequently in water supplies. They also form precipitates and attach to calcium and magnesium carbonates in limescale, often contributing a reddish-brown color. However, manganese and iron are an additional nuisance for the user, considered aesthetic contaminants. Each gives a disagreeable metallic taste to water and imparts a brownish stain to laundry and plumbing fixture.⁶ When pipes and heating elements are descaled, manganese and iron salts flake off as the calcium and magnesium salts are dissolved. Descaling, itself, does not get rid of the smell and stains caused by manganese and iron. But Home Water Plant phase 2, Aquasorb, treatment does (presuming the source of manganese and iron is the city's water supply, not deteriorated in-home piping).

How is limescale dissolved in pipes and appliances?

The Home Water Plant Descaler uses the carbonic acid already in the water.

Limescale is composed mainly of calcium carbonate and 5) ultimately forming further carbonic acid., plus smaller amounts of magnesium, manganese, or iron salts.⁷ Calcium, magnesium, and manganese carbonates are all insoluble in water, but are soluble in weak acids.

Looking back at figure 1, one sees that atmospheric carbon dioxide dissolves in water making a weak acid, carbonic acid. This carbonic acid weathers the rocks on earth and slowly dissolves them. Carbon dioxide is also byproduct of limescale formation itself (reactions 3, 4, and 5) ultimately forming further carbonic acid.

Carbonic acid contains two hydrogen ions. Descaler electrical energy frees one of these hydrogen ions in carbonic acid via an electrochemical reaction.⁸

Reaction 7: formation of hydrogen ions



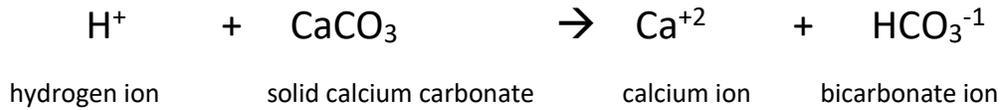
⁶ <https://water.usgs.gov/edu/groundwater-contaminants.html>.

⁷ Positive metal ions combined with negative ions in a crystalline structure.

⁸ "Electrochemical reactions" encompasses both facilitating electrical reactions chemically (e. g., deriving electricity from a battery) and facilitating chemical reactions through the introduction of electrical energy. In this instance, the latter type of reaction is meant.

The Hydrogen ions derived from the carbonic acid react with the solid calcium carbonate, limescale, to form soluble calcium and bicarbonate ions.⁹

Reaction 8: Reaction of hydrogen ions with limescale and formation of dissolved ions



The Home Water Plant Descaler sends out a continuous electrochemical signal that provides activation energy for separating a hydrogen ion from carbonic acid (reaction 7) already in the water. The freed hydrogen ion combines with the solid CaCO₃, limescale, and converts it into soluble ions (reaction 8). (See the “descaler energy” left-facing reaction arrows at reactions 3, 4 and 5.)

One overall reaction for the carbonic acid acting on the calcium carbonate can be written as:

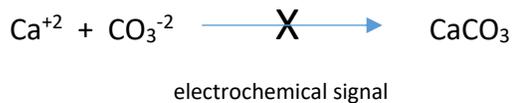
Reaction 9:



Reactions 8 and 9 specifically apply to calcium carbonate, the most prevalent form of lime scale; similar reactions occur with magnesium and manganese carbonate.

How does the Home Water Plant Descaler prevent limescale formation?

The Home Water Plant Descaler’s electrochemical signal also causes continuous movement of the dissolved ions in the water. The positive metal ions (Ca⁺² and Mg⁺²) and the negative ions (CO₃⁻²) are kept moving in the water by the signal, thus preventing them from getting close enough to each other to precipitate as new calcium or magnesium carbonate (limescale).



⁹ This is typical. The freed hydrogen ions from acids (weak or strong) are what dissolve carbonates and silicates.

Does all of the limescale dissolve and get washed away?

A byproduct of descaling limescale or dissolving limestone is a small amount of a white powdery substance. Any working descaler device has this same white powdery by-product, sometimes called lime dust. This white powder does not clog pipes or attach to heating elements. In the Home Water Plant, any dish, silver or glassware spotting from lime dust is prevented by the phase 4 dishwasher-only filter.

