WATER

CONDITIONING AND HOW IT WORKS

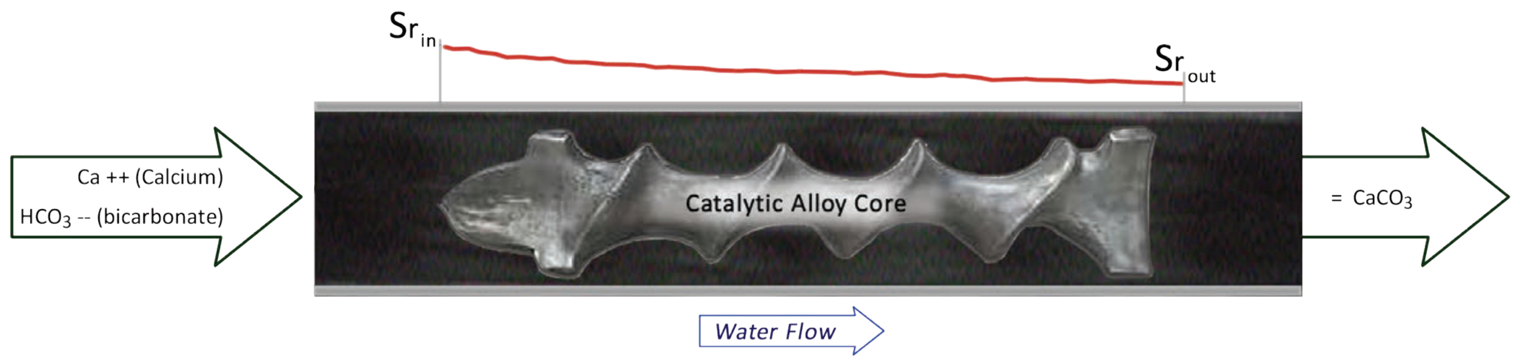
We think of water as a clear liquid but water really contains suspended solids as well as dissolved minerals and gases. These components are picked up as water passes through nature on the way to our homes. Water hardness is measured by the amount of dissolved calcium and magnesium in water.

Note: While magnesium contributes to the hardness level it's calcium that causes hard scale so that's what we address here.

How does hard water cause us problems?

Water will only dissolve a certain amount of calcium dependent upon conditions. The amount of dissolved calcium that can be held in water reduces as temperature or pH increases. Using temperature as an example, let's take a hard water and heat it to a temperature (x) where the water is at its absolute maximum capacity for dissolved calcium. This is known as the saturation point. Now we'll continue to apply heat taking the temperature above (x). As we exceed the saturation point an amount of dissolved calcium is forced out of solution (it precipitates meaning it is no longer dissolved).

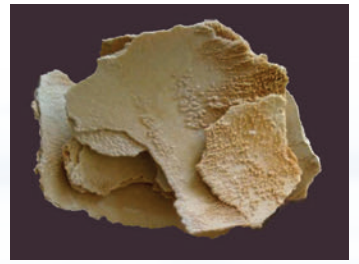
The saturation ratio (Sr) decrease of calcium in solution is initiated by the catalytic reaction



When calcium precipitates in this way it can combine with bicarbonate to form a hard calcium carbonate scale called calcite that bonds to the nearest receptive surface.

To prevent this from taking place our treatment reduces the amount of dissolved calcium by precipitating calcium carbonate in a form called aragonite, harmless insoluble crystals that are carried through the system to the drain or consumed.

Our treatment uses a catalytic reaction to induce the precipitation of aragonite (details below):



Calcite, a form of calcium carbonate, is what we call limescale or scale. When calcium carbonate precipitates as calcite it forms a hard deposit that causes numerous problems adhering to any receptive surface requiring acid or a significant mechanical effort to remove.

Aragonite, another form of calcium carbonate, has very different characteristics to calcite. When calcium carbonate precipitates as argonite it forms a non-adhering harmless insoluble crystal that is either consumed or carried through the system to the drain.

