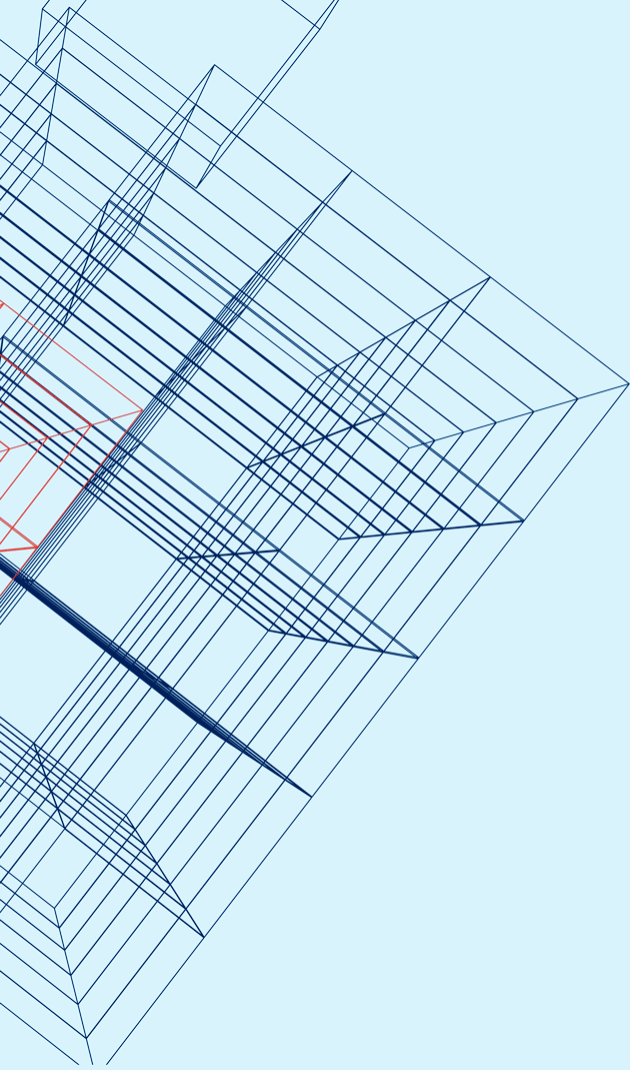




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Chemical-Free Water Conditioning System to Remove Scale and Biofoul

By
Chuck Widhalm, P.E.
D&W Marine Systems Management
a Service Disabled Veteran Owned Small Business
www.dwmsm.com

SPEAKER

Chuck Widhalm, P.E.



- BSEE from South Dakota School of Mines & Technology.
- Lived in Texas for 34 ½ years and moved to Arkansas.
- Focused on the Defense Industry for most of my career doing RF antenna/system design and have been working on applying Chemical Free Water Conditioning technology on projects since 2013.
- Oldest son graduated from the Naval Academy in 2013 and is a SeaBee finishing his Master's Degree at Texas A&M.
- Youngest son is working on his Master's in Bio-Astronautics at the University of Colorado – Boulder and supporting Science Projects on the International Space Station.

Agenda

- D&W Marine Systems Management – Who Are We?
- Hydropath Technology Background
- Cost of Scale and Bio-Fouling
- Installation
- How Does This Technology Work Against:
 - Scale
 - Bacteria & Algae
 - Filtration
- Key Applications and Case studies
 - Boilers, Pools, Cooling Towers, Kitchen/Galley
- Questions & Answers

Note: Various Vimeo Links provided at the end of this presentation for further investigation



MARINE SYSTEMS
MANAGEMENT, INC.



- Established in 2012 focused on Port Engineering Services
- Partnered with HydroFLOW-USA in 2015 to support the Maritime and Military facility sectors

Through 20 years of active duty in the USN as a pipefitter/welder then as a repair officer followed by 10 years as a USN civilian port engineer I witnessed many hundreds of thousands of maintenance dollars expended on chemical cleaning of various types of piping systems. I can't count the number of hours I expended trying to clear blockages caused by scale, bio foul, and struvite. The money and manhours spent on correcting these problems kept other maintenance worthy items unrepaired because maintenance money only goes so far. It boggles my mind why we continually throw good money after bad doing the same thing and get the same results.

Albert Einstein has two good quotes that relate to this: "Insanity is doing the same thing over and over and expecting different results." And, "The significant problems we face today cannot be solved at the same level of thinking we were at when we created them."

Jere Widhalm, D&W CEO, RCM SME

POLL #1

Do you have trouble with “hard water” at your facility?

(Multiple choice)

- a) Absolutely Yes
- b) Moderate
- c) No
- d) Don't Know

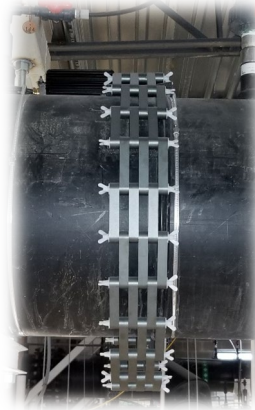


Hydropath Technology Background

The technology was developed in England over 25 years ago for calcium carbonate scale removal and scale prevention in domestic water heating applications. However, many other applications have been discovered in recent years



30" line between chiller and cooling tower, Hollywood Casino, Columbus, OH



Mounted on a 6 1/2" line for a belt filter press for struvite scale reduction, Wastewater Treatment facility Rockland County, NY

How *HydroFLOW* works - Overview

The *HydroFLOW* I Range unit is a small, robust device that is installed around a pipe and induces a unique frequency (the Hydropath signal) into the liquid medium.

The oscillating sine waves of the induced 150 kHz AC signal cause the positively and negatively charged ions to form loose clusters in the solution.

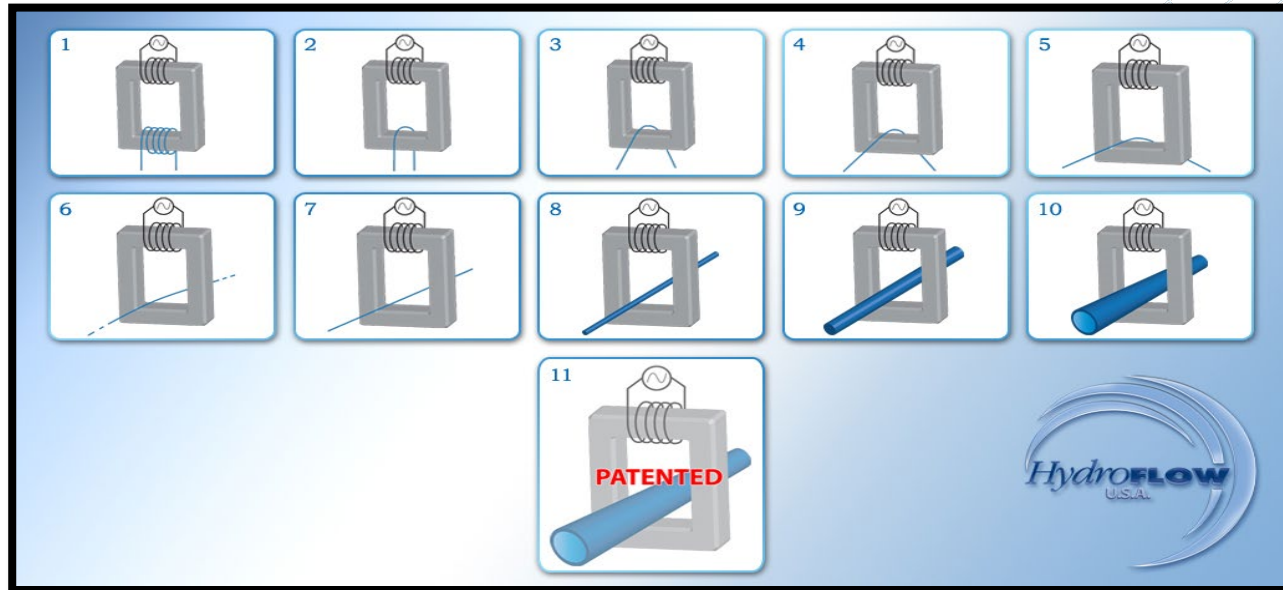
When certain physical conditions are created (i.e. pressure change, temperature change, turbulence, etc.) the clusters precipitate out of solution and form stable crystals (scale) that remain in suspension.

