Anti-Scale System

Training Book

Technology | Applications | Installation

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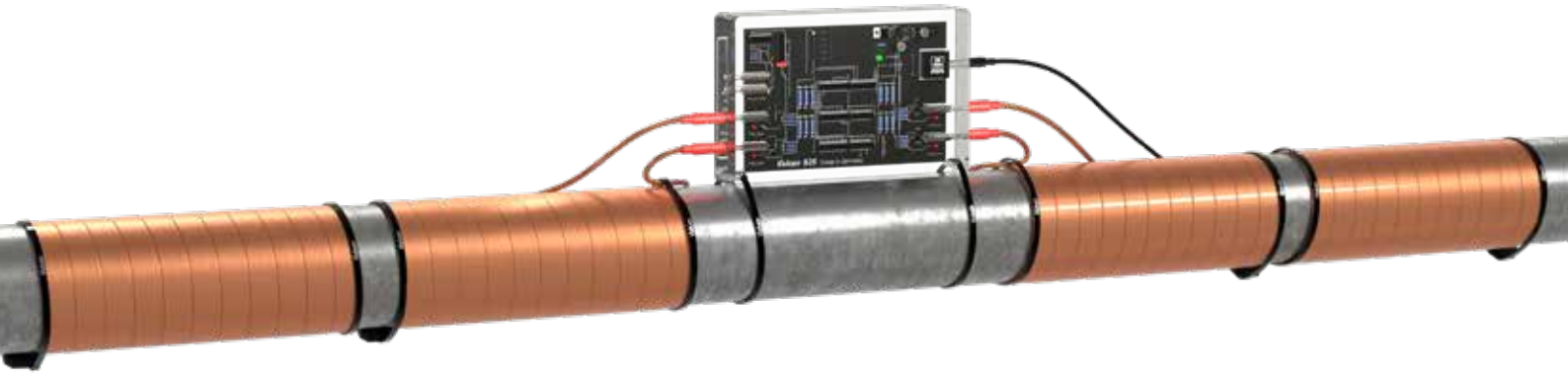
The information in the videos and in the training book is only for Vulcan distributors.

www.cwt-vulcan.com

Introduction

Over the years, physical water treatment has successfully proven to be an efficient method to improve the quality of our water without the addition of chemicals or salt. Nowadays, it has become even more important to capitalize on technologies which do not harm our environment but rather try to create an optimal balance between man and nature.

Vulcan is based on such a technology and is the result of over 40 years of constant research and improvements in the field of physical water treatment by Christiani Wassertechnik GmbH (CWT). Our latest generation of products continues to provide you with reliable German quality combined with an extensive warranty.



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I. Hard Water and the Scale and Rust Problem

1. The scale and rust problem

1.1 What is limescale?

Scale mainly consists of calcium and magnesium - two minerals that by themselves have a healthy effect on the human body. However, what is good for living organisms quickly becomes a scale problem as it deposits in the piping system, in machinery or on surfaces outside the piping system. So-called hard water holds high concentrations of calcium: the more calcium in the water, the harder the water and more problems.

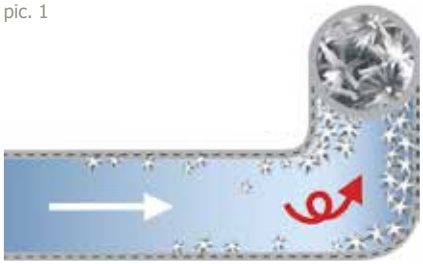
1.2 The formation of scale

Scale builds up whenever hard water flows through a pipe. Liquid calcium in untreated water crystallizes into a sticky structure (pic. 1). These crystals adhere to each other, adhere to surfaces and immediately produce solid scale deposits that have a very destructive effect.

pic. 1

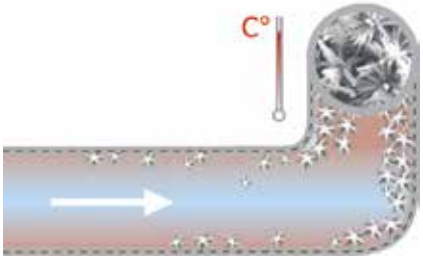
1.2.1 Changes of water pressure

Scale grows particularly well when the water pressure changes. This happens when water changes direction in a bend or intersection which then causes turbulence; or when it leaves the piping system through a faucet. This drop in pressure enhances the formation of calcium crystals, which will then grow into scale deposits.



