Whitepaper - Hydrosmart Electronic Water Conditioning

23rd December 2014

WP Version 2

Overview:

Hydrosmart works to dissolve limescale and iron, enhance plant growth and remediate soil salinity, by acting on charged minerals and polar non-minerals present in water. The "charges" on minerals are detailed here by reference to "particles", defined as atoms, molecules, compounds and aggregates. The explanation is appropriate for a public science-knowledge standard, and is complete. Compounds, molecules and aggregates that are targeted by Hydrosmart are generally "polar" i.e. partially soluble in water. Atoms targeted by Hydrosmart are "charged" and have either a negative charge or a positive charge.

Hydrosmart produces a pulsed electrical field. The direction of the field along the axis of the pipe is reversed by 180 degrees, roughly every microsecond. This is done via two helical antenna windings, as shown in Figure 1. The way the pulsed field acts on charged minerals is explained below.

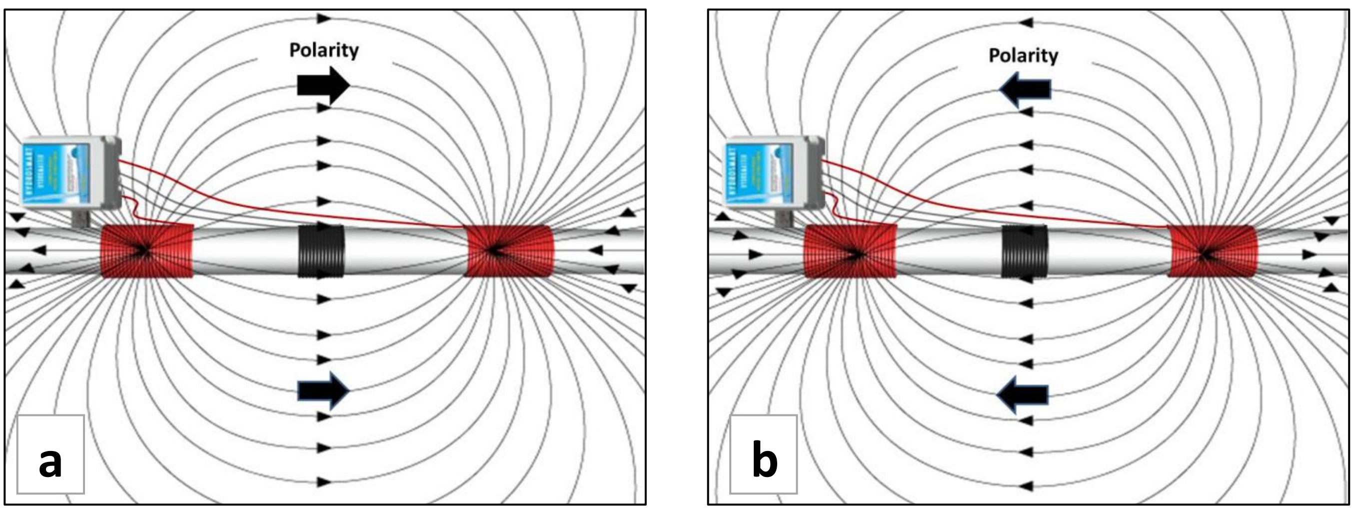


Figure 1. Pulsed field generated by the two helical antennae (red) of a Hydrosmart electronic water conditioner. Water flow is in any direction. The electric field is at greatest intensity (shown by closely spaced field lines) inside the pipe. **Panel a)** At time (a) the polarity of the electric field is along the pipe from left to right. **Panel b)** At time (b) the polarity of the field is along the pipe from right to left, i.e. shifted by 180 degrees from its position at time (a). Length of time between time (a) and time (b) is on the order of a microsecond, and the polarity reverses constantly at a fixed rate. This constant alternation of polarity has the effect of agitating the charged particles that are present in the water. If the field were static no particle agitation would occur.

Background: Salts, Scale and Iron - What they have in common

All atoms contain protons which are positively charged. All atoms, except some forms of hydrogen also contain electrons. Electrons are negatively charged. A charge of -1 (called "negative one") equals the charge on an electron. A charge of +1 (called "one") equals the charge on a proton. The exact number of protons and electrons in an atom determines its charge. The same is true for molecules and compounds.