The stable crystals are not able to adhere to surfaces as hard scale and are carried away with the flow, or can be filtered/harvested out of a system.



The Patent Behind Hydropath Technology

How does the Hydropath signal get into the pipe?

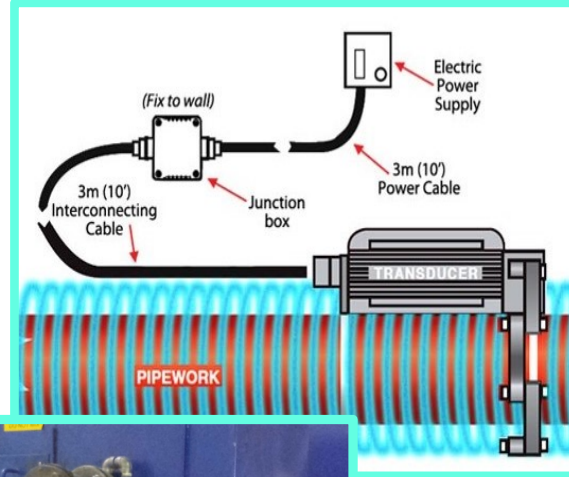


Transformer Theory

- AC current in primary coil.
- Electric field is induced through the ferrite links.
- AC current in secondary coil.
- The pipe and/or the water inside the pipe acts as the secondary coil.

Hassle Free Installation

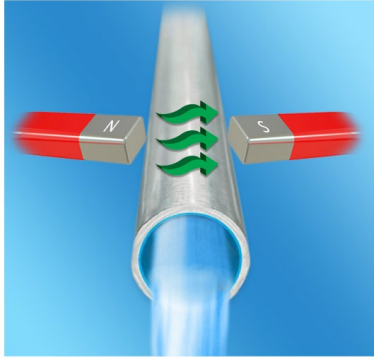
- The unit simply attaches around an existing pipe made of any material
- No plumbing or cutting of the piping is required
- 110V or 220V hard-wired
- On average, consumes about \$50 of electricity per year @ 10¢ /kWhr
- Average 10 year lifecycle



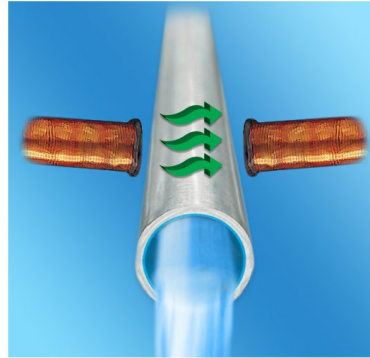
"Coaxial Rings" around the pipe or "Skin Effect", so the signal travels along the piping system, not just in one spot.



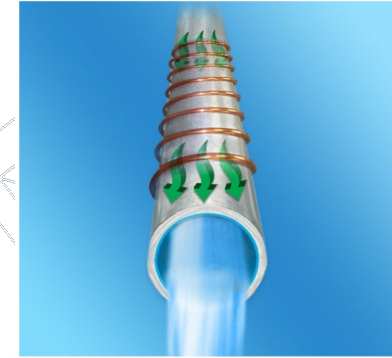
Other Chemical Free Water Conditioning Methods



A



B



C

- (A) A device using permanent magnets
- (B) A device using electromagnets
- (C) A device consisting of a coil wrapped around a pipe, which acts as an electromagnet

** The green lines represent lines of magnetic force*

Water Conditioning Methods

Three Basic Methods for Water Conditioning

1. Don't treat it all
2. Use Chemicals
3. Physical Water Conditioners - *Why we picked HydroFLOW as a partner*
 - Superior signal strength
 - Signal will work even if the water is not moving
 - Signal flows throughout the piping system (within reason), not just “locally”
 - Effect doesn't decay as soon as the water passes the unit
 - Mounts on the pipe with no cutting required
 - 3 Primary Advantages:
 - AC Decaying Sine Wave
 - Transformer Technology
 - Coaxial Rings

POLL #2

Do you know if you have scale or biofoul in your piping?

(Multiple choice)

- a) Yes
- b) No
- c) I don't know
- d) Don't know how to check
- e) None of the above



How Does This Technology Impact Scale?

The cost of scale and biological fouling

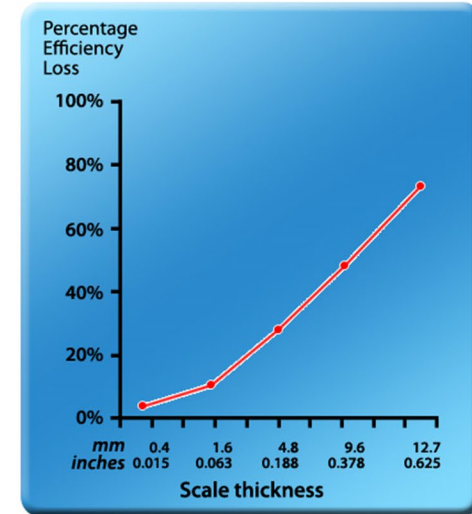
½ an inch of scale can cause heat transfer efficiency loss of 60%~80%

The Costs of Scale in Boiler Systems:

Scale Thickness	mm inches	0.4 0.015	0.8 0.031	1.6 0.063	3.2 0.125	4.8 0.188	6.4 0.252	9.6 0.378	12.7 0.5	15.9 0.625	19.1 0.752
Gallons of oil Wasted per 1000		40	70	110	180	270	380	480	600	740	900
Pounds of coal Wasted per Ton		80	140	220	360	540	760	960	1200	1480	1800
Gas Wasted per 1000 Cubic Feet		40	70	110	180	270	380	480	600	740	900
Average Efficiency Loss		4%	7%	11%	18%	27%	38%	48%	60%	74%	90%