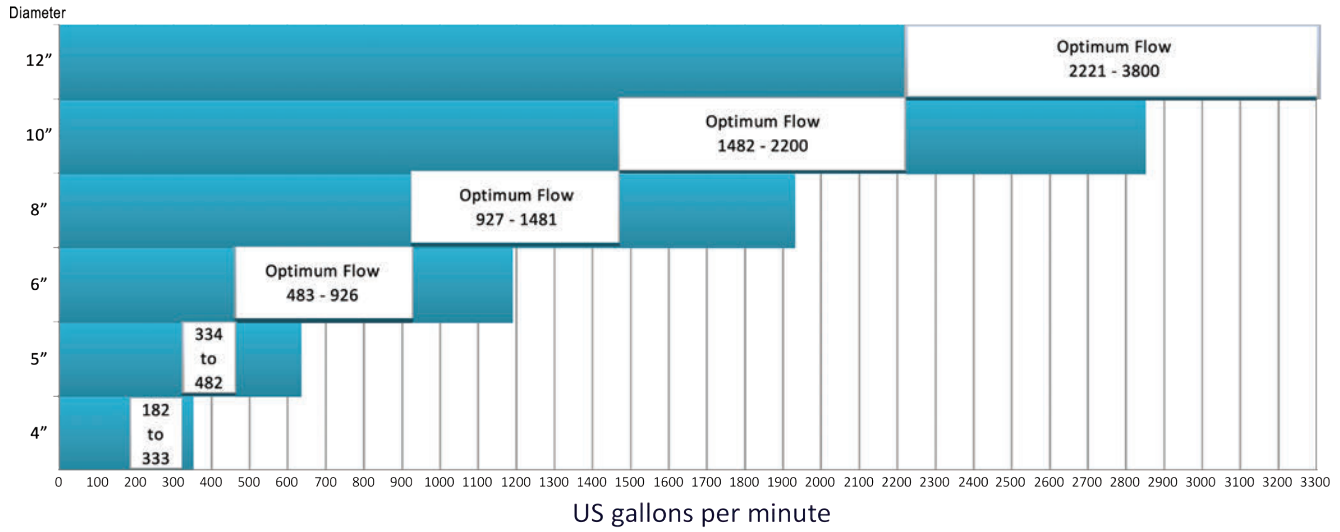
- The Fluid Dynamics scale prevention product line utilizes a non-sacrificial lead free alloy core with a special surface. As water passes over the core a catalytic reaction takes place.
- The reaction causes carbonic acid to precipitate. The reduction of this acidic component increases the pH of the solution.
- This pH increase triggers calcium and bicarbonate to come out of solution combining to form calcium carbonate (CaCO3) in its aragonite state. The pH increase is only temporary so there's no difference in pH readings before and after the unit.
- Catalytic treated water has a greater capacity for calcium. This greater capacity prevents scale deposition and in many cases any pre-existing scale is gradually absorbed.

