

# Eliminating Scale Build-up with 21<sup>st</sup> Century Technology

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## Introduction

Scale build-up is the formation of naturally occurring chemical compounds on solid surfaces, like pipes, fixtures, and appliances. These compounds are found in most water supplies and, in moderate amounts, are considered healthy<sup>1</sup> for human and animal consumption. Scale most often appears in hard water environments, but can also occur in soft water environments. If left untreated the effects of scale build-up can be devastating to a home or small business as the build-up can prematurely damage water heaters, major appliances, fixtures, and can even constrict water flow in pipes. Scale also decreases appliance efficiency and increases the cost of owning a home or operating a business.

This paper will explain how scale build-up materializes and your options for treatment.

## What is scale?

Scale is the accumulation of layers of compounds, typically carbonates of calcium and magnesium that adhere to solid surfaces such as faucets, shower heads, the inside of dishwashers, water heaters and coffee makers.

## What causes scale build-up?

When water becomes supersaturated with minerals like calcium and magnesium, the water cannot dissolve additional amounts of those elements. As a result, the excess amounts are precipitated out of the water as positively charged particles that bind with oppositely charged particles, the carbonates that are also naturally present in water, bonding together typically as calcium-carbonate and magnesium-carbonate. These carbonates tend to stick to each other and to solid surfaces forming scale.

## Where do the minerals that create scale come from?

Hard water refers to water with more minerals present than in soft water. Hard water typically originates in wells, aquifers, rivers and lakes. Most drinking water comes from hard water sources. The minerals come from rock and sediment in the ground at the source of the water. Water supply services, municipalities and other government agencies do not completely filter the minerals out of the water supply because of the cost associated with the process and the health benefits associated with consuming small amounts of minerals; some of these compounds are contained in your daily multi-vitamin.

Soft water, though defined as containing fewer minerals than hard water, can produce scale build-up when higher PH levels are present. The higher PH levels prohibit the water from

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<sup>1</sup> <http://ods.od.nih.gov/factsheets/Calcium-Consumer/> and <http://ods.od.nih.gov/factsheets/Magnesium/>

dissolving the calcium, which precipitates and bonds with negatively charged ions to form calcium-carbonate, or scale.

### **What are the consequences of scale build-up?**

Scale build-up can effectively reduce the inside diameter of, or even block, water pipes resulting in decreased water pressure and flow. In some cases scale build-up can require pipes to be replaced.

Scale build-up acts like an insulating layer on heating elements and causes appliances like hot water heaters, boilers, dishwashers, and coffee and espresso makers to work harder to do the same job, therefore driving up energy costs and shortening the life span of these products.

To battle scale build-up chemical cleansers are employed to remove the scale, sometimes shortening the lifespan of faucets and shower heads. Moreover additional time is spent battling the unsightly, and efficiency robbing, build-up of scale.

### **How can I reduce or eliminate scale build-up?**

The following are popular approaches for reducing or removing scale build-up:

- In industrial applications, such as closed-loop cooling systems, chemicals are used to treat water.
- Salt or potassium water treatment systems, often referred to as water softeners.
- Complete filtration.
- Reverse osmosis.
- Permanent magnets.
- Electro-magnetic water treatment.

### **What is the right way for me to reduce or eliminate scale build-up in my home or small business?**

Chemical processing is not a viable solution for the small business or home where the water is used for human consumption or will come in contact with humans or animals. Additionally this is not an environmentally friendly practice as the chemicals are diluted into the water and the entire solution must be properly disposed after treatment.

Water softeners replace the calcium and magnesium, healthy minerals, in water with sodium, a mineral that the FDA warns should be regulated; according to the 2005 Dietary Guidelines for Americans published by the U.S. Department of Health and Human Services and the U.S. Department of Agriculture, nearly all Americans consume more salt (sodium) than they need<sup>2</sup>. Additionally water softeners dump their brine solution into the environment when they regenerate, which can happen frequently. Finally water softeners are relatively expensive to operate because of the continued use of the consumable salt (sodium chloride) or potassium chloride pellets.