The Costs of Scale in Cooling Systems:

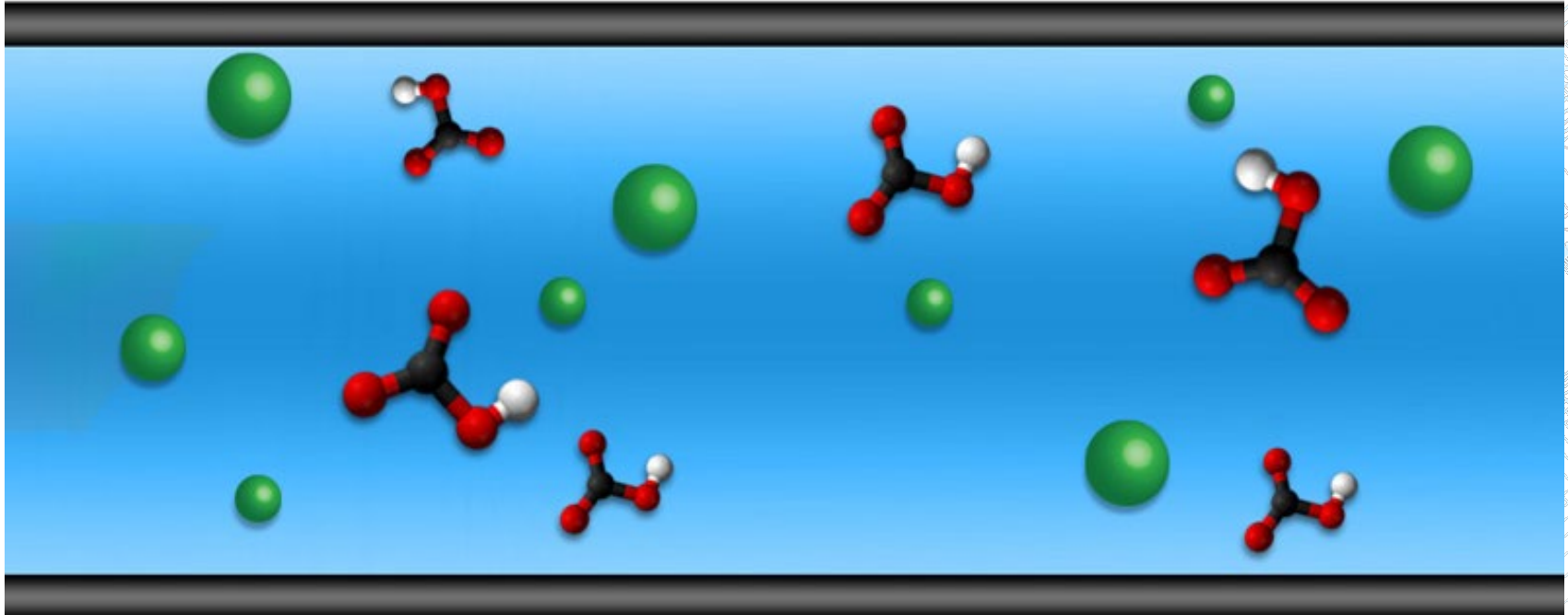
Scale Thickness	mm inches	0.5 0.019	1 0.039	2 0.078	4 0.157	6 0.236	8 0.314	10 0.393	12.7 0.5
Decrease in Condensing Capacity		5%	9%	17%	23%	29%	34%	50%	56%
Increase in Condensing Temp	°C °F	0.4 0.72	0.8 1.44	1.6 2.88	3.2 5.76	4.8 8.64	6.4 11.52	8 14.4	10 18
Increase in Energy Required		5.8%	10.6%	20.2%	29.4%	35.6%	46.8%	66%	76%



Even 1/16" is a significant impact on efficiency

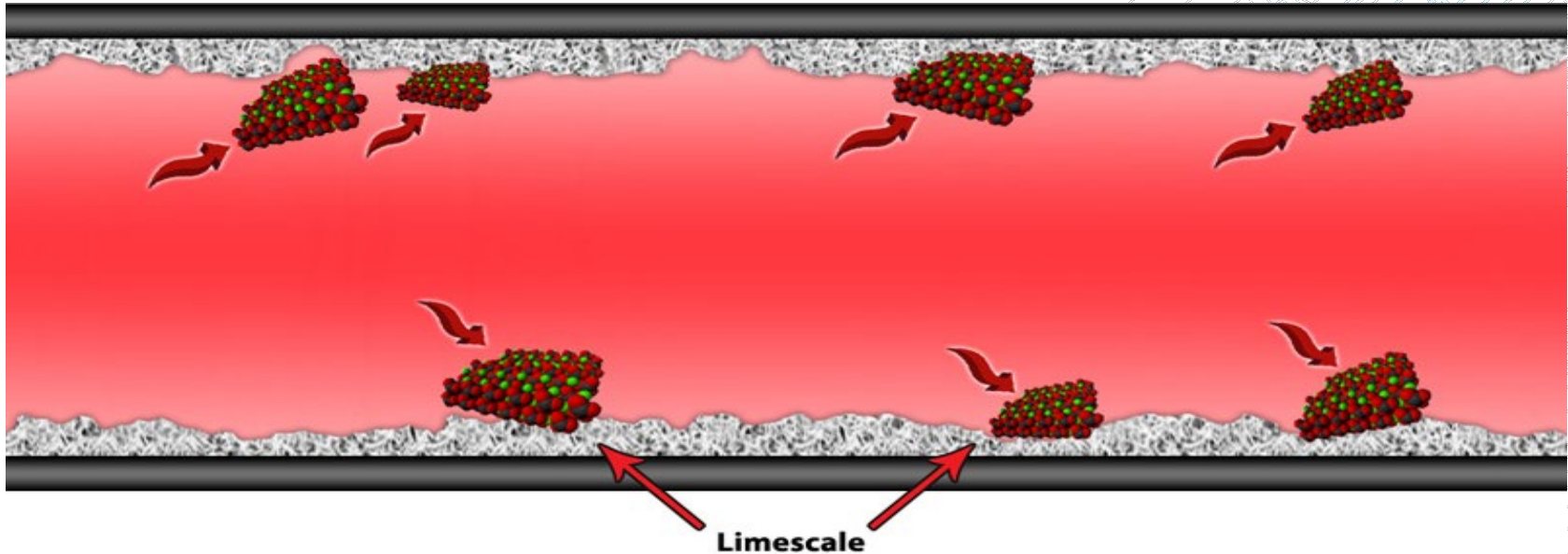
Without HydroFLOW

Minerals are dissolved in solution as Total Dissolved Solids.



