

#WASSERREVOLUTION 4.0

Summary Water Symposium 2019

40 Years of GRANDER®

Kitzbühel, 7 September 2019



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1. Introduction

Ever since GRANDER® water revitalization came into being, two questions have been its constant companions, and their importance has only grown: how does GRANDER® water revitalization work, and can its effects be substantiated scientifically?

Everyday practice, and the many empirically documented positive experiences, ran decades ahead of scientific explicability.

Newly emerged branches of science such as applied water physics (1), together with improved water analysis methods (2), have helped to understand the underlying mechanisms and the individual factors of GRANDER® water revitalization, and to reproduce and verify them in laboratory experiments.

Applied water physics

The focus of “applied water physics” is research into the fundamental properties of water — among them its interactions with electric, magnetic and electromagnetic fields, and the effect of such interactions on living organisms such as bacteria.

Over the past 40 years a great deal of research has been carried out on the effects of magnetic and electromagnetic treatment of water; more than a hundred articles and reports are available in the literature (see examples 10–29).

For a long time, the claim that a magnetic field acting on hard water influences the structure and morphology of calcium carbonate crystallization was viewed with scepticism by the scientific community. This was mainly because no plausible mechanism existed that could explain the lasting effect of magnetic fields once exposure had ended.

The application was therefore contested among specialists — and not only where GRANDER® water revitalization was concerned.

Wetsus — Europe’s centre of excellence for sustainable water technology

The interdisciplinary collaboration of European universities and research institutes (3) at WETSUS, Europe’s centre of excellence for sustainable water technology, brought a breakthrough in understanding magnetic water treatment from the perspective of water physics. (4)

Summary of the scientific results

The results of Dr Elmar Fuchs (5) and his team at Wetsus (6), published as *“Strong Gradients in Weak Magnetic Fields Induce DOLLOP Formation in Tap Water”*, were confirmed in a scientific peer-review procedure. (7)

In 2012 Coey published a theory on the mechanism of magnetic water treatment which is based on the gradient of the applied field rather than on its absolute strength.

This work by the Wetsus research group “Applied Water Physics” (Martina Sammer, Cees Kamp, Astrid H. Paulitsch-Fuchs, Adam D. Wexler, Cees J. N. Buisman and Elmar C. Fuchs) rests on the finding that the calcium carbonate nanoparticles contained in tap water — the “DOLLOPs” — restructure under certain conditions, among them those caused by the magnetic gradient, and thereby change the environment for dissolved substances such as lime. (8)

The results show an increased formation of nanometre-sized prenucleation clusters (oxyanion polymers, or “DOLLOPs”) following exposure to the magnetic field. They are therefore consistent with Coey’s theory, which accordingly also applies to very weak magnetic fields, as long as those fields contain strong gradients.

2. High-resolution water analysis

Advanced examination methods open up new possibilities in modern water analysis. This is true both of trace analysis, where the lowest concentrations of substances can be detected (pg/l), and of microbiological examination, where the number of bacteria in water can be established in less than an hour.

An illustration: Lake Achensee

Surface area	6.8 km ²
Volume	0.481 km ³

Dissolve a single sugar cube in Lake Achensee and that sugar can still be detected, using a highly developed measuring technique known as flow cytometry.



Fig. 2: Lake Achensee

Determining the total bacterial count in drinking water takes 72 hours using conventional methods, and only around 1% of the bacteria actually present can be made visible — the remaining 99% go undetected.

Flow cytometry. The flow cytometer detects 99% of all bacteria in the water and can even distinguish between living and dead cells. Examination time: under one hour. (11)

Flow cytometry allows the analysis of cells that pass an electrical voltage or a light source — usually laser beams — individually and at high speed. Depending on the shape, structure or staining of the cells, different effects are produced, and from these the properties of a cell can be derived.

3. Scientific publications

There is now a peer-reviewed scientific paper demonstrating the difference between treated and untreated water. (7)

“Strong Gradients in Weak Magnetic Fields Induce DOLLOP Formation in Tap Water”

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Result

- Revitalization changes the electrical alternating-current resistance (impedance) of the water.
- Revitalization leads to increased formation of lime nanoparticles, the so-called DOLLOPs.