1.2.2 Increase of water temperature

Scale also forms when the water temperature inside the system increases such as on heating elements or in radiators. The hotter the surfaces, the more scale problems will develop. These problems can specifically be found on heating elements, with water heaters and heat exchangers.

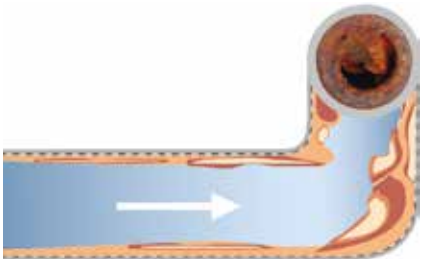


1.3 Problems caused by scale and rust

- Blocked piping system
- Loss of water pressure due to a reduced pipe diameter
- Rust accumulation in the pipes that may lead to corrosion
- Bacterial growth in pipes carrying drinking water
- Repeated repairs or replacement of household appliances
- Replacement of the whole piping system
- Loss of energy in the hot water circuit and high costs for heating
- Scale covered surfaces in bathroom and kitchen
- High cleaning costs and the need of aggressive cleaning agents
- Malfunctioning machinery
- High production costs due to maintenance
- Long pauses in production when machinery has to be maintained and cleaned leading to inefficient production planning
- Decrease in productivity

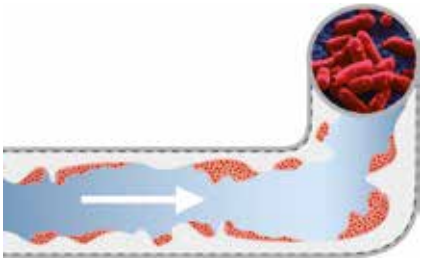
1.3.1 Rust - the common problem with scale

Unfortunately, scale deposits also attract other unwanted substances which again create even more problems and threats: The main components of scale are calcium and magnesium. This would lead us to believe that scale deposits have a white color. However, most scale deposits are brown. As soon as scale deposits build-up, iron and oxidized iron particles become embed into the scale. This also means that rust is firmly attached to the pipe which causes a serious threat to the pipe by pitting corrosion.



1.3.2 Bacterial growth - the side effect of scale

Scale deposits are also perfect breeding ground for bacteria and other unwanted micro-organisms. As the deposits have an uneven, rough surface, these little sockets are a perfect hide-out for bacteria to nest in. Whether in cold or hot water, you will always face an increase in potentially dangerous bacteria growth on the scale.



Water heater

Heat exchanger

Washing machine heating element

Pipe with scale deposits

Tube heat exchanger

Plate heat exchanger

II. Vulcan - Information and Technology

2. Vulcan - your electronic anti-scale system

2.1 Quick info

The salt-free alternative to water softeners
Vulcan is an eco-friendly water treatment system that protects your piping system and appliances against scale deposits and rust. The **Vulcan-Impulse-Technology** is based on the principle of physical water treatment. Special electronic impulses change the crystallization process of the liquid calcium. This way the hard scale loses its adhesive power. The technology works exclusively with capacitive electric impulses: no use of any salt or chemicals.

- The eco-friendly solution against scale problems
- No use of salt or chemicals
- Suitable for pipe diameters from $^1/_2$" to 40" (~10-1000 mm)
- Fully cast in acrylic for optimal quality endurance
- Do-it-Yourself installation without cutting the pipes
- Works on every pipe material – iron, inox, copper, stainless steel, galvanized iron, plastic, PVC, PE-x, hose, compound pipes, etc.

2.2 The Vulcan full acrylic cast

The special Vulcan acrylic cast guarantees the best quality. Vulcan is especially designed for use in humid, wet, very cold or very hot areas.

The acrylic cast ensures that the **circuit board is protected**. The parts are fully covered in acrylic. Therefore the parts can not move and are fixed in place. This guarantees a high life expectancy.

