

WRAP™ Physical Water Treatment

The Science Whitepaper



Physics vs. Chemistry

Scaling and corrosion of cooling towers and boilers are expensive, serious problems that have traditionally been treated with chemicals. However, in reality, corrosion and scale are the result of a physical process. Flowing water has a positive charge, which it transfers to feedwater pipes. The positively charged pipes then attract both oxygen atoms and calcium carbonates. The oxygen molecules cause oxidation and corrosion. The carbonates form scale.

So, if the problem is physical, why do people treat it chemically? Particularly when the effectiveness of chemical treatment is questionable, due to ongoing problems such as:

- * Continued scale buildup, with subsequent loss of pressure and increased power consumption
- * Periodic shut downs for acid bath descaling, resulting in lost productivity and profits
- * The need to replace components due to corrosion and re-tube heat exchangers
- * The time required to constantly mix and test chemicals, yet end up with inconsistent water chemistry from day-to-day; even hour-to-hour?

Today, there is an alternative. Magnetic water treatment (MWT) relies on the laws of physics instead of the guess-work of chemistry. There is no longer any need to juggle toxic and hazardous chemical cocktails. MWT provides continuous and consistent feedwater protection, hour after hour, week after week – forever.

The Science

The issue with feedwater systems is that scale has a much lower heat transfer capability, calling on more fuel consumption to transfer the same amount of energy. Even a thin film can increase energy consumption by nearly 10%. Applying a magnetic field alters the reaction between scale-forming ions in hard water.

Using externally mounted magnets, Second Earth's WRAP system cathodically protects pipes by creating a "Faraday Generator" through the interaction of the magnetic field and the flowing water. Michael Faraday recognized that a conducting fluid moving through magnetic lines of force would generate a perpendicular electric current. With WRAP, the magnetic field is the "stator" and moving water the "armature". While this only creates millivolts of power, it's sufficient to give the piping a negative charge with respect to the water stream as long as it flows.

In an article in the *Coast Guard Engineer's Digest*, researchers state "The manner in which suspended carbonates and water molecules interact with each other and the pipe/tube walls is altered by changing the relative charge of the wall with respect to the water stream. The dipolar water molecules' negatively charged oxygen end is repelled by the negatively charged pipe walls, thus reducing its corrosive effect. Scale forming carbonates, also negative, are repelled and remain in suspension until the feedwater becomes supersaturated. At this point, they precipitate and form a soft sludge...which is removed via blow-down."

Research by the American Society of Corrosion Engineers (ASCE) found that untreated water precipitated a ratio of calcite (hard scale) to aragonite (soft scale) of approximately 80% to 20% while the ratio measured in magnetically treated water was almost the opposite - 30% to 70%. The higher percentage of aragonite causes the formation of a sludge, which can be easily removed via a blow-down. This clearly demonstrates that using MWT, altering these particles' crystalline structure can cause their chemical behavior to change.

But MWT does more than just keep scale and corrosion away from pipes. It actually removes any scale that was present inside the pipes when the magnets were applied. It does this by ionizing the water, breaking away one of the positively charged hydrogen atoms. This extra H+ molecule, now a hydroxal ion, is attracted to the negatively charged pipe, where it interacts with the existing calcite scale. The hydrogen ion dissolves the hard scale back into the water as "soft" aragonite.

The negatively charged pipe, through the law of "like charges repel", holds the corrosive causing oxygen molecules and scale causing aragonite in suspension. This keeps the pipes free from scale and protects equipment from corrosion. A study by NASA compared scale formation using chemicals vs. MWT. They found that scale build up using chemicals could range from 1 to 50 mils per year, with 4 mils per year being considered acceptable. However, using MWT, they found 0.0 mils of scale – absolutely no buildup over time.

The Research

Magnetic technology has been cited in the literature and investigated since the turn of the 19th Century. Initial studies looked at lodestones or naturally occurring magnetic minerals to decrease the formation of scale in cooking and laundry applications.

Today, support for the effectiveness of green, sustainable MWT over toxic chemicals in industrial feedwater comes from numerous studies and reports. These include The Department of Energy (DOE), the US Coast Guard, NASA, the American Society of Corrosion Engineers (ASCE) and more. Supporting the research is the success of actual installations applying MWT. According to the DOE, there are hundreds of thousands of successful installations that show MWT is capable of controlling scale for months or years, while eliminating the periodic cleaning or descaling of process equipment.

Coast Guard engineers found that "the primary advantage of MWT is its continuous treatment of the water stream, resulting in water chemistry that is virtually consistent over time...MWT achieve (a) consistently high level of water quality, while significantly reducing boiler PMS requirements."

The DOE sees the technology saving money in four critical areas: energy costs, water consumption and discharge costs, maintenance costs, and water-softening system operating costs. Since permanent magnets use no electricity, both the on-site electricity used for chemical treatment as well as the off-site energy required to produce and transport the chemicals will be eliminated. Energy consumption reductions lead to reductions in air combustion emissions: CO₂, NO_x, SO_x.

In addition, the handling and storage requirements for the chemicals—lime, soda ash, salt and acid—have been eliminated, as has training for their use, storage and handling. Periodic maintenance of the water-softening equipment and chemicals is eliminated, while heat exchanger inspection and cleaning cycle is reduced to an inspection cycle.

The WRAP™ Solution

WRAP combines this 200-year-old science with new technology – rare earth magnets. As the Coast Guard Engineering Digest noted, "Until recently, externally mounted permanent magnetic systems did not have the ability to project a magnetic field into the water stream of sufficient strength to product consistent results." WRAP magnets provide twice the gauss flux density (GFD) required to create a sufficiently powerful field. (Technically, it's 22,500 GFD vs. the 10,000 GFD necessary.)

The Coast Guard engineers also found that “Once installed, the devices are virtually maintenance free and retain their strength indefinitely.” This is due to the fact that rare-earth magnets only lose 0.1% of their field strength every 10 years. Since WRAP™ magnets provide more than twice the field strength required, this means that they will last for *five thousand years!*

No-Risk Savings Guarantee

In the end, however, the scientific research is not important. What matters are results. You want to know if MWT will work in your facility, on your applications. That’s why Second Earth has put together a no-risk test and installation agreement, to let you prove it for yourself.

We’re so confident that we can save you up to 50% of your monthly costs for chemical feedwater treatment that we’re offering a service contract that includes both the technology and support for *half of what you’re paying today*. Let us install WRAP™ on one of your cooling towers or boilers for just 30 days and we know you will be convinced.

For more details on our No-Risk Savings Guarantee, go to: www.secondearthinc.com/agreement.html. Or call us at 336-912-0957.

References

The Coast Guard Engineer’s Digest. “Naval Engineers Evaluate Magnetic Boiler Feedwater Treatment as an Alternative to Chemicals.” Volume 31. Number 253.

Federal Technology Alert. “Non-Chemical Technologies for Scale and Hardness Control.” The US Department of Energy.