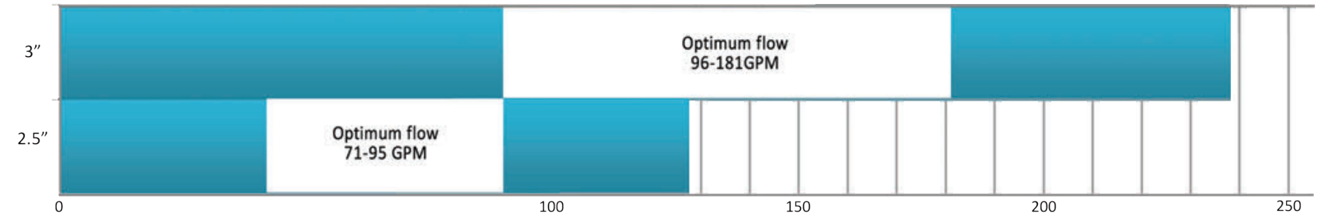
SIZING GUIDANCE

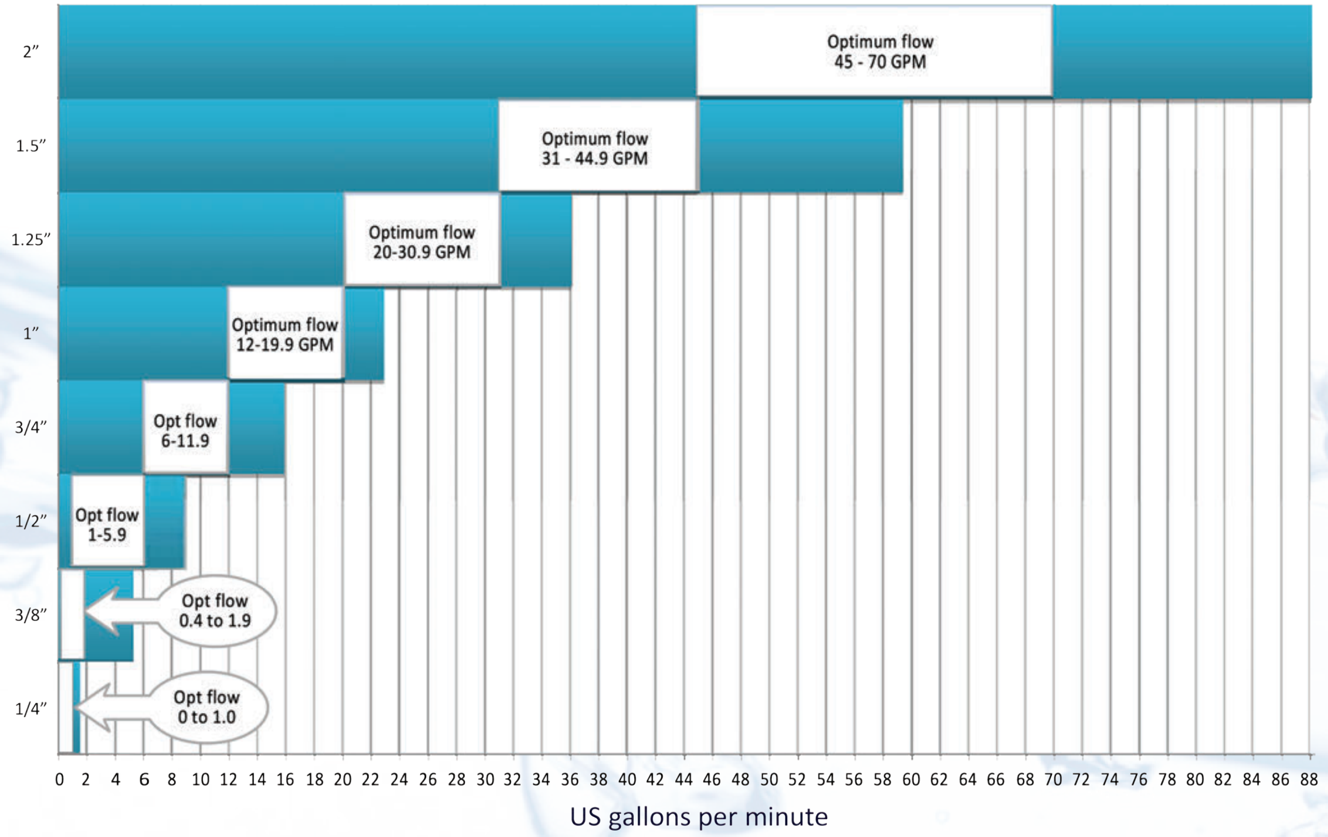
For the most effective treatment it's important that turbulent interaction with the catalytic core takes place. Our conditioners should always be sized based on flow rate. Never oversize our conditioners as they will not perform adequately (bigger is not better!) Use the average flow of the system to size the correct conditioner.

For intermittent flow systems, while the greatest degree of treatment will occur during peak times treatment still takes place at other flow rates maintaining scale prevention requirements.

Note: Larger sizes and charts are available, the Fluid Dynamics product line is scalable to accommodate any flow rate