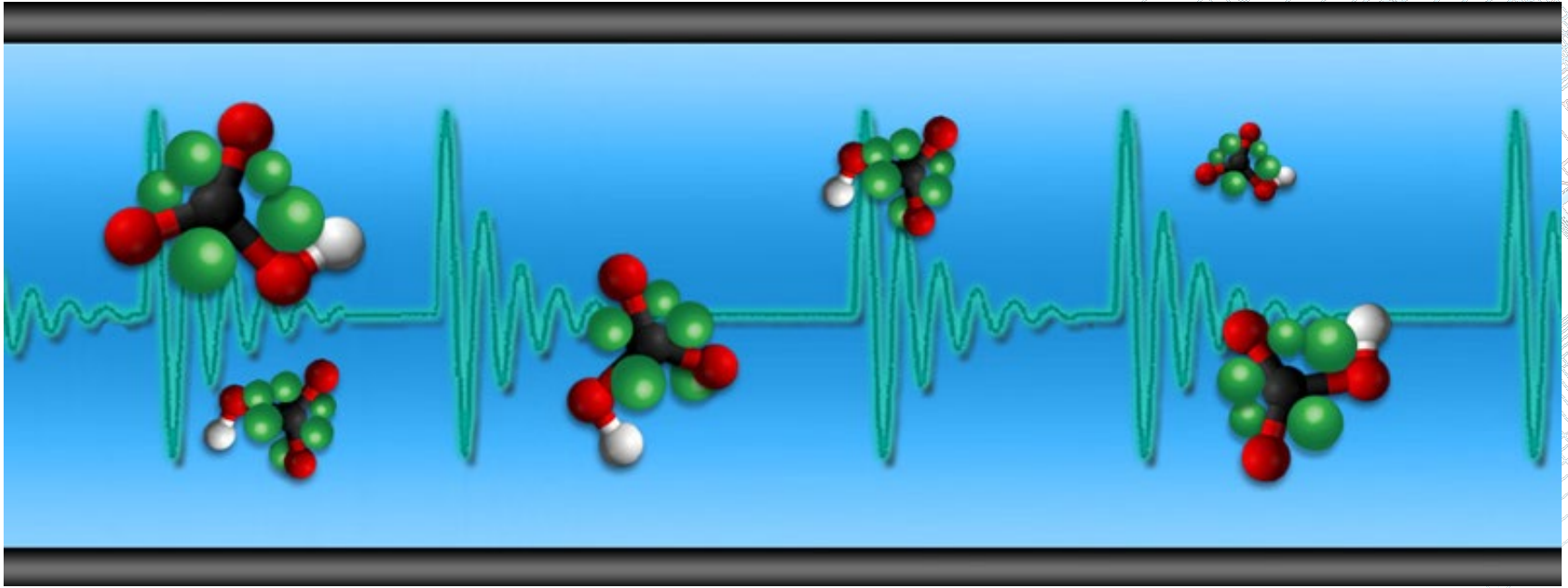
Without HydroFLOW

When temperature or pressure change occurs, minerals precipitate out of solution and accumulate as hard scale.



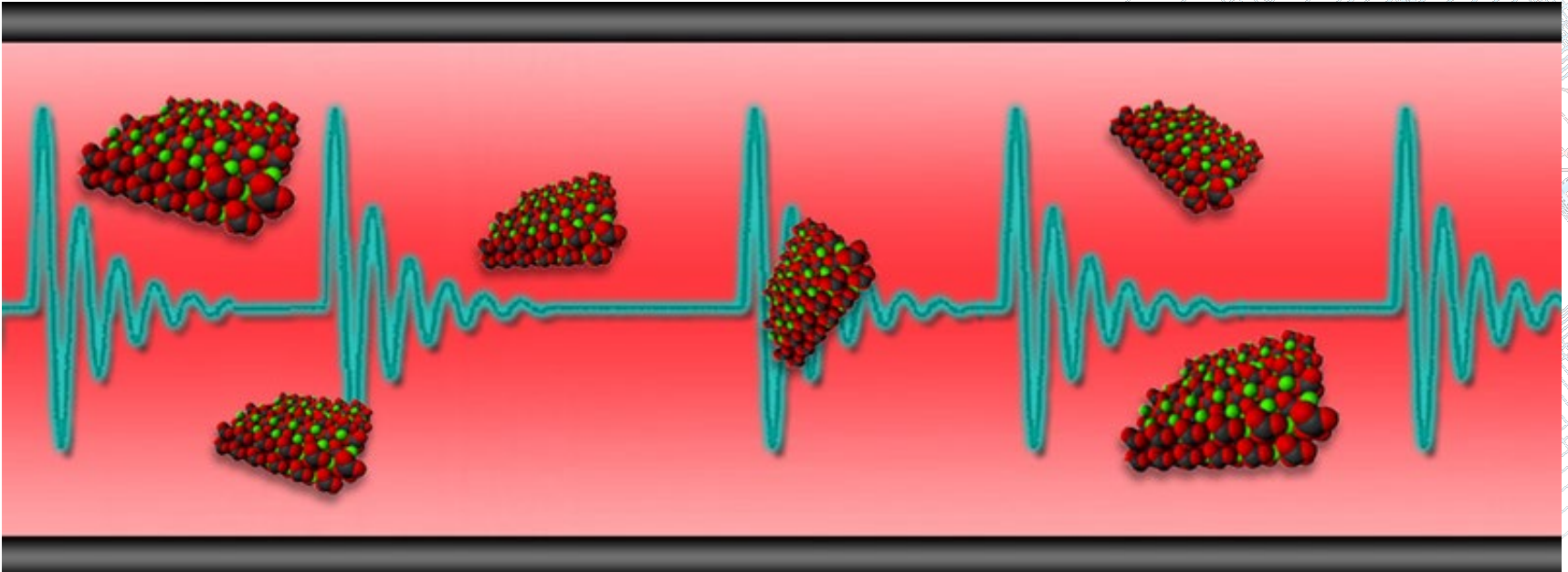
With HydroFLOW

When the Hydropath signal is present, dissolved minerals combine together to form loosely held together clusters.