It **protects the unit from humidity,** e.g. when installed outdoor. The full body acrylic cast protects from dust and dirt, e.g. when installed in a basement.

The full body acrylic cast **protects against heat and coldness** as acrylic is a perfect isolating material. E.g. when installed in extremely hot areas with outdoor temperature up to 45-50°C (~113 - 122 °F) or in very cold temperatures down to -25°C (~-13°F).

The acrylic cast ensures a very long product life. The Vulcan's solid acrylic **isolating material** ensures that the electronic components are perfectly isolated from the inside as well. The most common cause of a malfunction in electronic devices is a burn-out on the circuit board due to excessively high operating temperatures. The thick acrylic covering together with the **vacuum prevents heat production**. This "cooling" of the unit ensures a long life.

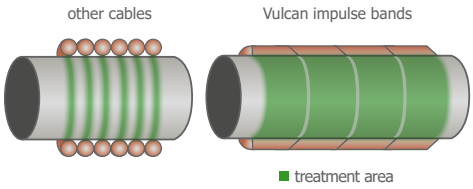
2.3 The Vulcan impulse bands

Vulcan operates with customized isolated copper impulse bands that are designed to firmly connect to the pipe. They are extremely thin and flexible with minimized isolation. This way, they achieve minimal spacing loss and maximize the direct-contact-ratio to 97.5%. Their special copper material with a high degree of alloy purity guarantees the best possible transfer output. The copper treatment bands are a crucial factor to the performance of the water treatment.

The pipe diameter / treatment area ratio

The impulse bands cover the surface area that is vital for the treatment. The surface of the pipe that is covered by the impulse band is the "treatment area". This area needs to be large enough to ensure that the impulses are transmitted through the pipe.

Treatment with round cables vs. impulse bands



Comparison: The Vulcan Impulse Bands accumulate more direct contact compared to round cables as there is less spacing. The direct contact ratio reaches 97.5%.

2.4 Quality indicators - 12 reasons why Vulcan is so good

Vulcan clearly stands out with its quality and performance.
Please compare Vulcan against other products by matching some quality indicators:

German 48 Volt Impulse-Technology (capacitive): The water is treated with electric impulses that control scale in an eco-friendly "green" way. It is an electric system that is not magnetic-based.

Vulcan works on a **frequency range between 3-32 kHz** with different frequency peaks (wobbling distribution). The secret to the right performance of physical water treatment lies in the composition of these impulses. CWT has developed and fine-tuned these for over 40 years.

Vulcan uses **customized isolated copper impulse bands**. How the impulses are transferred into the water is crucial. The design of the bands increases the surface area that transports the impulses. This improves transmission by up to 40%.

The **original acrylic cast** is unique to the Vulcan product line. It offers maximum protection for the parts secure and sealed in place.

Vulcan comes with external **UL and TÜV-approved** electronic switching adaptors. They operate with a very low power consumption of 100-240V and equalize possible power instabilty.

Vulcan is not magnetic-based. Therefore, it operates **100% independent of the velocity** (water flow rate) in the pipe and constantly provides reliable impulses that guarantee the right output at all times.

Material-matching programs for different materials: Vulcan treats any pipe material. No need to buy a different product for metal, PVC, plastic etc. any more.

The **automatic memory** program keeps Vulcan running correctly. In case of the unlikely event of a power failure Vulcan automatically resets back to the last program once power is regained.

Vulcan holds numerous **certifications** by renowned international institutions: the German TÜV, the German CE, the UL-approval (USA/Canada) for switching adaptors etc.

Vulcan requires very little electrical power as it is **very economical**. The units operate with 2.2 to max. 4.0 Watt. The running costs are appox. $ US 5-7 (~4-6 EUR) per year.

Made-in-Germany: Vulcan is a **German quality** product that has been manufactured by the family-run Christiani Wassertechnik GmbH, Berlin since 1991.

25-year warranty is granted for all Vulcan units. Due to the special acrylic protection these units keep on running with a life expectancy of over 30 years.