ABSTRACT:

The limescale that clogs pipes and attaches to heating elements in hot water heaters and dishwashers is directly caused by metal ions (mostly calcium and magnesium) being deposited as carbonate crystals. Limescale ions come mainly from dissolved limestone. Limestone is slowly dissolved by carbonic acid formed when atmospheric carbon dioxide dissolves in surface water. The dissolved calcium and magnesium and other ions from dissolved limestone travel with water flow and are later re-crystallized as limescale on pipes and heating elements.

The Home Water Plant Descaler dissolves limescale without adding chemicals or salts. The Home Water Plant Descaler activates the carbonic acid, already in water, to eliminate limescale in pipes and appliances. The carbonic acid in water comes from the natural dissolving of carbon dioxide from the air at the city's water source (e. g., reservoir or well), and secondarily from the reactions that make carbonate salts (limescale). The Home Water Plant® Descaler produces a constant electrochemical signal activating this carbonic acid to release hydrogen ions. These hydrogen ions combine with solid calcium carbonate, converting it into soluble ions that wash away. The electrochemical signal also generates movement of the dissolved ions in hard water to prevent the formation of new limescale.

Author:

Sharon Laska Sequim, WA, 2016
Abbreviated Curriculum Vitae

Education:

B.S. Biochemistry, University of Wisconsin

M.S. Chemistry, University of Washington

M.B.A. City University

M.S. Education, Seattle Pacific University

Work History:

15 years at University of Washington in
Clinical Chemistry, University Hospital

5 years at the first Biotech Company in
Seattle – Oncogen. Later Oncogen was
purchased by Bristol-Meyers. Developed
a diagnostic blood test for breast cancer

4 years at Baxter Healthcare in Chicago.
Developed an automated blood test for
syphilis for the American Red Cross for
blood banking

5 years at a start-up biotech company.
VP of Manufacturing and Customer
Service. Responsible for all reagent
manufacturing, including water quality
and reagent shelf-life

14 years teaching chemistry and
advanced chemistry in Seattle area high
schools



Home Water Plant

HOME WATER PLANT + (SILICA TREATMENT) SPECIFICATIONS SCIENCE AND TECHNOLOGY

85% of the United States has hard water, i.e., containing calcium and magnesium of 7 gpg (grains per gallon) or more. That statistic underlies the *Home Water Plant* Phase 3 scale treatment and prevention design. Calcium and magnesium, or carbonate, scaling seems an ever-present problem, and the *Home Water Plant* is designed to treat the most common problems faced by homeowners supplied through city water plants.

A considerable number of localities face another scaling problem, silica or its relatives. Silica (SiO_2 or silicon dioxide) is a combination of silicone and oxygen, the two most abundant elements on earth. As is the case with calcium and magnesium, almost any water from a city water plant will contain at least a slight amount of silica. When the silica level reaches 12 or 14-15 ppm (parts per million), it becomes a serious problem. But when, in some communities, silica exceeds this loosely defined level it becomes a recognized, particularly annoying problem. Pipes and appliance heating elements, dishes, silver and glassware scale. The *Home Water Plant* + (*Silica Treatment*) system prevents scaling from silica and its anion relatives: silicates, sulfates, phosphates, fluoride, chloride, bromide, carbonate and hydrate. Anions are negatively charged ions: atoms with more electrons than protons.

The second tank media in the *Home Water Plant* + (*Silica Treatment*) includes ceramic hydroxyapatite, which behaves as a cationic, positively charged surface to capture anions such as sulfates, silicates and phosphates.

REGENERATION

The *silica* + media is easily regenerated to 99% of its original effectiveness by annually depositing a packet of desorption media into an aperture on the tank valve. Harmless effluent is run, say, from a hose bib or bathtub faucet for 15 or 20 minutes. If desorption is performed by a *Home Water Plant* dealer as part of annual maintenance, the *silica* + media is warranted for 10 years.