With HydroFLOW

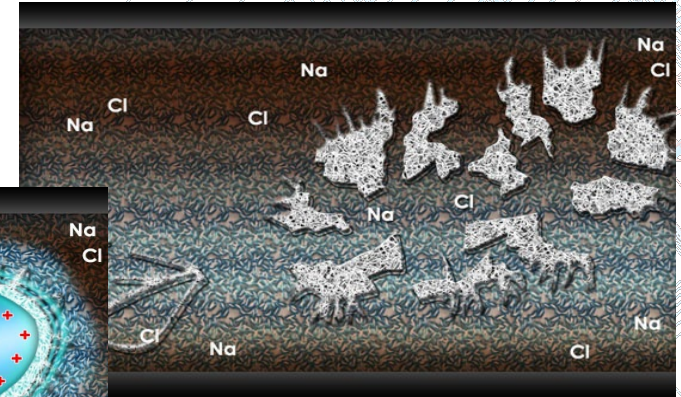
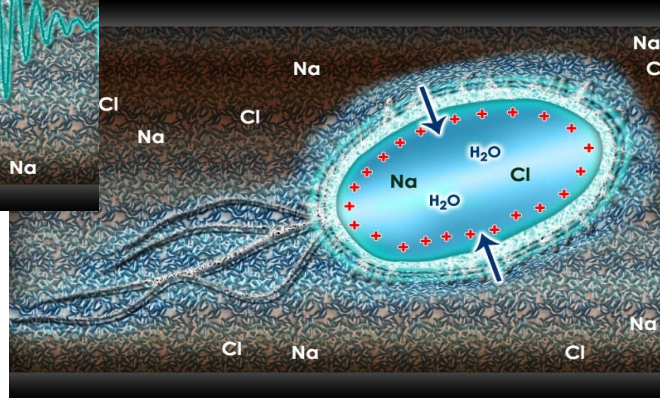
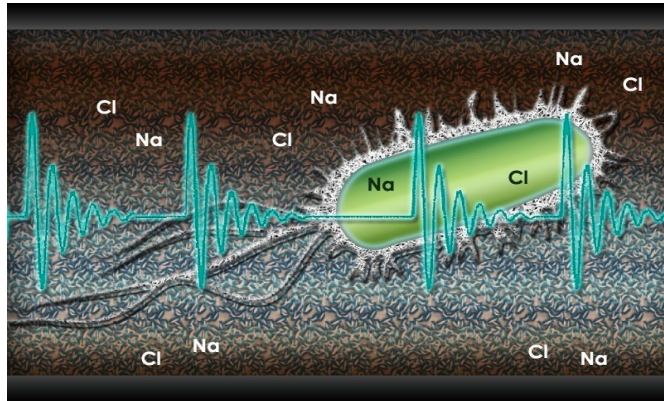
When the clusters precipitate out of solution, they form stable calcite crystals that do not accumulate as hard scale.



How Does This Technology Impact Bacteria & Algae?

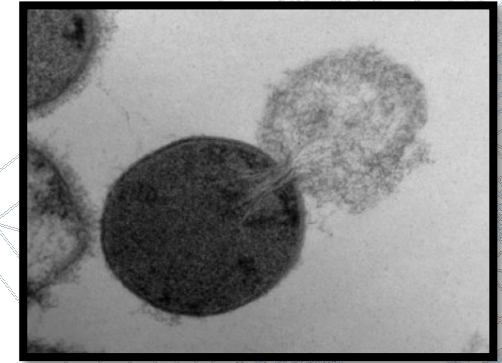
Bacteria and Algae Treatment

Water (H₂O) with “H” being positively charged and “O” being negatively charged. The Hydropath signal charges the bacterium surface either as a positive, or negative which aligns water into pure water wetting layer. Bacterium then pulls pure water into itself, through the semi-permeable membrane via osmosis. This creates osmotic pressure and will cause the bacterium to burst.



Other Bacteria/Algae Deactivation Mechanisms

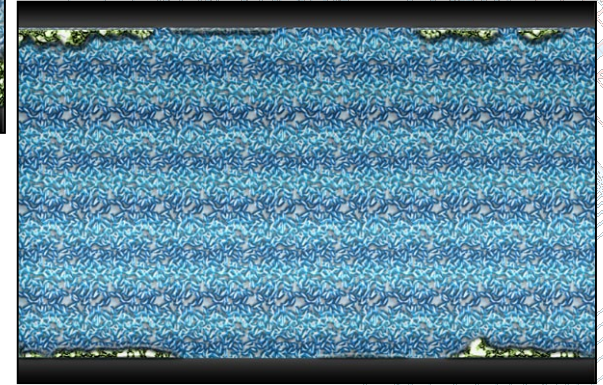
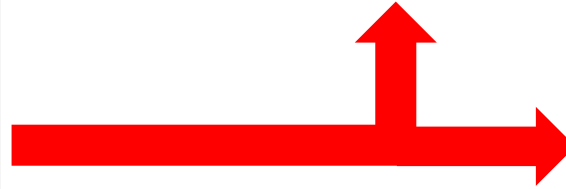
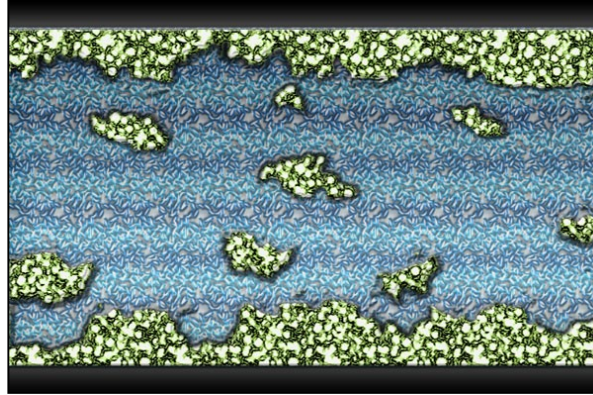
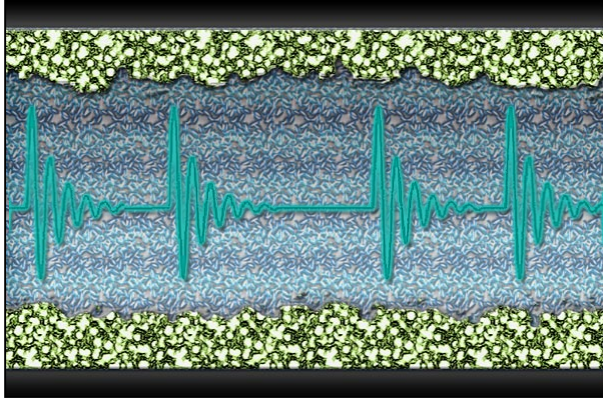
Cell Lysis - A process in which a cell is broken down or destroyed as a result of some external force or condition, such as exposure to the Hydropath signal.



Irreversible Electroporation - A novel procedure that uses discrete probes to deliver high-voltage localized electric current to induce cell death without thermal-induced coagulative necrosis. The Hydropath signal is believed to cause irreversible electroporation to take place in single cell waterborne pathogens.

Biofouling

Bacteria and algae cling to pipe surfaces and form a layer known as biofilm.

