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MAGNETIC WATER DEMYSTIFIED

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Are the Waters of the East Different from the Waters of the West?

Slowly, but steadily, physical treatments of water with magnetic fields become known and accepted in the Western World. They have been utilized since about 25 years in many countries of the Eastern World, the USSR and Mainland China for instance. There, hundreds of success- reports have been published, most of them admitting the lack of a fully satisfying scientific explanation. These papers describe - often in great detail - the observation of reduced formation of hard lime scale, the elimination of old lime scale deposits, accelerated plant growth, desalination of soils, improvement of concrete, better cleaning, faster drying, better taste and smell of drinking water, changes of freezing modes, beneficial effects on patients with kidney stones, and minute changes in some physical constants of the water, such as viscosity, IR absorption, surface tension, to name just a few.

Many of these reports are authored by scientific teams of universities or government agencies, describing years of experimentation and subsequent routine applications in larger forms. Resulting savings in the use of chemicals, of energy, and of equipment are substantial, according to these reports.

But:

Contradicting these descriptions originating from Eastern countries are a number of reports of tests and checks by teams working in countries of the West. No change of the water was found by magnetic treatment according to some of these reports. Some of these evaluations concede to find some effects when long-time observations were made. In a number of States within the USA magnetic water treatment has officially been declared to be a hoax or its advertisement has been outlawed to be fraudulent.

How can such discrepancies of opinion exist for tens of years in our small and supposedly communicative, scientific world?

A number of reasons for different opinions are caused by a number of obvious differences in the circumstances prevailing in the respective countries, for instance:

The peoples of the Western world insist to be able to understand what they are doing or using. Theoretically unexplained processes have the stigma of black magic or superstition.

The West is used to and takes for granted the unrestricted availability of chemicals for all purposes in reliable quality and purchasing price which is not so in many countries of the East.

The Russians do not have a particularly good reputation in matters of research on water after the disaster of the claim by Deryagin to have found the "Polywater" in the 1960's (The history of this scientific misfiring is well presented in FELIX FRANK'S booklet Polywater, the MIT Press Cambridge, MA. 1981).

The Free-Enterprise system permits anybody to take advantage of potential-lyfast profits with wild claims about an important item, such as water. Many partially informed or irresponsible sales-people give the entire issue a bad name by false promises, such as "No need for chemicals!" The Correct statement would be: "Chemicals become more effective in magnetically treated water, so that one needs chemicals in reduced amounts."

What is Magnetic Water Treatment? (As described by Russian papers)

A number of conditions are given in the Russian papers about the details of their experiences; here are a few:

The water to be treated has to move across magnetic fields not stronger than 1000 to 2000 Oersted.

For a certain flow-velocity the effect is a maximum.

It usually works better for water of a lower temperature.

Some small changes of the physical constants of the water last only for a few minutes.

The capability of the water to prevent formation of hard lime scale may last for up to 2 days.

Instead of forming hard lime scale ("Slake") clinging to the walls of the container, the calcium carbonate of magnetically treated water forms a soft sludge ("Shlam"), flowing with the water. Reliable observations of the effects of the magnetic treatment require several weeks. Many attempts of faster results have not always been conclusive.

The magnetically treated water is able to dissolve formerly deposited lime scale.

Soil can be de-salinated.

Harvests are significantly improved in quantity and quality.

Our own Experiments and Observations.

Prospects.

Confronted with the challenging discrepancy between 400+ computer references of papers from the East and a score of opposing, critical surveys from Western countries, we probed into the matter experimentally. We had the facilities of the California State Polytechnic University, Pomona, at our disposal, where the author has been teaching Physics for 10 years, and acoustics just at this time. The author had been working in materials research for most of his professional life, permanent magnetism and crystallography being his specialties. He was familiar with the many unsolved puzzles of water by his early works as a physics student in Cottingen, Germany.

Why is there lime scale?

The formation of hard lime scale at the container walls by the CaCO_3 content of water is a consequence of the scarcity of nucleation centers in ordinary water. When the concentration of the CaCO_3 exceeds the solubility, the solidification can begin only at appropriate starting points most of the time at foreign matter. If no foreign matter is present in the form of particles in the liquid, solidification can start only at the walls of the container. Ordinary water tends to surround any foreign particulate with complexes of 100 to 200 water molecules each. The water molecules agglomerate around every foreign particle in ordinary water. They form cages around them which makes them ineffective as nuclei. Then, the container walls are the only non-water substances available. The resulting crystals are of the dendritic mode. They are characterized by few starting points attached firmly to the wall and extended systems of crystals clinging to one another and to the wall around the starting point. The dendritic crystallization mode is the initiation of the formation of hard lime scale which, if further solidification of the mineral occurs, grows layer over layer on the first set of dendrites.

Early detection of lime scale.