In technical terms the word “salt” has a different or broader meaning than just common sodium chloride (sea salt). Instead, the meaning includes all other salts as well. “Salts” are formed from a metal and a non metal.

Metals and non-metals both have charges. Metal atoms have a relative shortage of electrons, while non-metals have spare electrons to donate. As such metals (electron acceptors) and non-metals (electron donors) tend to associate (Table 1).

Table 1. Compounds or “salts” that cause problems in plumbing, irrigation, and agriculture

Charge couple						
Metal	*symbol*	**charge**	**Non-metal**	**components**	**charge**	**Common name**
Iron	Fe (III)	+3	oxide	½ O_3	-3	Iron oxide (Fe_2O_3), iron scale
Calcium	Ca	+2	carbonate	CO_3	-2	Calcium carbonate, calcium scale
Calcium	Ca	+2	sulphate	SO_4	-2	Calcium sulphate, gypsum
Magnesium	Mg	+2	carbonate	CO_3	-2	Magnesium carbonate, calcium scale
Manganese	Mn	+2	oxide	O_2	-2	Manganese oxide, manganese dioxide
Sodium	Na	+1	chloride	Cl	-1	Sodium chloride, salt, sea salt

Notice how the negative charges exactly balance the positive charge in each combination of a metal and a non-metal. It is this stability, from association, that causes precipitation as scale or a salt layer. Mixed salts can also form together, such as a mix of calcium carbonate and magnesium carbonate, or a mix of manganese oxide and iron oxide.

Mechanism

All metal atoms have a positive charge, and so will respond to a pulsed-polarity electrical field. Similarly, all non-metal molecules have a negative charge, and so will respond to a pulsed-polarity electrical field.

When minerals are hit by a pulsed electrical field, they can break down into their original charged constituents, which have been “uncoupled” so to speak. For example calcium carbonate can break down into calcium and carbonate.

It takes time for uncoupled constituents of minerals to reform salts. As such, these charged constituents have a finite window of opportunity to effect or dissolve scale and crusts present downstream, before they themselves reform salts. For instance, during the brief time that the charged constituents are unpaired, typically a few days, they are able to scavenge oppositely charged constituents from downstream scale, slowly making the scale more porous, until the point where the scale drops away from internal pipe surfaces and plumbing infrastructure.

Beneficial changes made to saline soil, occur on this same basis. Salt is present in soil as the constituent pair sodium and chloride. When incoming water is treated with Hydrosmart to dissociate sodium and chloride, these free charges (Na and Cl) enter the soil and scavenge out or “dislodge” elements of the salt that is already in the soil. In this way, the salt washes down to lower soil layers, and plants are again able to grow.

To emphasise that the positively charged atoms in Table 1 are metals, note that the metals: calcium, sodium and magnesium, can be found in solid form in laboratories (Figure 2 a-f), that is if they are stabilised against corrosion or stabilised against exposure to their natural partner non-metals. Hydrosmart does not revert these metals to solid shiny form, but rather washes away their salts. More accurately, it temporarily breaks down salts of the chemical constitutions shown in Figure 2g, which then reform as the same salts elsewhere.

Natural association of metals with non-metals forms **salts** responsible for **scale iron and salt deposits**

Figure 2. Metals of calcium, sodium, magnesium and manganese and their respective salts. a) Calcium metal granules, b) Pieces of shiny calcium metal pieces in a bag for protection, c) Shiny sodium metal is so soft it can be cut with a knife, d) Magnesium metal, e) Manganese metal, f) Iron metal, g) Salt compounds (left to right): calcium carbonate; magnesium carbonate; sodium chloride; calcium sulphate, manganese oxide; iron oxide. **Hydrosmart** acts on salts to break them down into constituents, which then reform as the same salts elsewhere.

Quantification of need, and variety of applications

Electronic water conditioning is used to treat water in the range 0 ppm to 8,000 ppm (parts per million) of total dissolved solids, on different applications. For comparison, seawater weighs in at 35,000 ppm. Another way to think of ppm is as mg/L. The usual way to determine how many parts per million you have in your water is by measuring the electrical conductivity (EC) with a TDS meter. This can be done on its own, or in combination with a chemical water analysis.