The evidence was established by three independent measurement methods.

a) Impedance spectroscopy

In this method a defined alternating current is fed into a measuring cell filled with the water under examination. The frequency of the alternating current is varied, and the electrical alternating-current resistance (impedance) together with the phase shift of the sample are determined.

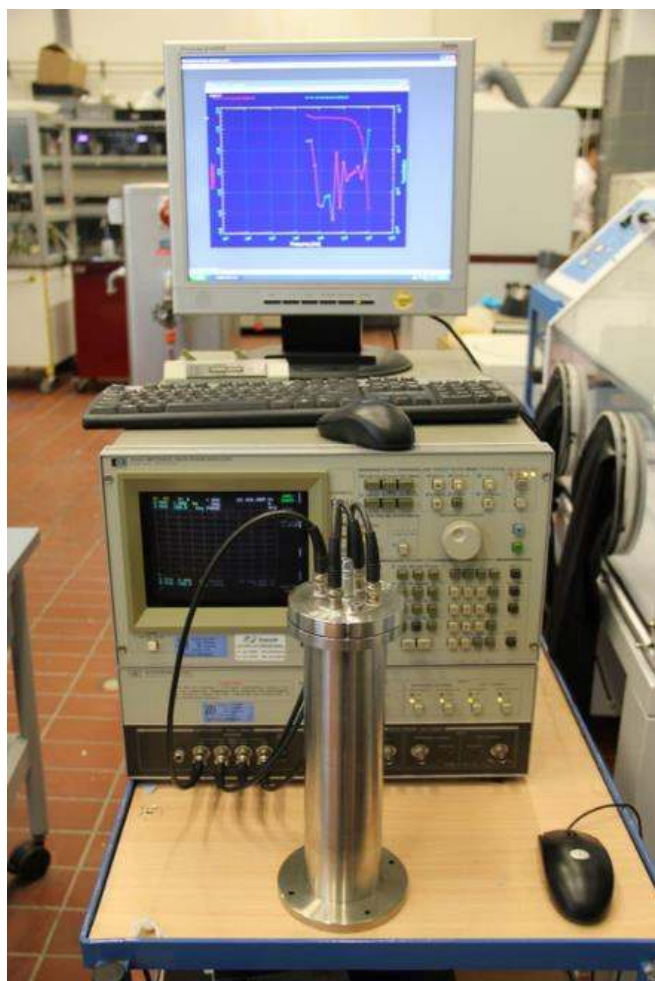


Fig. 3: Impedance analyser — HP4194A (Hewlett-Packard, California, USA). The BDS 1200 sample holder consists of a connection head and shielding and is connected to the analyser by four BNC cables.

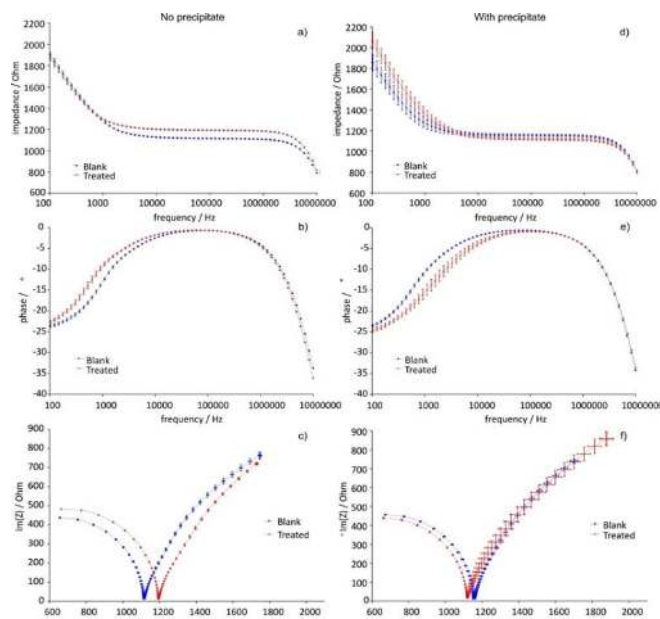


Fig. 4: Comparison — treated versus untreated samples. Significant, frequency-dependent differences appear between untreated samples and samples treated with GRANDER. (8)