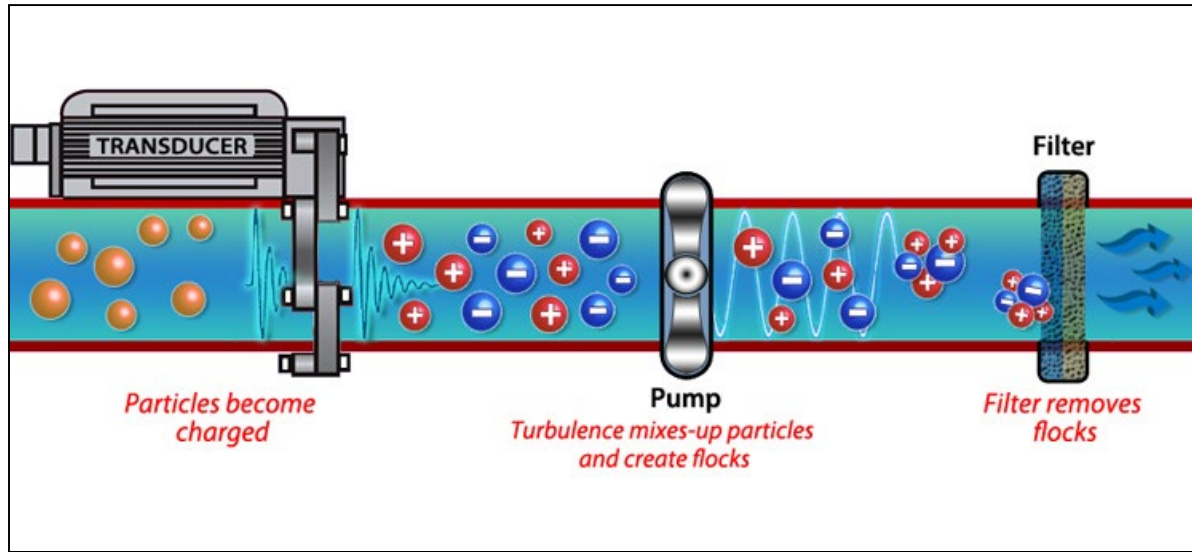


The Hydropath signal causes the release of biofilm.

How Does This Technology Enhance Filtration

Filtration Enhancement

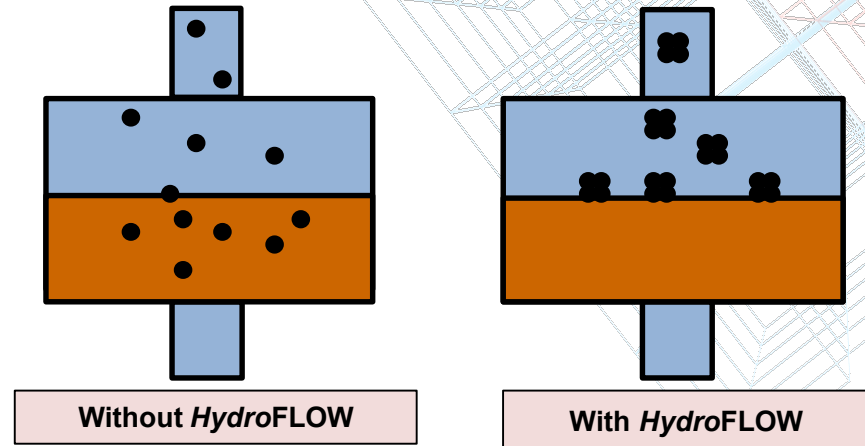
HydroFLOW improves water clarity and reduces backwash by causing suspended particles to clump together into a flock so that they are more easily filtered out of water systems.



Filtration Enhancement

The Hydropath signal causes suspended solids to clump together as larger flocks. These flocks accumulate on the surface of the filter media and are easier to remove via backwash.

HydroFLOW greatly reduces the frequency and duration of filter backwashing which significantly reduces make-up water usage and sewer charges.



Key Applications / Case Studies



Cooling Towers / Boilers / Pools

Kitchen / Galley / Scullery



POLL #3

Which of the below utilities/systems do you have in your facilities?

(Multiple choice)

- a) Boilers, Hot Water Heaters, Steamers
- b) Cooling Towers or Chillers
- c) Swimming Pools
- d) Combination of the 3



Case Studies - Kitchen / Galley / Scullery

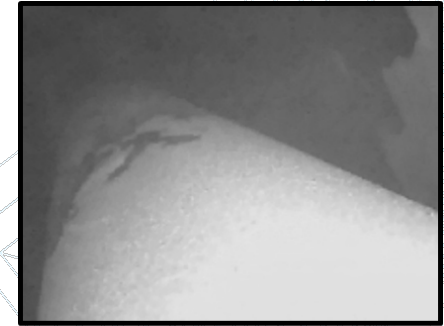
- **Customer:** The Anoka-Hennepin School District is Minnesota's largest, serving approximately 38,000 students
- **Water hardness:** The potable water in the district is considered very hard (roughly 17 GPG or 290 PPM or mg/L)
- **Objective:** Treat feed water to two Cleveland Ultra 10 Double Steamer Ovens, which are prone to build-up of scale, with a *HydroFLOW S38* physical water conditioner
- **Duration:** Three month product evaluation



Case Studies - Kitchen / Galley / Scullery



HydroFLOW S38 installed on cold water supply line feeding the steamer oven



*Without HydroFLOW
Thick layer of hard scale*



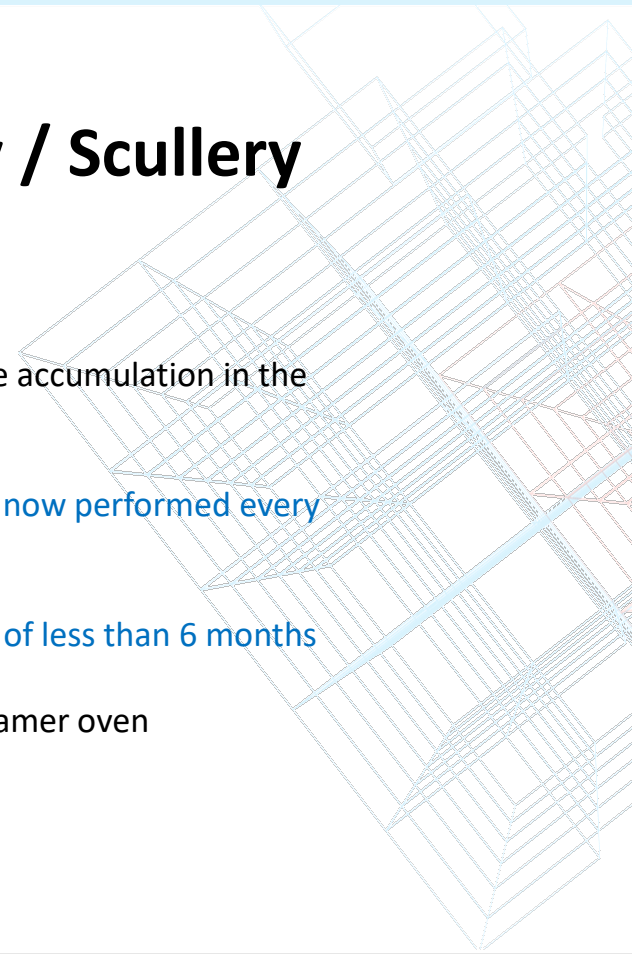
*With HydroFLOW
Thin layer of loose scale*

Note: These pictures were taken with an inspection (borescope) camera entering through a side porthole.

Case Studies - Kitchen / Galley / Scullery

Results

- At each monthly inspection, there was dramatically less scale accumulation in the *HydroFLOW* treated steamer oven
- *HydroFLOW* reduced maintenance costs by 75% - cleaning is now performed every 4 weeks, instead of every week
- Chemical and labor savings provided a return on investment of less than 6 months
- As a result of reduced acid cleaning, the resiliency of the steamer oven strengthened significantly



POLL #4

If you have a pool on your premise, do you have an issue with “chlorine” smell being strong?

