Sialex™ at work (Scale and corrosion control):

Employed to initially break up and remove existing scale and corrosion as well as decreasing the tendency for scale and or corrosion to form.

Water may contain varying amounts of “Scale” creating materials. Calcium is one of the most commonly found “Scale” creating materials.

Water as we know it and make use of is not limited to Hydrogen (H) and Oxygen (O_2). Water used for the home and industry is typically a result of evaporation of seawater and lake water. The sun heats the surface water causing evaporation. Water vapour, as a result of this process, creates clouds, cools and returns to earth in the form of rain. During this evaporation process salts and minerals present before evaporation are left behind.

At the same time carbon dioxide (a by-product of industrial activity and plant photosynthesis) is also released into the atmosphere. As rain falls to earth carbon dioxide is absorbed, in varying degrees, where it combines with the hydrogen and oxygen, to form varying amounts of carbonic acid.

Having fallen to the earth as rainfall, rainwater flows across rocks and stones as it flows into rivers and lakes. These rivers and lakes are the source of water for use by municipalities. In some cases rainwater penetrates through soil and rock and gathers underground in pools which in turn provide well water. During this phase rainwater, when coming into contact with calcium, a common material found rocks, dissolves this calcium (due to the carbonic acid present in the rainwater), and retains this calcium in suspension.

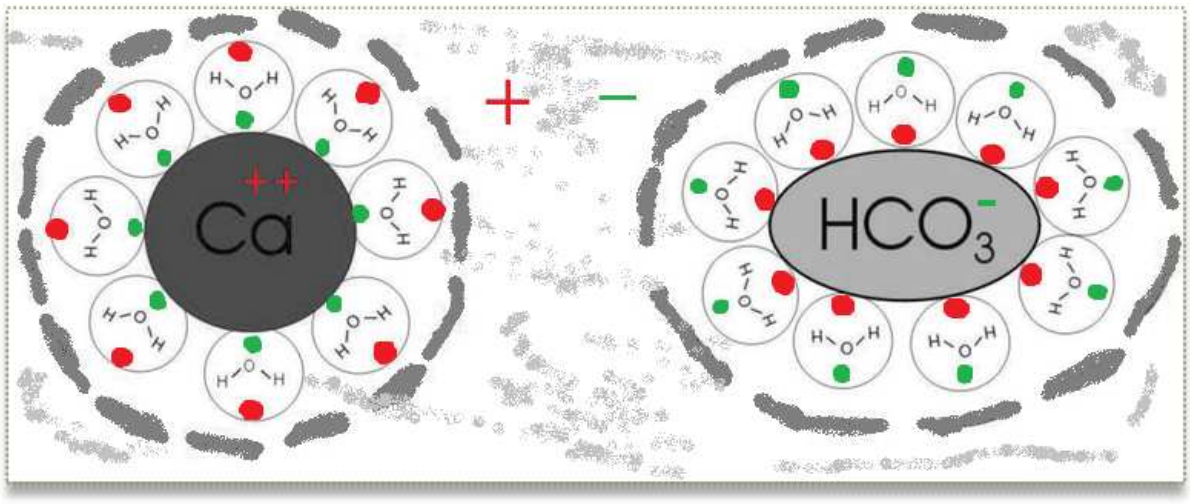
Water processing plants do not remove calcium and other suspended solids during the water treatment stage. In fact calcium is viewed as a “Healthy” material to be found in water.

In chemical terms the above can be summarised:

(Water) **H_2O** + (Carbon dioxide) **CO_2** = Carbonic acid **(H_2CO_3)**
(Present in rainwater)

(H_2CO_3) + Calcium carbonate **$CaCO_3$** = **Ca (HCO_3)$_2$**
(Present in rocks) *(Calcium hydrogen carbonate)*

Ca (HCO_3)$_2$ (Calcium hydrogen carbonate), also known as calcium bi-carbonate, is suspended in water as two separate components surrounded by an “Envelope” of water molecules.



Electrical attraction holds calcium ions in balance

(DRAWING #1)

This is a weak bonding which can be easily disrupted. The energy necessary to affect this can be generated by temperature, turbulence, changes in pressure, all can lead to a breaking of this relationship which in turn results in “Crystallization”.

Crystallization can be described chemically:

$$Ca(HCO_3)_2 = CaCO_3 + H_2O + CO_2$$

It is important to know that this reaction can also be reversed.

$$CaCO_3 + H_2O + CO_2 = Ca(HCO_3)_2$$

The direction of the reaction is dependent upon the “Carbonic Acid” $Ca(HCO_3)_2$ balance.

Excess CO_2 leads to $CaCO_3$ dissolving. A decrease in localized CO_2 content leads to $CaCO_3$ becoming solid.

For scale to occur the H_2O “envelope” is opened and at the same time the Carbonic acid balance changes in favor of less CO_2. This prompts a “Crystallization / Nuclei” formation to occur in the water. These nuclei are electrically attracted to inner surfaces wetted by water. Further crystals attach and trap other material to form what we call “Scale”.

Sialex™devices creates an environment which allows Ca $(HCO_3)_2$ to be "washed" through the water circuit (pipes etc) as a crystal. The "Crystallizing" occurs in the water before the Ca $(HCO_3)_2$ have an opportunity to "crystallize" on the surfaces of the water circuit.

It does this by:

- Creating Crystallization nuclei in the water
- Adjusting the carbonic acid balance

Using electrical principles based around frequency modulation, SialexRings introduces "pulses" sometimes described as "Oscillations" into water exposed to the device. This occurs at the point the Ring is located on to the water pipe.

The "pulses" or "Oscillations" impact upon the water molecules (envelope) surrounding calcium and hydrogen carbonate ions creating rapid pressure changes which result in rupturing this "envelope" and a localised "out-gassing"/ decrease in the CO_2 occurs. The "released" Calcium ions react with each other. These molecules form "seed" nuclei leading to crystal formation in the water.

These crystals are electrically neutral and are not attracted to surfaces (where they would normally create "Scale", but instead move through the water system without sticking to pipe walls.

Removal of existing "Scale" already present on inner pipe surfaces:

As "suspended calcium" can be returned to a solid state so too can solid calcium be returned to a "suspended state".

$$CaCO_3 + H_2O + CO_2 = Ca(HCO_3)_2$$

As a result of the Sialex™Ring "effect" to balance the equation if there is an decrease in CO_2 there is an increase in carbonic acid (Ca $(HCO_3)_2$). This acid gradually breaks down the existing $CaCO_3$ attached to the inner walls of the pipes. . The "Scale" already in place is not uniform. It tends to be irregular in structure with voids and imperfections as well as containing many trapped contaminants. Depending on the amount of "scale" already present this process can take weeks, months or even years. But once started the process is continual. It can also be noted that as this "existing" scale is removed the material washed from the system tends to be irregular in shape.

Corrosion:

Sialex™Rings operate at two levels when providing "corrosion control". At one level the removal of "Scale" reduces sites / opportunities for localized corrosion to occur. Added to this Sialex™Rings provide a degree of cathodic protection slowing down a typical anode / cathode reaction. For further details on corrosion and how Sialex™Rings combat this problem please refer to "What is corrosion"…..