DOLLOP formation was tested in at least 16 independent experiments with 12 measurements per experiment. One measurement covers the impedance at 65 frequencies, with two parameters — phase and impedance — recorded per frequency. (8)

b) Laser scattering

The number of calcium carbonate nanoparticles (DOLLOPs) was measured using a flow cytometer. (8)

c) Scanning electron microscope



Fig. 7: Scanning electron microscope

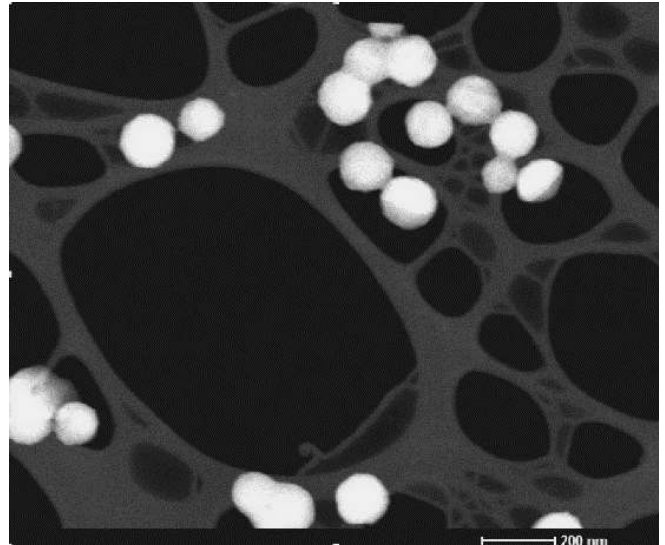


Fig. 8: DOLLOPs — CaCO_3 nanoparticles

After treatment with GRANDER® water revitalization, increased DOLLOP formation is evident. DOLLOPs can act as crystallization nuclei for the formation of lime crystals and thereby influence the way lime is deposited. (8)(9)

4. Understanding the GRANDER® effects

Changed deposition behaviour

When dissolved lime crystallizes on the pipe wall, the cross-section of the pipe is reduced and flow resistance rises. The mostly rough lime surface can also offer improved growth conditions for unwanted bacteria and biofilms.