(Multiple choice)

- a) Yes
- b) No
- c) It's not so bad....
- d) Not Applicable



Case Studies - Pools

Yakama Nation - Youth Activities City of Yakima, WA



375,000 Gallon Pool



Case Studies - Pools

Results

Chemical	Without HydroFLOW	With HydroFLOW
Dicalite	\$1,560.00	\$520.00
Chlorine	\$26,880.00	\$13,440.00
Shock	\$1,950.00	\$1,300.00
Sunscreen stabalizer	\$3,030.00	\$2,020.00
Muriatic acid	\$1,046.00	\$523.00
	\$34,466.00	\$17,803.00

5 month return on investment (swim season)

Quote from Isha Wyman, Pool Manager: “At the end of May, when the *HydroFLOW* device was turned on, we noticed immediate changes; the monitor kept reading high levels of pH and Chlorine. [We had to keep reducing our chemicals in order to get the pH to stabilize between 7.2 and 8.0 and the Chlorine to stay at 1.0 ppm.](#) Our customers gave us compliments throughout the last 3 months of the bathing season. The state inspector claims our pool is the cleanest in the Yakima Valley!”

Case Studies - Boilers

BBU Bakery in Carlisle, Pennsylvania



Equipment: Two 150 HP steam boilers
HydroFLOW Device: Industrial Range Model
Evaluation period: 6 months

Case Studies - Boilers

Background: Plant with extremely hard water. Steam boilers serviced and alternated every 6 months. Chemicals and softened water assist in reducing the accumulation of scale but the steam boilers still suffer from accumulation of 1/4" which corresponds to 30~40% efficiency loss.



Results: After 6 months, only a thin layer of brittle scale was found. It is estimated that the fuel consumption savings throughout this evaluation period was over \$50K with a return on investment of under 5 months.

Case Studies - Boilers

Currently have trials on several water heaters at Lackland Air Force Base and Fort Sam Houston

Background: The Dorm building's water is heated by 6 hot water heaters, 3 on each side of the building. A *HydroFLOW* i60 was installed on water heater #3, during a heat exchanger replacement, for the purpose of extending its life cycle beyond the typical 4 to 9 month timeframe.



Water enters the water heater's heat exchanger and is heated-up with natural gas. The purpose of the *HydroFLOW* installation was to reduce accumulation of limescale inside the heat exchanger.

First Inspection Findings (5 months after *HydroFLOW* was installed):

- A borescope camera was used to inspect the heat exchanger tubes. No hard limescale accumulation was observed.
- Below is a picture of the upper section of the heat exchanger, with no visible limescale accumulation.

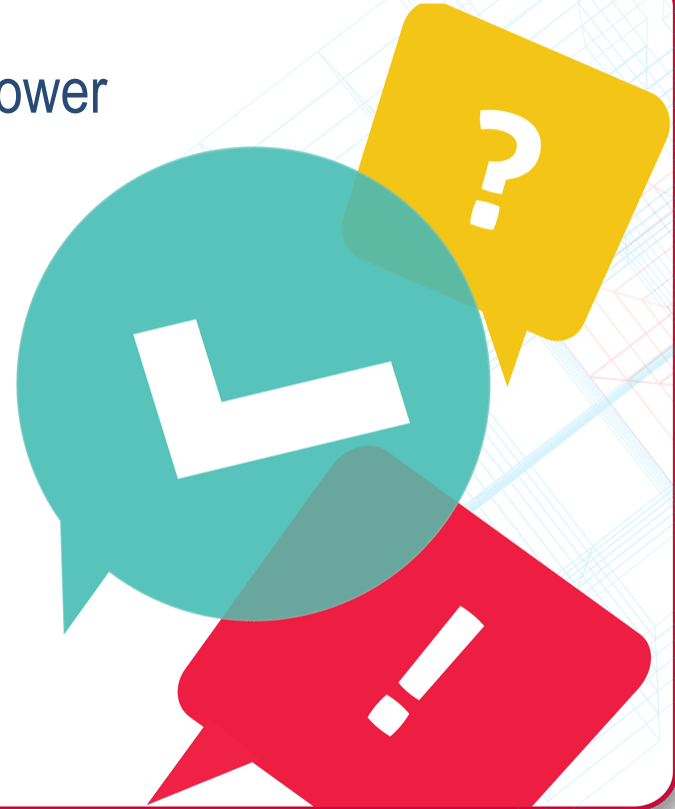


POLL #5

How often do you take a boiler, chiller, cooling tower offline for maintenance?

(Multiple choice)

- a) Annually
- b) Bi-Annually
- c) More than twice a year
- d) I don't know
- e) Never



Case Studies - Cooling Towers

Cooling Towers are great applications for this technology – Biofoul and scale together!

Background: A Fortune 100 company which is headquartered in Houston, Texas, identified the need to improve water conservation, save energy and reduce chemical usage in their two 1,000 ton cooling towers.



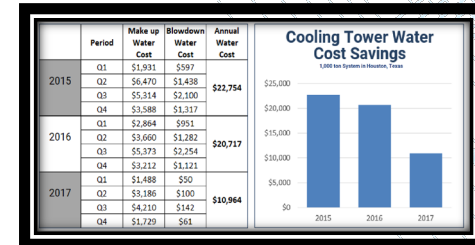
Case Studies - Cooling Towers

Key Success Factors

- Prevent scale and biofouling accumulation in the tower and chillers
- Install make-up and blowdown meters, pH and conductivity sensors for cloud-based data analysis – remote data monitoring
- 50% water reduction with cost savings
- Optimize chemical program effectiveness and change to eco-friendly chemistry
- Extend service life of equipment, fill and piping
- Reduce energy costs and maintenance expenses

Results

- Key success factors were met within a few months
- Existing chiller scale removed during first 6 months
- 2.6 million gallons conserved annually per 1,000 ton cooling tower
- Planned implementation in other facilities throughout the US

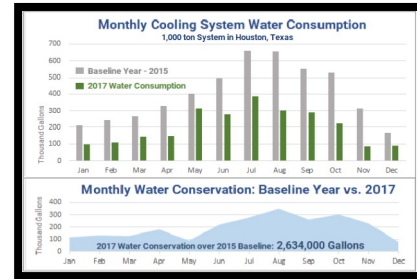
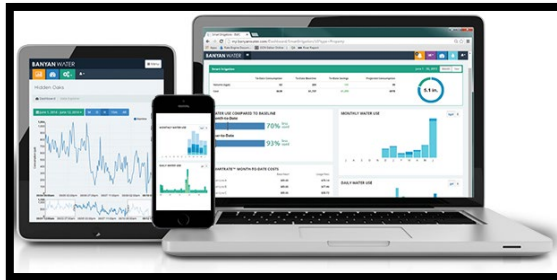


Adding Wireless Remote Monitoring to the Equation

Case Studies - Cooling Towers

Quote from the facilities manager: “HydroFLOW significantly improved the operation of our cooling system, in terms of cost and maintenance. The technology pays for itself with the monthly savings it achieves.”