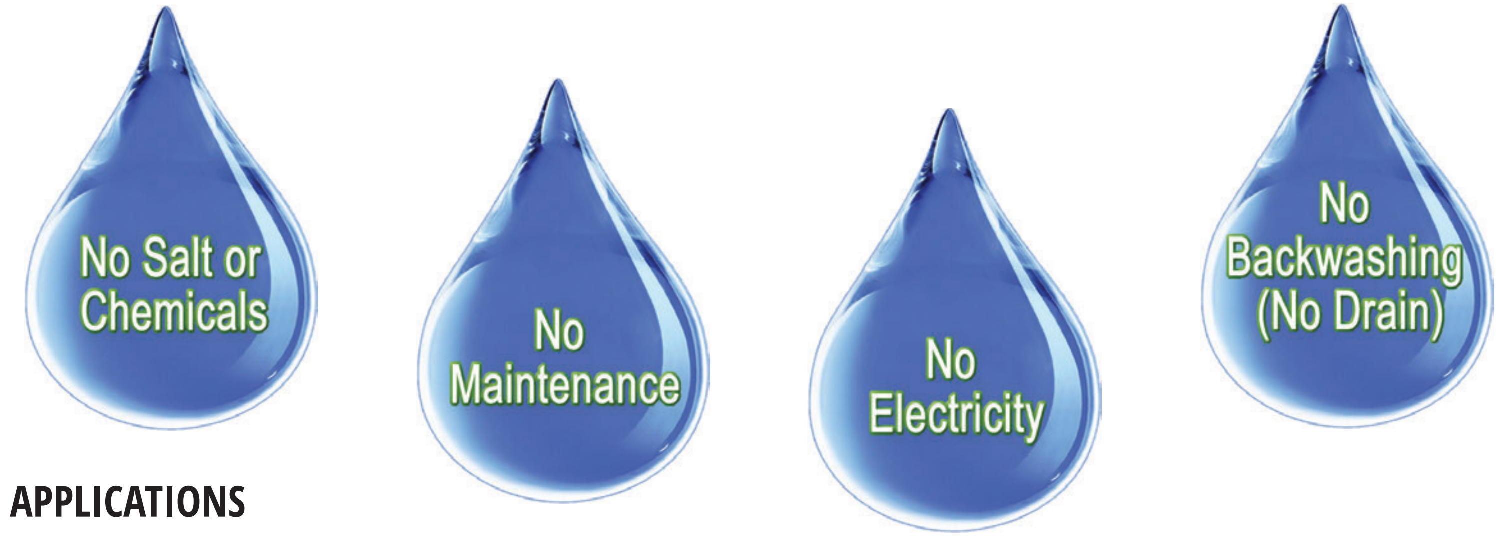




SCALETRON®

www.scalepreventionusa.com

STOP Hard Limescale Without Softening Water



APPLICATIONS


Showerhead before and after with just a short period of treament.


Water heaters.
Boilers, low pressure calorifiers.
Evaporative cooling, cooling towers etc.
Heat exchangers - plate type.
Heat exchangers - tube type.
Humidifiers (air washers).
Condensers.
Irrigation systems.
Ice making machines.
Steam mixing valves.

Whole house protection.
Injection molding machines.
Vacuum pumps and valves.
Compressors.
Chemical reaction vessels condensers.
Refrigeration general condensors, B.A.C type, compressors, sterilizers, temperature probes.
Dish washers, bottle washers etc.

Heat exchangers

Cooling Towers

Spray nozzles.
Cereals, bakeries, vegetable processing.
Film and x-ray processing furnaces.
General cooling systems.
Extruders.
Presses
and many more...

Fluid Dynamics
Hard water solutions since 1973

Over a million installations worldwide

FAQ'S

IS ANYTHING ADDED TO THE WATER DURING TREATMENT?

No, both catalytic and combination treatment use non-sacrifical components so nothing is added to the water during the process.

WHAT HAPPENS TO THE TREATED CALCIUM CARBONATE?

Our conditioners cause calcium carbonate to precipitate as an insoluble crystal. Calcium carbonate is still CaCO3 just in an altered way.

Think of water itself, its H20 but can take the form of water, ice, steam or snow. Many other compounds are the same and our conditioners exploit the ability to create a stable non-adhering formation of calcium carbonate.
Once precipitated calcium carbonate remains as microscopic crystals in suspension in the water and will float round eventually exiting a drain or bleed valve. If treated water is remaining in a static environment for a prolonged period of time then this crystal suspension can often settle out and take the form of very fine powder or soft sludge.

There is no record of this deposition having enough consistency to cause blockages in valves or outlets.

WHY ARE OUR CONDITIONERS CONSIDERED SO GREEN?

Our conditioners can be considered amongst the greenest water treatment available. It is a completely power free system and has no sacrificial components requiring regular replacement. There is no salt required, no wasted water and our conditioners require no replacement parts.

MIXING TREATED AND UNTREATED WATER

Mixing treated and untreated water will have an impact on treatment quality. If two separate sources are supplying a single piece of equipment and do not mix before the area where scaling would occur both should be treated.

IS TREATED WATER SAFE TO CONSUME?

Catalytic and MagCat systems have been used in potable systems for over 40 years and have received numerous safety certifications some of which are listed in this handbook.

NSF/ANSI
61 & 372

APPROVED WRAS MATERIAL

WHY IS SELECTING THE RIGHT DIAMETER SO IMPORTANT?

Selecting the wrong size diameter including using a larger diameter than needed can compromise water delivery and affect treatment quality. Size should be selected based on flow rate and if required suitable reducers should be used to connect to intended pipework.