TECHNICAL SPECIFICATIONS

Tank

Dimensions — 9" x 48"

Effective Flow Rate (gpm) — 8

Max/Min pressure — 100 psi/30 psi
pH level — 6.0-9.5
plumbing inlet/outlet size — 1"

Media

Appearance — white/opaque solid granules
Odor — odorless new pH (10 g/l)
Relative Density — 700-800 g/cm³
Solubility — non-soluble
Decomposition Temperature — $\geq 212^{\circ}$ F

Home Water Plant

PHASE 4 TREATMENT DISHWASHER-ONLY SEQUESTERING SPECIFICATIONS SCIENCE AND TECHNOLOGY



The fourth phase of *Home Water Plant* treatment is a dishwasher-only sequestering media treatment.

This phase complements the second phase of *Home Water Plant* treatment: hard water limescale removal and prevention. Second phase treatment renders limescale, calcium and magnesium ions, soluble, so they wash away. These healthy minerals are left in your water for drinking,

For your dishwasher, it makes sense to have further, belt-and-suspenders, protection against etching and spotting, simply because they are such an aggravating nuisance and the alternative is washing and drying by hand.

The dishwasher-only filter is installed in-line, directly to your dishwasher. The filter cartridge contains food quality, slowly soluble, polyphosphate beads. These beads dissolve at a controlled concentration to further prevent scale formation in the dishwasher. The polyphosphate inhibits precipitation of potentially scaling material, essentially sequestering it to prevent spotting and etching on dishes, silver and glassware.

The dishwasher-only cartridge should be replaced annually.

The dishwasher-only media is tested and certified by NSF International against NSF/ANSI standard 42 for material requirements only and certified by NSF to NSF/ANSI standard 60, drinking water treatment chemicals-health effects.

TECHNICAL SPECIFICATIONS

Flow rate (gpm) — 0.5

Max pressure (psig) — 125

Temperature (F) — 35-140

Height (in.) — 14



Home Water Plant

PHASE 1 TREATMENT SEDIMENTS REMOVAL SPECIFICATIONS SCIENCE AND TECHNOLOGY

SEDIMENTS

Water discharged from your city plant is only “pretty safe.” And then, sediments, dirt and the like, enter the water stream at reservoirs and pump stations and through miles of city water mains. Many of these pipes are over 100 years old. Some are cracked, or scum lined. There are 240,000 city water main breaks in the US annually.

TREATMENT

Home Water Plant 1st phase treatment is a sediment prefilter, and more. The filter housing contains an inexpensive, easily replaced, radial flow, dual-gradient filter cartridge. Its primary purpose is to filter out sediments which might, otherwise, reduce Phase 2 efficiency and leave your water turbid, but it captures many contaminant particles as well.

“Radial flow” means that entry water flows laterally, from the outside to the inside of the filter cartridge. These cartridges are manufactured from spun polypropylene fibers. Fiber density increases toward the center, or inner gradient, of the filter cartridge, thus “dual gradient.” Outer gradient fibers capture sediments greater than 25 μm ; inner gradient fibers capture sediments greater than 1 μm , e.g., cysts. (A μm , a micron, equals 39 millionths of an inch; a red blood cell is 6-8 μm .)

Effective filter depth equals 230% of standard spun-polypropylene or string-wound filters, providing very high particulate reduction efficiency and added loading capacity. *The Home*



Water Plant 1st phase filter captures up to three times the sediment of other similarly-sized cartridges.

The sediment reduction efficiency of first phase treatment is about 92% of particle sizes above 10 µm and 98% of particle sizes 70 µm and above.

Our experience is that, in moderate-use household conditions, Phase 1 cartridges will last up to 16 months. But water quality and circumstances vary widely. Four pre-teen or teenage daughters will run through a filtration system rather more quickly. City water main breaks, virtually ingesting dirt, may quickly exhaust a prefilter. We strongly recommend annual replacement. A noticeable drop in water pressure in less than 12 months tells you the prefilter cartridge should be replaced. Cartridges are inexpensive and easily replaced.

Tested and certified by NSF International to NSF/ANSI standard 42 for material requirements only.



TECHNICAL SPECIFICATIONS

Dimensions — 4 ½ X 20"

Media — polypropylene

Temperature rating — 40-145° F

Outside micron rating (nominal) — 25 µm

Inside micron rating (nominal) — 1 µm

Approximate pressure drop at 8 gpm — ½ psi (8 gpm approximates a shower, two faucets and a washing machine operating simultaneously). Typically, home water pressures approximate 75 psi, so a ½ psi differential is unnoticeable.