Cloud-based remote monitoring system (RMS): Per the customer’s requirements, data collection sensors were installed throughout the cooling system. The RMS enables the customer to monitor the system’s performance 24/7 via smartphone, tablet, laptop or desktop.



Case Studies - Cooling Towers

Cooling Towers are great applications for this technology – Biofoul and scale together!

Nellis Air Force Base

May 3, 2016

We installed a Hydro FLOW device on one of our cooling towers about a year ago and have not utilized any industrial water treatment chemicals at all in the last 9-10 months of operation.

All scale was removed by the device, there has been no bio fouling or return of scale matter since the removal of chemicals.

James Romero
99 CES, CEOIH
HVAC/MECHANICAL/CONTROLS SYSTEMS
FOREMAN
Nellis Air Force Base

March 2019 Update: Inspected both the cooling tower and HydroPath unit. Both in good operating condition.

Instead of the hard scale that typically accumulates inside the cooling tower, loose brown mud like material was found. A garden hose was used to easily remove the mud like substance from the fill material and the drift eliminators.





9 September 2011

POWERTECH IPC COMPANY LIMITED
UNIT 6, 12/F., WAH SHING CENTRE,
11 SHING YIP STREET,
KWUN TONG,
KOWLOON, HONG KONG

Dear Norris Leung,

The performance of disinfection rate of *Legionella* in tap water by using AquaKLEAR

Thank you for using our services, I am pleased to summarize the laboratory result for the performance for your reference.

Testing parameters : *Legionella pneumophila* SG1

Methodology Reference for *Legionella* testing : AS/NZS 3896

ALS Method Code : EM016

Testing period : 9 - 16 August 2011

Culture used : *Legionella pneumophila* NCTC 11404

Summary of procedure:

Tap water is used and added with the suspension of legionella culture which is approx. 10^4 - 10^5 cfu/ml. This water sample is then treated by AquaKLEAR (Commercial & Industrial Ranges) for one hour at a flow velocity of 5m/s. Water sample was collected and transferred into sterilize bottles to carry out the legionella testing immediately and also conducted with the control for the comparison.

Testing result: The disinfection rate is 99.7% after the exposure of 1 hour in your system

Should you have any question, please feel free to contact us.

Yours sincerely,

Independent Lab Reports

In Reciprocating Loop Systems

Legionella

e-Coli & Staph Bacteria

PRO-ADVANCE TECHNOLOGY CO., LTD.

9F., No.83, Sec. 3, Dusing Rd., Banciao City, Taipei County 220, Taiwan (R.O.C)

REPORT NO. : RI/2004/60016

PAGE NO. : 1 之 1

DATE : 2004/6/28

THE FOLLOWING MERCHANDISE WAS(WERE) SUBMITTED AND IDENTIFIED BY THE CLIENT AS :

PRODUCT NAME

SAMPLE SUBMITTED

PRODUCT

DESCRIPTION

STYLE/ITEM NO.

MANUFACTURER

COUNTRY OF ORIGIN

SAMPLE RECEIVED

TESTING DATE

PHYSICAL WATER CONDITIONER

PRO-ADVANCE TECHNOLOGY CO., LTD.

1.KILL BACTERIUM 2. PREVENT SCALE

HYDROFLOW, AQUAKLEAR, SPAKLEAR, STEAMKLEAR

HYDROPATH (UK)LTD

UK

2004/6/11

2004/6/11

TEST ITEM /METHOD

Reference To AATCC 100 : 1. *Staphylococcus aureus* AACC 6538
2. *Escherichia coli* AACC 8739

TEST RESULT:

TREATMEANT (REACTION TIME : 1 HR)

<u>TEST BACTERIA</u>	<u>Counts (Before Circulation) (CFU/ml)</u>	<u>Counts (After Circulation for 1 hour) (CFU/ml)</u>	<u>Reduction(%)</u>
<i>Staphylococcus aureus</i>	1.2×10^5	<1	99.99
<i>Escherichia coli</i>	1.3×10^5	<1	99.99

Summary Comments:

Main Benefits of Hydropath Technology

- Dissolves and removes existing scale
- Prevents new scale accumulation
- Treats bacteria and algae
- Enhances filtration efficiency
- Reduces operational expenses
- **Bottom Line: Makes a facilities manager's life easier!**



Additional Research Available to you!

- D&W Marine Systems Management Website: www.dwmsm.com
- HydroFLOW-USA Website: www.hydroflow-usa.com
 - Industrial Case Studies Archive: https://www.hydroflow-usa.com/Case_studies/Industrial
 - Commercial Case Studies Archive: https://www.hydroflow-usa.com/Case_studies/Commercial
- Interactive US Water Hardness Map: www.hydroflow-usa.com/water-hardness-map
- HydroFLOW Overview: <https://vimeo.com/110159146>
- Transformer Theory: <https://vimeo.com/239483917>
- Foodservice Video: <https://vimeo.com/125498366>
- Non-Chemical Flocculation: <https://vimeo.com/297755376>
- Swimming Pools: <https://vimeo.com/334474583>
- Wapato Pool Interview: <https://vimeo.com/107645625>
- University of Vermont Struvite Study: <https://www.hydroflow-usa.com/assets/files/12441574724505.pdf>



Q&A AND FEEDBACK

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chuck.widhalm@dwmsm.com
972-345-5525

**D&W Marine Systems Management
Service Disabled Veteran Owned Small
Business**
www.dwmsm.com

Various Terminologies

- **Supersaturation** is a solution that contains more of the dissolved material than could be dissolved by the solvent under normal circumstances. Total Dissolved Solids
- **Total Dissolved Solids (TDS)** is a measure of the combined **total** of organic and inorganic substances contained in a liquid. This includes anything present in water other than the pure H₂O molecules. These solids are primarily minerals, salts and organic matter that can be a general indicator of water quality.
- **Total Suspended Solids (TSS)** are **solids** in water that can be trapped by a filter. TSS can include a wide variety of material, such as silt, decaying plant and animal matter, industrial wastes, and sewage.
- **Limescale** is a hard chalky deposit, consisting mainly of calcium carbonate (CaCO₃), that often builds up inside kettles, hot water boilers, and pipework, especially that for hot water. It is also often found as a similar deposit on the inner surfaces of old pipes and other surfaces where "hard water" has evaporated
- **Biofouling** or biological fouling is the accumulation of microorganisms, plants, algae, or small animals on wetted surfaces that have a mechanical function, causing structural or other functional deficiencies.
- **Osmotic Pressure** is the minimum pressure which needs to be applied to a solution to prevent the inward flow of its pure solvent across a semipermeable membrane. It is also defined as the measure of the tendency of a solution to take in pure solvent by osmosis.
- **Osmosis** is a process by which molecules of a solvent tend to pass through a semipermeable membrane from a less concentrated solution into a more concentrated one, thus equalizing the concentrations on each side of the membrane.
- In colloid chemistry, **Flocculation** refers to the process by which fine particulates are caused to clump together into a floc. The floc may then float to the top of the liquid (creaming), settle to the bottom of the liquid (sedimentation), or be readily filtered from the liquid.