When you phone Hydrosmart, the consultants may ask either for what the problems are, or for what your TDS/EC is. They need some qualification of the issues that the water is causing on your property. From their wide experience, when you cite either your problem (e.g. calcium scale, plant or turf growth problems, iron scale) or the TDS level, the consultants will know whether Hydrosmart can help in your situation, and to what extent the problem will be ameliorated when Hydrosmart is installed.

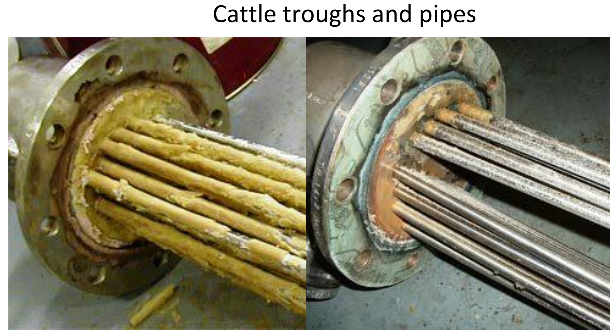
Hydrosmart is put to a wide variety of uses. The common ground shared is the presence of minerals in the water, causing difficulties in using the water effectively. If water is over 2000 ppm of salinity, over 5 ppm iron, or over 500 ppm calcium, then an Enhanced Output (EO) Hydrosmart is needed. Below that a standard Digital Hydrosmart is sufficient. After installing Hydrosmart, the water does what it was supposed to do, and living on the land can continue, having drought-proofed your operation by making good use of imperfect water.

Vineyards, drippers

Cattle troughs and pipes

Orchards

Homes



Removal of limescale from any surface contacting water

Figure 3. Some examples of applications of Hydrosmart. Other industries with successful outcomes also include mining.

Low power draw

The two antennae of Hydrosmart are open coils, not closed electromagnetic coils, and so do not draw significant current. This means the wattage of the unit is less than a standard light bulb. The unit can either be powered by 240V/120V AC mains (50/60Hz) or by a 12V DC battery supply charged by solar panel or generator. A Trifield meter (optionally available from Hydrosmart) can be used to observe the activity of the Hydrosmart by holding the meter against the coils. Another way to establish the functional state of the unit is by looking at the display.

No water flow restriction

The electrical field method facilitates water treatment independent of water flow rate. If a user has a fast flow rate pre-existing, the installation of Hydrosmart does not alter that situation, and the Hydrosmart does not restrict flow. On the flipside, user with a slow flow rate pre-existing, are also able to obtain water treatment from Hydrosmart and the unit does not restrict their water flow in order to speed the flow. In other words, treatment by the electrical field method is independent of water flow rate, and users may have any flow rate.

Research and Development

Hydrosmart is patented in the US and Australia, and undergoes active development to ensure that all applications are at current world standard. The Australian Federal government supports development through an R&D rebate (2015), including both national and international trials.

Contact Hydrosmart on +61 8 8357 3334 or info@hydrosmart.com.au to have your operation counted as a scientific trial. The only requirement is either presence of a strict baseline for before-and-after studies, or presence of a parallel control trial which is untreated in the case of reductionist (strict) trials.

Contact and Information

bob.moore@hydrosmart.com
www.hydrosmart.com.au (further technical details)

Appendix 1: Image sources for Figure 2

Ca
http://m.c.lnkd.licdn.com/mpr/mpr/p/1/005/08b/02c/33d2b7f.jpg
http://www.metimexco.com/photos/categorie10.jpg

Na
http://www.chem.uiuc.edu/webfunchem/ProtonsNeutrons/protons9.htm

Mg
http://www.farwestcorrosion.com/media/catalog/product/cache/1/image/9df78eab33525d08d6e5fb8d27136e95/a/l/alumaloy_1.jpg

Mn
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Fe
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$CaCO_3$
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$MgCO_3$
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MnO_2
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NaCl
http://www.swensonproducts.com/Portals/0/GranularMaterials/images/Rock-Salt.jpg

Fe_20_3
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$CaSO_4$
http://www.spiritrockshop.com/images/_02062.JPG

Appendix 2: Creative Commons License information