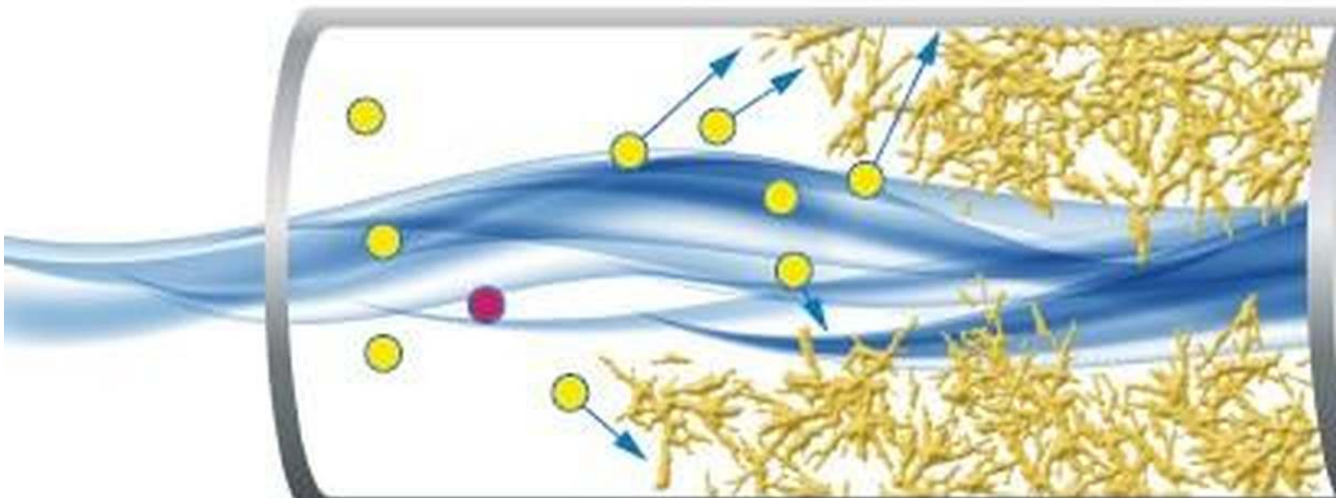


Fig. 9b — without revitalization, few DOLLOPs. Dissolved lime crystallizes on the pipe walls and narrows the cross-section, restricting the flow. (9)

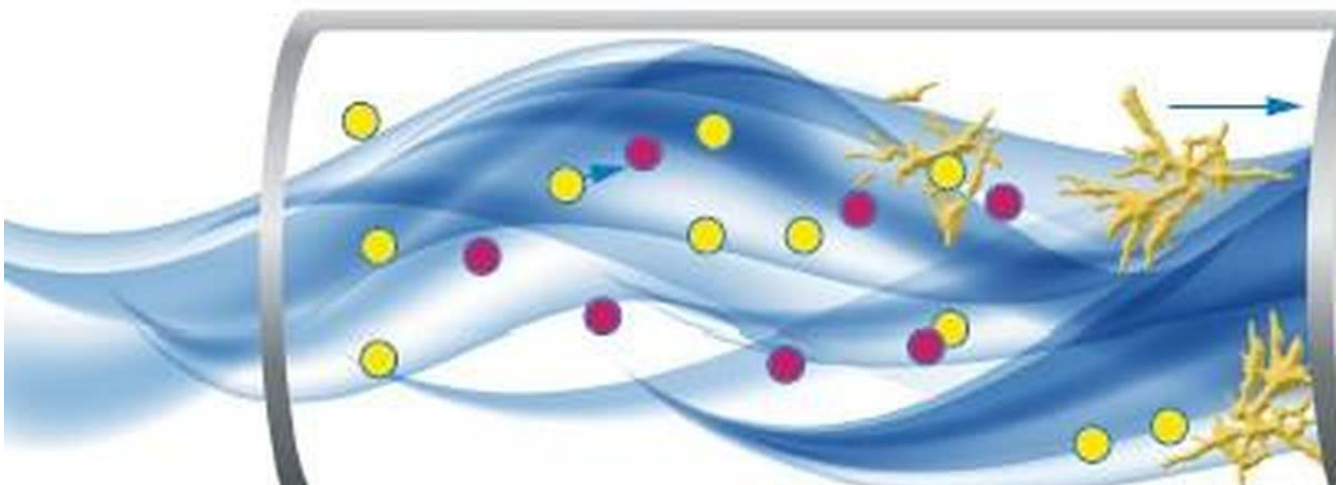


Fig. 9c — with revitalization, many DOLLOPs. Thanks to the DOLLOPs, dissolved lime already crystallizes within the water itself and is flushed out, leaving the full bore free. (9)

Where the concentration of DOLLOPs in the water is high, crystal formation begins in the water itself and only to a minor extent on the pipe surfaces. The crystals therefore no longer adhere to the pipe but are carried away with the flow. (8)