Microscopic observation of the beginning of crystallization in the form of dendrites reveals the tendency for scale formation immediately. We placed drops of water on glass slides and permitted the water to evaporate under observation with magnifications from 50 to 400 times. The microscope was equipped with polarizer and analyzer in order to improve the contrast for the optically active CaCO_3 crystals. We compared drops of ordinary water as it came from the tap with drops of the same water after it had passed through magnetic fields; the drops were evaporating side by side on the same glass slide under identical conditions.

Magnetic effects? The area formerly covered with the water is now covered with a lattice of thin dendritic crystals, the rim of the drop is studded with a number of thick, strongly light-polarizing dendritic crystals which had grown each from one point at the glass on the periphery of the drop. These crystals were firmly attached to the glass of the slide; they fractured if one attempted to dislocate them with a microscopic needle. This entire drop periphery contained 124 such prominent crystal systems.

The entire drop circumference contained 41 such crystals. So: The number of these crystals which had grown on the glass was reduced by about two thirds by the magnetic treatment of this water. The effectivity of the treatment with respect to reduction of such glass-attached crystals was therefore 67%. Assuming that these crystals are the start of scale formation, the magnetic treatment would have had an effectivity of 67%.

An economical quantitative method.

This simple method of comparing the microscopic crystal count without and with the magnetic treatment permits within hours a quantitative estimate of the effectivity of the treatment with regard to scale reduction. The counting is greatly facilitated by the fact that in a circular water drop on a glass slide, almost the entire mineral matter solidifies at the outer circumference of the drop. This was found to be caused by a convection within every circular drop of evaporating water. This convection is caused by the evaporation cooling at the surface of the drop; it transports the heavier substances within the drop radially from the center to the outer perimeter of the drop where they become concentrated and solidified. Furthermore, after counting all crystals of the entire perimeter of many drops it was found that the distribution of the crystals along the perimeter is even enough that the crystal count within a section of only 1/12 of the entire drop is usually representative for the entire drop.

With this straight forward and economical working scheme we investigated the effectivity of magnetic fields for various flow velocities, for various numbers of magnets, for different pole arrangements and for different waters.

First findings.

The relationship between effectivity and flow velocity had in almost all cases a maximum for one velocity. The plot of the values had the shapes of resonance curves. Variations of the distances between the magnets confirmed the relation between the flow velocity and the sequence of the fields crossed by the water, as indicated by the two curves.

Magnetic arrangement.

Hundreds of field arrangements have been tested with a number of different water types. Maximum effectivity was achieved with arrangements where

the fields originated from simple, ring-shaped permanent magnets of barium ferrite of a medium grade. The arrangement was granted a US Patent in 1981. By "tuning" such a device to a certain water velocity the effectivity of such a device could be brought close to 100% with 8 ring-magnets. Water which contains a large amount of admixtures shows additional effects if it passes repeatedly through a magnetic device. The admixed algicides, bactericides, and softening chemicals produce an extended dendritic crystallization over the entire area of the evaporated drop.

The formerly hidden foreign particle becomes available to the over concentrated calcium carbonate, so that the dissolved calcium carbonate diffuses to this particle equally from all sides simultaneously. So, the typical circular disk shape of a seeded crystal appears. If the effectivity of the magnetic treatment was high, no calcium carbonate needs to wait to diffuse to the container wall in order to solidify. Therefore reduction of the hard scale formation can be understood as an internal seeding effect in the magnetically treated water.

Entropy/Energy

Skeptics might doubt this process to be possible because the former mixture of liquid water and liquid calcium carbonate is being turned into liquid water and separated, solid calcium carbonate. This unmixing means a lowering of the entropy of the system. Any entropy lowering requires the expense of energy which cannot come from the permanent magnets. The needed energy can only be delivered by the kinetic energy of the flowing water. For this reason, no effect can be expected if the water does not move.

Can this process also accomplish the often doubted claim of removal of formerly deposited hard lime scale?

Having no restriction for the solidification of the calcium carbonate the liquid water is soon depleted of dissolved calcium carbonate. Having some of the large cage-clusters in pieces the depleted water is particularly active (reduced viscosity and surface tension). If the water streams passed calcium deposits, it replenishes its calcium carbonate content by dissolving stationary solid calcium carbonate. It may be mentioned here, that in many cases of rather thick deposits, the dissolving does not precede piecemeal from the outer layer, as the customary acid washes do. The magnetically treated water rather weakens the bond between the wall and the calcium carbonate, so that the scale breaks off in rather large pieces from the walls on which they had grown. This dissolving process may take several days or even weeks. But under advantageous circumstances only hours may be required to loosen old, hard deposits and render them removable.

Can water have a memory?

According to many reports of success, the water retains its capability of re-

ducing scale for up to 2 days. Critical comments try to make this fact appear to be absurd by calling it a "memory" of the water for its "magnetic experience." We realize that the treated water has its specific scale reducing capability as long as its calcium carbonate is in the solid form of the inert micro crystals.

We have investigated these crystals with high magnification for many different waters and varied treatments. Using the interference colors of the polarized light the thickness of the disk-shaped crystals can be estimated to be from 0.1 μ m to 2.4 μ m. (About 4 times the wavelength of red light).