2.5 German quality certifications

The German TÜV/GS is an independent institution that assesses products for safety and reliability. When a product passes the strict regulations it is awarded the TÜV/GS mark which indicates that the product was tested and certified for safety according to the "German Equipment Safety Law". The GS mark is a certification that includes periodic factory inspections covering the quality system for the production. This law requires inspectors to frequently assess whether the manufacturer is able to maintain all the specifications of the tested product in his production. During this factory inspection, the implementation of the quality system, the production environment, and production related testing and measurement equipment is evaluated.

CE Approval

The CE mark certifies that a product has met German and European Union consumer safety, health or environmental requirements. "CWT hereby declares that this product is operating in accordance with the following EUguidelines: 73/23/EG; 89/336/EG which is certified by the CE-mark. The equipment corresponds to the requirements of the German Industrial Safety Act and the European low-voltage guidelines."

Certificate of Origin Germany

The Certificate of Origin (CO) names and officially approves the country where the goods are actually produced. For Germany the certificate is issued by the German Chamber of Commerce (IHK). It approves the German origin (Made in Germany) after thorough investigation of the origin of each individual part of the product and after assessment of the production site in Germany.

UL Approval (USA/Canada)

The UL - Underwriters Laboratories Inc. is an international quality and safety approval institution with headquarters in Illinois, USA. The UL-mark on a product states that UL has tested and evaluated the product and determined that the electronics fulfill the strict safety guidelines. All Vulcan switching power adaptors are meeting these requirements and comply with international standards.

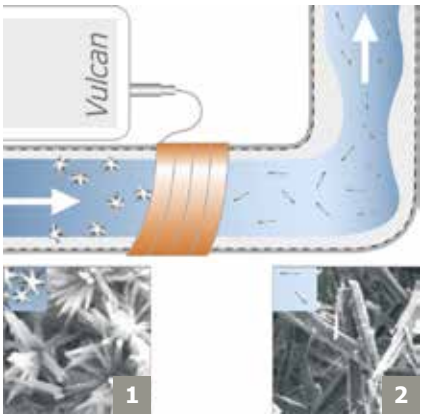
3. The Vulcan technology

3.1 Electronic scale protection - the 3 Vulcan effects

3.1.1 1st Vulcan effect

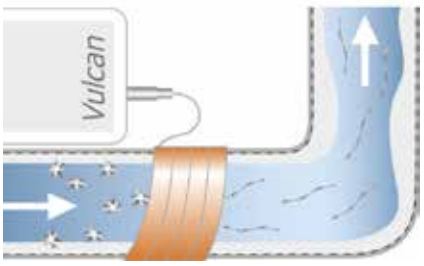
Vulcan reduces scaling in pipes and appliances

Without the Vulcan water treatment, scale particles in the water form sticky crystals that then build solid deposits. The Vulcan-Impulse-Technology modifies the crystallization of calcium and magnesium using the natural process of electrophoresis. The crystals become smoother and rod-shaped and can no longer attach to each other. Scale is now washed away in the water as a fine powder. The formation of new deposits is prevented. The more of the rod-shaped crystals that are created, the stronger the positive effect of scale-prevention.



Mono crystals as a result of the Vulcan water treatment

When mono-crystals are created by the impulse variation, it is important that they grow as long as possible before they start their way through the piping system. The larger the crystals, the longer it takes until the crystals fall apart again and eventually "die". In warm water, these crystals grow faster and therefore are stronger and live longer. This explains why the Vulcan-effect lasts the longest in warm water (up to seven days) and shorter in cold water (approx. two days).



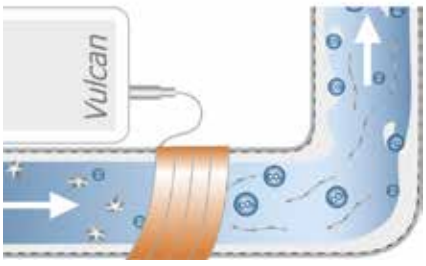
3.1.2 2nd Vulcan effect

Vulcan gently sanitizes the piping system

Two simultaneous processes take place in untreated, hard water:

a. In the first process, scale deposits result from calcium crystals adhering to each other which then adhere to surfaces. This first process produces carbonic acid (H_2CO_3) as a side product.

b. During a second process, the carbonic acid simultaneously breaks down the existing scale deposits. This is referred to as the "natural resolving process". Because the build-up process takes place much faster than the natural resolving process the pipes' diameter constantly decreases.