5. Benefits of the GRANDER® effects

Example: the tendency to form deposits

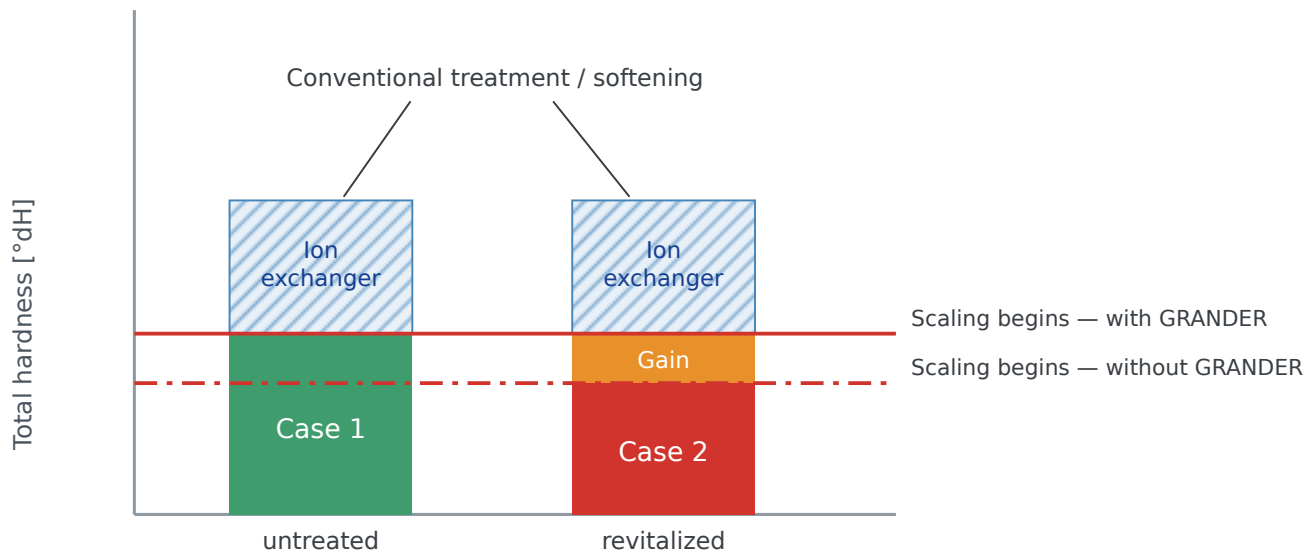


Fig. 10: Tendency to form deposits. In revitalized water, deposits only start to form at a higher degree of hardness, so the residual hardness after an ion exchanger can be set higher — the orange band is the gain.

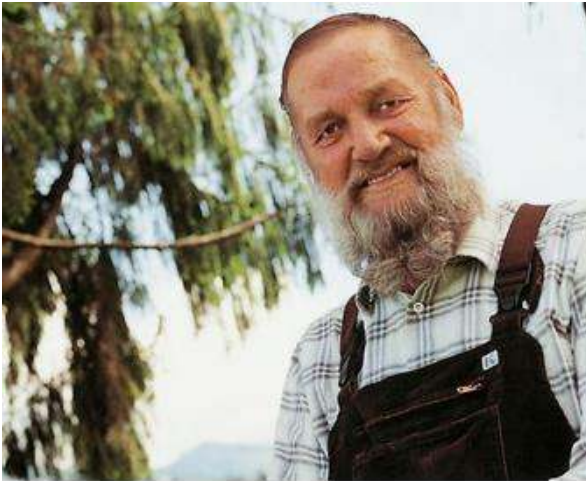
Water has the ability to dissolve lime, and the pH value and temperature play an essential part in this. Saturation with other minerals and substances also determines how much lime stays dissolved in the water, and at what point it begins to crystallize out.

In revitalized water, deposits only begin to form at a higher degree of hardness than in untreated water. Where water is very hard and conditions unfavourable, combining revitalization with conventional treatment (an ion exchanger) is recommended if lime deposits are to be avoided altogether.

What revitalization means for deposits

- Revitalized water tolerates a higher degree of hardness without forming deposits.
- In combination with an ion exchanger, the residual hardness can be set to a higher value.
- It saves costs for chemicals, electricity and maintenance.
- The water tastes better.

6. Visions for a sustainable future



“We do not see the small, and we do not understand the large.”

Johann Grander

Thanks to modern measuring technology we can at last see at least part of the small. With his knowledge, Johann Grander was decades ahead of us.

Making use of the natural forces of revitalized water
is an important step towards sustainability and health.

The stronger and more natural a water is,
the less treatment it requires.
That saves resources, protects our environment and helps to save costs.

Our philosophy is to strengthen the positive forces of water
and to bring it into a natural balance.

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