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<sup>2</sup> <http://www.fda.gov/ForConsumers/ConsumerUpdates/ucm181577.htm>

Complete filtration and reverse osmosis systems remove the healthy minerals, like calcium and magnesium, that can form scale, but at considerable ongoing expense and robbing those consuming the water of the healthy benefits the naturally occurring minerals provide.

Permanent magnets can perform minimally effective descaling, but will only work on water with a fixed flow. Over time permanent magnets lose their strength for a host of reasons from electrical currents present in the home to exposure to heat, like a hot water pipe. This eventual slow dissipation of strength ultimately renders them ineffective, even for the specific flow rate for which they were intended. Finally permanent magnets are not a good choice for preventing scale build-up because they are not cost efficient, or powerful enough to treat an entire home or small business from a single point of installation.

Electromagnetic water treatment based on the Lorentz Force effect on charged particles suspended in water is a very efficient method of eliminating scale build-up.

### **What is the Lorentz Force and how does it work?**

Hendrik Lorentz, a Dutch physicist who won the 1902 Nobel Prize for Physics, defined the relationship between a charged particle and an electromagnetic field by the equation as detailed below:

$$\mathbf{F} = q[\mathbf{E} + (\mathbf{v} \times \mathbf{B})]$$

**F** is the force in newtons

**E** is the electric field in volts per meter

**B** is the Magnetic field in teslas

*q* is the electric charge of the particle in coulombs

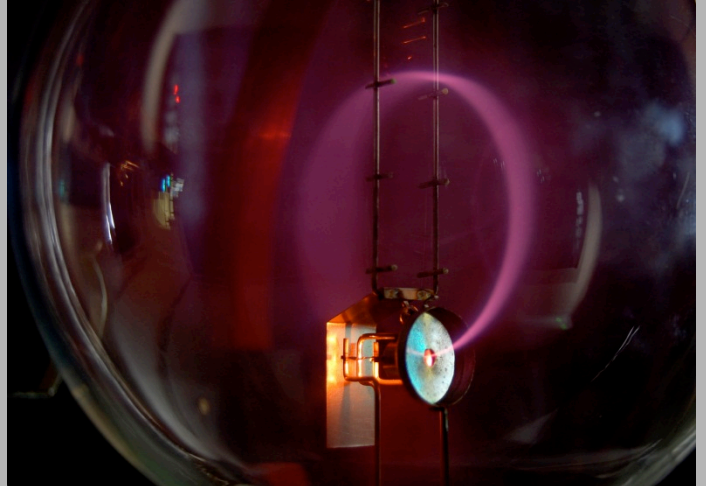
**v** is the instantaneous velocity of the particle in meter per second

**x** is the vector cross product

The Lorentz Force is the principle that electromagnetic water treatment is founded on. By applying an electromagnetic field to water a force can be applied to alter the particles in the stream of water, encouraging them to remain solvent (diluted) in the water, rather than bonding with the carbonates present in water, which produces scale.

*Image: The Lorentz Force at Work*

A beam of electrons moving in a circle due to the presence of a magnetic field. The purple light is emitted along the electron path due to the electrons colliding with gas molecules in the bulb.