WHY ISN'T THERE A BIGGER EFFECT ON PRESSURE LOSSES?

Both catalytic and Magcat systems have internal components designed to minimise resistance as water passes through it.

WHAT IS THE GENERAL LIFE EXPECTANCY OF THE CONDITIONERS?

Dependant on use, a minimum of 10 years can be expected however it is not uncommon for conditioners to last between 15-20 years.

HOW LONG WILL IT TAKE BEFORE A DIFFERENCE IS NOTICED FOLLOWING INSTALLATION?

Depends entirely on frequency of use and if there are significant limescale deposits already present. If significant scale is already present it can take several months before any difference is noticed. However in some cases results can be seen in a matter of weeks.

INSTALLATION GUIDE ON RECIRCULATING HOT WATER SYSTEMS

If installing conditioners for treating a recirculating hot water system the general practice is to ensure the supply to the water heater is treated and it is good practice to ensure that the return part of the recirculating system also has a conditioner on it. This can be avoided in some modern systems where the water is kept at a relatively consistent temperature and where there is fast rate of water consumption. Where water is circulating with with hot and cooler water continually mixing the treatment efficiency will eventually start to degrade.

GSA Catalyst-Based Device Reduces Calcite Buildup, Requires Minimal Maintenance

GSA's Green Proving Ground (GPG) program commissioned the Oak Ridge National Laboratory (ORNL) to assess the effectiveness of a catalytic insert that alters the chemistry of hard water to prevent calcite buildup. Researchers assessing the technology at the Frank E. Moss Federal Court House in Salt Lake City, Utah, found that the catalyst-based non-chemical water treatment (NCWT) system dramatically reduced calcite buildup and had immediate payback when compared to a chemical (salt-based) system.

Payback at other locations will depend on the ongoing remediation costs of calcite buildup.

What We Did

RESEARCHERS ASSESSED NCWT IMPACT ON SYSTEM CALCIFICATION IN HIGH HARD WATER CONDITIONS

Researchers from ORNL tested the catalyst-based technology in an electric domestic water heater. The water heater provided an ideal test-bed because it is located in an area of high groundwater hardness and had no installed calcite control technology.

Over the course of 18 months, ORNL conducted pre- and post-installation assessments of calcite formation on water system heating elements and documented energy use, incidence of element failure, and labor and material costs. Researchers also conducted a preliminary economic analysis of installed cost and potential savings on the courthouse's cooling tower.

What We Concluded

At the Moss Federal Courthouse, the catalyst-based non-chemical water treatment prevented calcite buildup with minimal O&M costs.

The technology should be considered for any heating system with calcification issues, including hydronic heating systems and boilers, condensing boilers, and gas and electric water heaters.

The harder the water, the more likely NCWT will be cost-effective. As a next step, GPG will evaluate the technology in cooling tower applications, following preliminary modeling that found it to be life-cycle cost-effective.

GPG FINDINGS 019

FEBRUARY 2015

CATALYST-BASED NON-CHEMICAL WATER TREATMENT SYSTEM

OPPORTUNITY

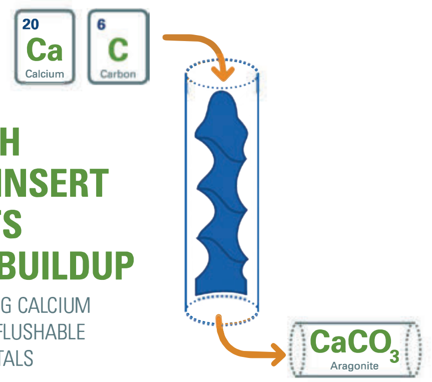
What percentage of the U.S. has hard water?

85%
OF THE UNITED STATES HAS HARD (>121 MG/L) WATER[1]

CALCITE BUILDUP
due to hard water restricts water flow and causes heating systems to overheat and fail

TECHNOLOGY

How does the Catalyst-Based NCWT work?



PIPE WITH HELICAL INSERT PREVENTS CALCITE BUILDUP
BY TRANSFORMING CALCIUM AND CARBON TO FLUSHABLE ARAGONITE CRYSTALS

M&V

Where did Measurement and Verification occur?

OAK RIDGE NATIONAL LABORATORY assessed the effectiveness of the catalyst-based NCWT at the Moss Federal Courthouse in Salt Lake City, Utah. Before installation of NCWT, commercial-grade heating elements overheated and failed after only two months of operation.