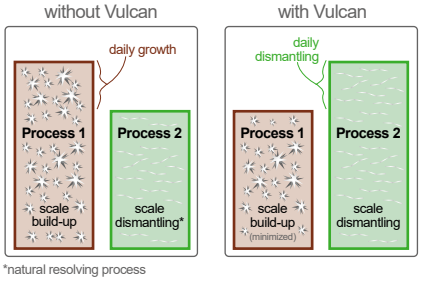
$Ca(HCO_3)_2$ + Vulcan → $CaCO_3$ + CO_2 + H_2O

Calcium hydrogen carbonate- | Vulcan impulse | Mono-crystal | Carbon dioxide | Water

CO_2 + H_2O → H_2CO_3

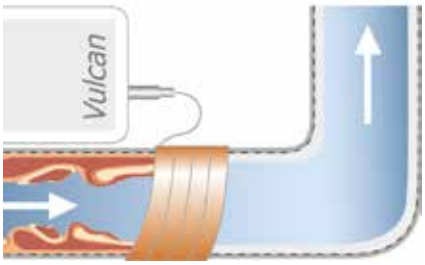
Carbon dioxide | Water | Carbonic acid

The Vulcan water treatment changes the balance between the scaling process and natural resolving process. The mono-crystals can no longer form deposits, therefore the scale build-up of the first process is reduced. The natural scale-resolving-process now needs only to deal with existing deposits and can effectively combat them. Thus scale is removed faster than it forms. The natural surplus of carbonic acid dissolves the scale from the scale. Gradually and carefully, the deposits in the pipes will be removed.



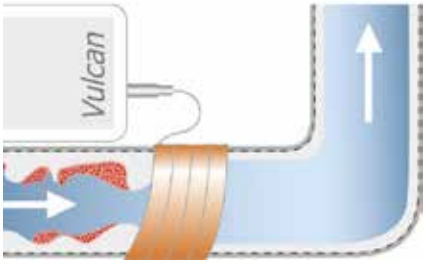
The reduction of scale = the reduction of rust

As soon as scale deposits have built up, iron particles become embedded into it. Thus, the scale and the rust blend into one material that are seen as red-colored deposits in the pipe. When the Vulcan treatment dismantles the scale, it simultaneously reduces also rust with it. Clearing out the deposits is a gentle process where scale is brought back into solution and washed out in the water as: calcium, magnesium and iron. It is absolutely safe to drink as these are all healthy minerals.



The reduction of scale = the reduction of bacteria

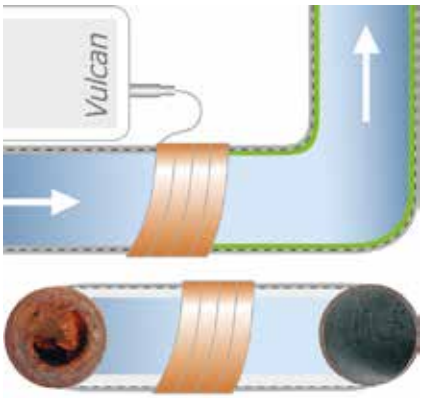
We know that scale acts as a breeding ground for bacteria and other unwanted substances. As soon as Vulcan is installed and the scale is reduced, the bacteria breeding ground is also reduced. This way, bacterial contamination is greatly reduced or even fully removed.



3.1.3 3rd Vulcan effect

Vulcan protects against rust damage and corrosion

Copper and/or iron oxidation occurs in all metal pipes through contact with calciferous (hard) water. These oxides seriously affect the pipe surfaces and may lead to corrosion. The Vulcan-impulse-technology generates an electrophoresis effect which produces a protective metal-carbonate layer. According to the material of the pipe, this layer consists of copper carbonate, iron-carbonate or zinc-carbonate and settles on all shiny metal surfaces. It protects the pipe from aggressive substances which could lead to corrosion.



Does the Vulcan treatment have a softening effect on the water?