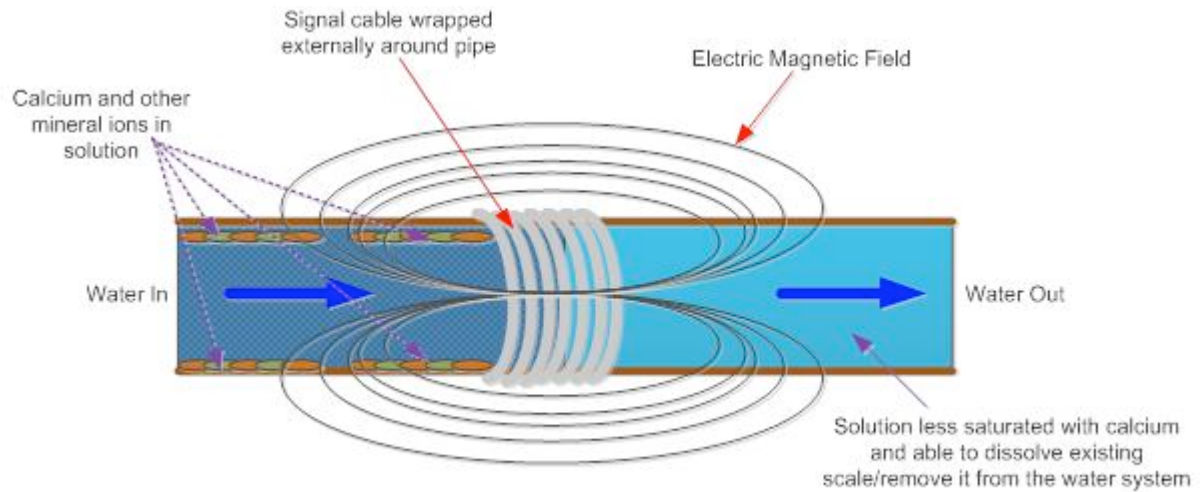


The Lorentz Force equation allows for variations in the instantaneous velocity of a charged particle (the rate of water flow). By varying the frequency of the electromagnetic field a force can be imparted to the charged particles within the magnetic field; it is the variable  $v$ , the instantaneous velocity, in the Lorentz Force equation that dictates the electromagnetic field must also vary to accommodate different velocities in water flow. The ability to quickly alter the frequency of the electromagnetic field is critical to effectively apply a force to the particles suspended in all the potential rates of the water flow possible in a given water pipe.

### **How does a ScaleRID system work and what makes it different than other systems?**

ScaleRID descaling water treatment systems utilize double wound coils to induce a continuously variable-frequency electromagnetic field which exerts a force on a charged particle, namely the ions of calcium and magnesium. The ScaleRID systems employ modern micro-processors for built-in intelligence in the descaling process. The micro-processor controlled electromagnetic field is able to greatly affect scale producing compounds during the nucleation process, which allows these ions to precipitate out of the water in a crystalline form that is not likely to adhere to solid surfaces; instead the compounds pass through the pipes and down the drain. This modern micro-processor design enables the frequency to quickly and consistently vary more efficiently, which is critical to effectively treating water on a wide spectrum of flow rates as that water passes through the influence of this magnetic field. By rapidly varying the frequency of the induced electromagnetic field and using patent pending technology to more efficiently deliver, saturate, regulate and shift the frequency of electromagnetic field, the ScaleRID water treatment devices provide the most complete implementation of electric water descaling treatment available to date. Additionally the ScaleRID systems utilize a MOSFET technology which moves beyond old-school designs that depend on dated transistors to amplify the frequency of the electromagnetic field. MOSFET technology is commonly employed in high-end audio equipment where the ability to quickly and accurately amplify and modulate frequencies is critical to the quality and accuracy of the sound reproduced. Modern MOSFET technology allows the ScaleRID product to reach higher and lower

frequencies than other electromagnetic water treatment technologies. Furthermore MOSFET technology can produce these frequency peaks and valleys with much greater efficiency; with lower power consumption. With the ScaleRID MOSFET technology less energy is turned to heat, which ultimately degrades transistor performance that can degrade the performance of transistor based electromagnetic water treatment systems over a period of time.



## Conclusion

These unique documented features make the ScaleRID Water Treatment Systems the most effective environmentally friendly electronic water treatment system that treats water by increasing the nominal precipitation rate of certain minerals in the water and as a result alters the materialization of mineral build up, decreasing the formation of scale on the surfaces of pipes, fixtures and appliances connected to your home's water system.