Transformation in the solid state.

With hundreds of evaporated drops of different waters under continuous observation before and after various treatments, it is one of the most astounding findings that these dry, seemingly immobile crystals, sitting on the glass slides, keep changing their mode for weeks in their solid state.

Most significant is the transformation of the disk-shaped circular crystal platelets. After about 20 hours they develop holes in their centers and some of their matter turns into thin needles bundled up at the location of the disk. The disk-shape is a meta-stable crystal form of calcium carbonate; it transforms into the more stable form of acicular crystals within days. These needle-shaped crystals then dissolve also, most of them last only 2 or 3 days. That is the reason for the fact that the scale-reducing properties of the treated water last for 2 days only.

For more research.

Many questions remain for more investigations. The influence of temperature has not been investigated as yet. It can only be assumed to be of essence according to Russian reports. Also, the type of the water from different sources seems to be of importance. Some mountain spring waters require particularly well adjusted magnet sequences in order to be effective. According to findings by geologists about the type of mountain water coming from narrow spaces of defect structures within mineral deposits, such water may have formed only few complexes of a specific size. Therefore the required resonance is a narrow one and therefore difficult to achieve.

The effectivity of the magnetic treatment may also be influenced by certain mineral contents of the water - such as silicates - which appear to interfere with the magnetic treatment.

Freshly fallen rainwater did not show much effect from the magnetic treatment. It has been found to contain as many seeded disc-shaped crystals as water after the magnetic treatment! It is believed that the raindrops passing on their way down through the electric fields of the clouds may undergo a sort of natural treatment with electric fields.

The actual physical changes of the water.

Another wide open field of questions remains to be investigated; that are the short-lived effects of magnetic fields on the physical constants of the water. These effects are so minute that their measurements are beset with uncertainties. Yet their effects for the usefulness of the water are often of great importance, as for instance the surface tension which determines many parameters of the water quality. A number of experiences are reported from many sides, and some of our own observations with respect to these changes in the physical structure of liquid water will be mentioned in the next section.

Learning more about liquid water.

Assuming that the interactions between magnetic fields and moving water are of the nature which are here proposed, the study of magnetic water treatment opens new avenues for the study of the structure of liquid water. So far, no systematic study has been attempted of this issue. Nobody doubts the overwhelming importance of the use of water for virtually every human endeavor, yet there is no correlation which could oversee all the many separate researches into water by the various users. (In the 6 volumes of his comprehensive treatise "WATER," Felix Franks decries this fact and has tried in his lifetime to change this lack of concerted effort.) The magnetic water treatment issue might be one way to make the few known facts of the physical structure of water more generally available. One important step in this respect is that the general public learns that there are fundamental problems with the physical structure of water.

At this time, even the more sophisticated users and investigators of water think most of the time only in chemical terms of the water. Almost without exception, "testing of water" is considered a chemical analysis. Understanding the nature of the magnetic treatment of water as to be only a phase-change of some components of the water, it is evident that any chemical analysis of the water before and after the treatment cannot possibly show a change. The magnetic treatment does not actually add or remove anything from the water. A standard chemical analysis brings all the substances into an all over dissolved state, thus undoing the effects of the magnetic treatment. Many negative test results have been published because of this exclusively chemical thinking.

Again, it has to be said that many of these misconceptions have their origin in the misrepresentation of the method by insufficiently trained sales personnel. They try to compare the effects of the magnetic devices with softening chemicals or ion exchangers. So, the water users are disappointed and consider the entire issue a swindle.

What are the Consequences for Future Water Usage For Industries?

Simple magnetic treatment units with their best effectivity at a fixed water flow rate serve with advantage in such installations which require a constant flow rate. The size of the treatment unit can be selected to fit the exact requirement of the machinery.

Very small units may serve in drip irrigation at every separate outlet with one gallon/hour flow rate, or a larger unit may be used for the entire irrigation system. Ice machines, solar panel, steam cleaners may have a precisely fitted magnetic unit permanently built in. Without it they would plug up within a few weeks of use and would have then to be washed out with acid to remove the accumulated hard lime scale. The built-in magnetic units keep these machines running for many months without an acid wash.

In the case of steam cleaners, an additional benefit results from the lessened surface tension of the magnetically treated water. Oral, unpublished reports of increased cleaning power of detergents confirm the microscopically found change of the water-detergent mixture. Instead of the drop circumference which is usually well defined by the surface tension, the treated water wets the glass surface much better improving the activity of the added detergent.

Another potential application of magnetic water treatment has been looked into for the oil industry. The fossil water which comes up with the oil is extremely heavy with minerals. Its separation from the oil and subsequent replacement under ground can be facilitated by magnetic treatment.

Some preliminary investigation (non-published) was successful for one narrow range of flow rate. The massive dendritic crystal growth has been replaced with a multitude of small, rectangular crystals. Much further investigation is needed to reap the potential benefits from magnetic water treatment for a number of problems of the oil industry. As for instance a better separation of the oil from the water.