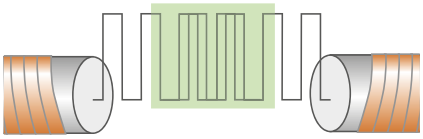
The treatment does **NOT** change the overall water hardness. Unlike in chemical water treatment systems (e.g. a water softener that uses salt) the water treated by Vulcan does not lose minerals, such as calcium and magnesium. The natural composition of the elements in the water remains the same. However, due to a change of the water surface tension your skin will feel remarkably softer. You are sure to feel this effect when taking a shower or even simply washing your hands. Most importantly, scale loses its adhesive characteristic. The treatment does not, however, change the measured water hardness. So on a chemical level you have the same hardness before and after the treatment.

3.2 Physical water treatment - how it works

Vulcan is a phsyical water treatment system that does NOT use chemicals or salt. It does not change the chemical mixture of the water. Instead, it changes the physical characteristics of the scale crystals in a way that the scale particles loose their adhesive power. Vulcan does not need to have direct contact with the water and sits outside of the pipe.

It treats the water with electric impulses which are generated in the electronic unit and are controlled by a computerized microchip. The signal-frequencies are transmitted via the Vulcan impulse-bands that are wrapped around the pipe. The bands interact as pairs and form a frequency-field that treats the water as it flows by.

3.2.1 The Vulcan impulse field



The Vulcan impulse bands act as pairs with a right side and a left side. Each side triggers an alternating specific signal pattern which is send ten times per second onto the pipe. The electronic impulse field is generated from frequencies between 3,000 and 32,000 Hz. Due do the alternation of the signal sides, which means that only one impulse band side is active at a time, the frequencies in the impulse field are overlapping. This effect multiplies the frequency patterns which again creates specific (harmonic) overtones.

The Vulcan treatment is executed precisely, because the one-step impulse generation exactly generates the desired outcome. It is operating completely independent from the velocity (water flow rate) and as the electricity is provided from the power supply, allowing a continuous stream of impulse field generation.

3.2.2 Two natural phenomena


1. Untreated crystals

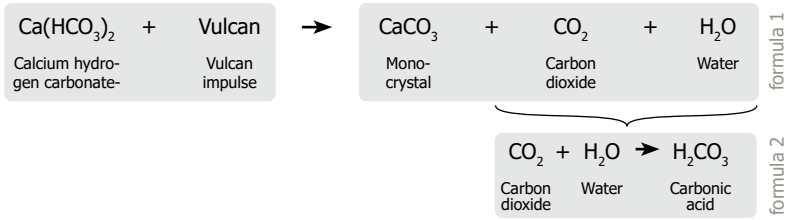
Scale deposits build up when the liquid calcium in the water forms crystals that stick together (pic. 1). Physical water treatment creates a different kind of calcium crystal structure that loses its power to attach to surfaces and build deposits. These harmless new **mono-crystals** (pic. 2) **are the key players in the Vulcan water treatment**. Vulcan generates various processes to produce these mono-crystals and sanitize the piping system:

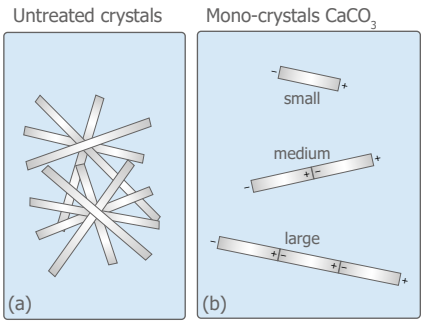

2. Mono-crystals ($CaCO_3$)

a) Separation of $Ca(HCO_3)_2$ by controlled electrophoresis

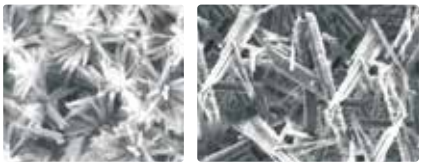
The alternating frequencies in the impulse field create an electronic gradient that manifests the electric potential in the water. This potential influences the liquid calcium [$Ca(HCO_3)_2$] and separates its individual parts.