RESULTS

How did Catalyst-Based NCWT perform in M&V?

EFFECTIVE
REDUCTION OF CALCITE
NO BUILDUP AFTER 18 MONTHS[2]

O&M
MINIMAL
NO MOVING PARTS OR CHEMICALS[3]

<2 yrs
PAYBACK; IMMEDIATE WHEN COMPARED TO CHEMICAL SYSTEMS[4]

NCWT vs. Salt-Based System in Salt Lake City
Payback for NCWT is immediate compared to a salt-based system

	Salt-Based System	NCWT
Equipment Cost	$2,600	**$1,192—¾" diameter pipe** Unit pricing ranges between $798 for a ⅜" pipe and $96,360 for a 16" pipe.
Installation Cost	$600	**$500 —10 hours @ $50/hr** Installation for new construction is $0, as it incurs no additional costs over baseline.
Maintenance Costs/year	$1,850—$350 chemicals, $1,500 labor	**$100—biannual tank cleaning** Required in systems without a drain.
Simple Payback		Immediate

DEPLOYMENT

Where does M&V recommend deploying Catalyst-Based NCWT?

FACILITIES WITH HARD WATER
Any heating system with calcification issues including hydronic heating systems and boilers, condensing boilers, and gas and electric water heaters. The harder the water, the more likely NCWT will be cost-effective

[1]American Water Works Association, Public Notice Article, May 2007 [2]Catalyst-Based Non-Chemical Water Treatment System, Frank E. Moss U.S. Courthouse, Salt Lake City, Utah, Dan Howett (ORNL) October 2014, p.1 [3]Ibid, p.24 [4]Ibid, p.25

GSA GPG Green Proving Ground Program
The Green Proving Ground program leverages GSA's real estate portfolio to test innovative building technologies and provide recommendations on their deployment. www.gsa.gov/gpg

CALCITE BUILDUP DRAMATICALLY REDUCED Before installation of the catalytic-based technology, and in the absence of any kind of water treatment, commercial-grade heating elements had such significant calcite buildup that they overheated and failed after only two months of operation. After installation, elements had little visible calcite buildup even after eighteen months of operation.

PAYBACK WILL BE SITE-SPECIFIC The catalyst-based system had minimal operational costs beyond the initial installed cost of $1,692. At the Moss Federal courthouse, simple payback was less than two years, when compared to the cost of replacing failed heating elements. When compared to the cost of a conventional salt-based system, payback is immediate. The harder the water, the more likeley NCWT will be cost-effective.

MINIMAL OPERATIONS AND MAINTENANCE Little training is needed for site personnel, as there are no moving parts or chemicals added. In installations where there is high iron content, the catalytic device may require periodic cleaning. In systems without a drain, calcite can form a soft sludge in the bottom of the tank which should be removed either manually or with a wet & dry vacuum every 18-24 months.

DEPLOY WHERE THERE IS HIGH WATER HARDNESS Catalyst-based NCWT technology should be considered for any GSA facility with calcification issues. Remote locations, where access to power, chemicals, and labor makes conventional water softening impractical and expensive, may benefit particularly from this technology.

Table ES-2. Retrofit Economic Assessment

Cost Elements to Compare	Baseline Salt-Based Water Treatment System	Test-Bed Installation Catalyst-Based Water Treatment System
Equipment Cost[2]	$0	$1,192
Installation[3]	$0	$500
Maintenance Labor	$1,500/yr	$100/yr
Maintenance Material	$350/yr	$0/yr
Simple Payback	N/A	<1 year
Savings-to-Investment Ratio	N/A	1.0[4]

Table ES-3. End of Life Economic Assessment

Cost Elements to Compare	Baseline Salt-Based Water Treatment System	Test-Bed Installation Catalyst-Based Water Treatment System
Equipment Cost	$2,600	$1,192
Installation	$600	$500
Maintenance Labor	$1,500/yr	$100/yr
Maintenance Material	$350/yr	$0/yr
Simple Payback	N/A	Immediate
Savings-to-Investment Ratio	N/A	N/A[5]

"Before we installed the catalytic insert, our hot water heating elements failed every six weeks because our water is so hard. With the inserts in place, regular inspections show there is essentially no scale build up at all."

-Daniel Wang
Property Manager
Frank E. Moss Federal Courthouse Salt Lake City, Utah
Great Lakes Region
U.S. General Services Administration