Separation of $Ca(HCO_3)$





pic. 3



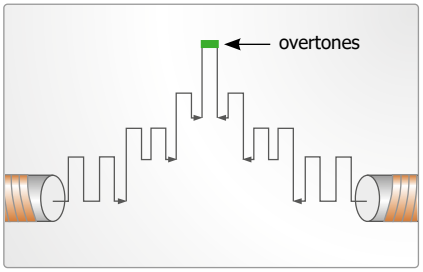
As opposed to the typically chaotic clustered calcium-crystal (a), the treated crystal forms as well ordered mono-crystal (b) (the so called aragonit shape) that is stream-lined between the one end (+) and the other end (-).

This is the birth of the calcium mono-crystal, which can only grow into two opposite directions and can therefore not cluster together with other mono-crystals to form scale deposits. The mono-calcium-crystal forms in a rod shape (pic. 3) between one end (+) and the other end (-). In this form they can no longer stick together and forms deposits. During its journey in the pipe system it will grow in size. The longer the mono-crystal, the better the effect of the treatment.

The separation of the water components due to the electrophoresis also changes the balance of calcium and carbonic acid, which creates a slight surplus of carbonic acid (formula 2). This small rise in free carbonic acid helps the cleaning of already existing scale deposits.

b) Separation of $Ca(HCO_3)_2$ by overtone treatment

The Vulcan impulse treatment controls the creation of overtones as a result of overlapping frequencies. The overtones are set to meet the characteristics of a water cluster which is basically the smallest entity of water. The extreme short wave lengths of the overtone parallels that of the water cluster to the extent that the two begin resonating with each other. Just as a high-pitch tone can burst a wine glass if it resonates with the glass, matching the wave-length of the overtone with the water cluster achieves the same result: the water cluster bursts.
When a water cluster bursts the same process of separation of the $Ca(HCO_3)_2$ components happens (compare formula 1). The stronger this effect, the more the mono-crystals grow, which results in the desired effect of scale and rust dismantling.



➔ Mono-crystals and carbonic acid

Both the controlled electrophoresis (a.) and the overtone-treatment (b.) result in separating the liquid calcium [$Ca(CO_3)_2$] into its individual substances. This way, Vulcan generates the rare mono-crystals and a higher level of carbonic acid.

- The mono-crystals prevent scale building up on surfaces
- Carbonic acid is the key ingredient to dismantling already existing scale deposits.

4. External factors and their influence on the treatment

As the eco-friendly technology of physical water treatment operates within the laws of nature, we have to consider some of these laws. It is important for the Vulcan water treatment to create as many of the mono-crystals as possible. However, the mono-crystal structure does not last forever. From the moment of its creation, it has only a limited life expectancy. Time, distance and temperature determine how long the crystal will last and this again determines how long the effect will last.

4.1 The time factor

The effect of the Vulcan lasts a minimum time span of 48h in cold water and up to 7 days in warm water.

- In warm water (= more than 30°C/ 86°F) the effect lasts up to 7 days
- In cold water (= below 30°C/ 86°F) the effect lasts up to 2 days

Why does the temperature have an effect on how long the Vulcan effect is active?
When mono-crystals are created by the impulse variation, it is important that they grow as long as possible before they start their way through the piping system. The larger the crystals, the longer it takes until they fall apart again.
It is well known in nature that **heat** speeds up the growth process. It is the same with the mono-crystals. In **warm water,** the crystals grow faster and longer than in cold water. This results in a much higher number of crystals, together with a larger size of the individual crystals. The larger crystals then survive up to 7 days.

Cold water does not promote the crystal's growth as much and they are usually smaller. However, in cold water the scale deposits are usually less prominent. In the cold-water setting the effect lasts up to 2 days.

4.2 The distance factor

We know that the mono-crystals do not last forever. The travelled distance has an effect on the crystal's life expectancy. When they begin their journey through the piping system they fall apart during that time.

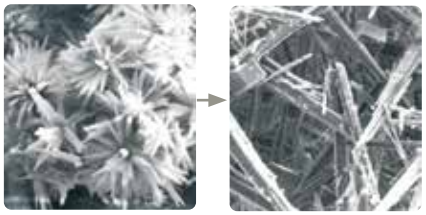
Several factors such as complexity of the piping, the number of intersections and divisions, variations of pipe diameters throughout the piping system or the existence of pumps all have some influence on the crystal's life. For example, passing through turbulence in a bend promotes the growth of a mono-crystal and will help to extend its life.

Experience shows that the Vulcan effect will start to diminish after a distance of approximately 2.000 m (~ 1.2 miles) in the pipe. However, long distances of 2 km (~ 1.2 miles) or more are rarely reached within buildings. Furthermore, with the favorable pipe system setup, the effect often last longer.

4.3 The combination factors: Temperature - Pressure - Type of heating

a. Temperature and its effect on the treatment

The water temperature itself is one factor that has some influence on the duration of the treatment (how long the effect will last). We learned that warm water (30°C/86°F or more) has a positive effect on the growth of the mono-crystals (see section 4.1) and therefore supports the Vulcan treatment.



Extreme heat such as a heating element surface temperature of above 95°C (203°F) may also influence the treatment's outcome. What we observe with the scale situation on a heating element is that the heating element stays cleaner at 98°C (208°F) surface temperatures than at 110°C (230°F) or than at 130°C (266°F) and so on. This is a natural finding as heat promotes the scale formation. In general, the calcium crystals naturally want to gain back their common shape.

b. Combinations: a mixture of influences

The combination of several external factors together influence the treatment and it is not always possible to know the exact outcome in advance:

Temperature is one influence to consider. A second factor to keep an eye on is high pressure (e.g. in boilers/ steamers). What also comes into the equations is the way the heating is generated (gas, electrical, heat exchanging, burner etc).

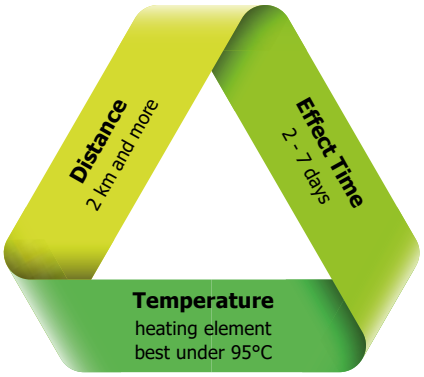
- When there is extreme heat, a specific pressure and heat generation involved, this mixture may have a somewhat different treatment effect.

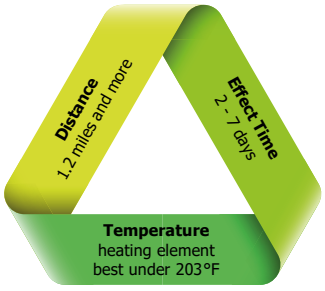
Please consider that in such a situation it may be best to test and see.

Conclusion

When several factors including extremely high heating element temperatures and high pressure together with one of the several possibilities occur together, the treatment effect is not always easy to predict. Always put in a trial installation! When the customer understands these variables he knows what to expect and what not.

Vulcan working range - metric system (°C, km)





USA System (°F, miles)

4.4 The water quality factor

The individual composition of water and very high concentrations of certain substances can influence the Vulcan treatment.

4.4.1 High concentration of iron (Fe) and other metals

Iron is naturally found in water. Very high iron content is typically found in water wells which then often causes problems with rust. If the iron content reaches more than **1 mg/l (1 ppm)** it may have a negative effect on the treatment. Other metals, for example: copper(Cu), aluminium(Al), lead(Pb), nickel(Ni), Zinc(Zn) can affect the Vulcan treatment.

Treating the iron problem: We advise to treat any problems with very high iron content in the water with a de-ironing filter. This will ensure that the Vulcan treatment can reach its full potential.

4.4.2 High concentration of manganese (Mn)

Manganese is naturally found in water. Very high manganese content is typically found in water wells which then often causes problems with rust. If the manganese content reaches more than **0.1 mg/l (0.1 ppm)** it may have a negative effect on the treatment.

Treating the manganese problem: We advise to treat any problems with very high manganese content in the water with a de-manganization filter. This will ensure that the Vulcan treatment can reach its full potential.

4.4.3 High concentration of salts - (Cl, PO, NO_3)

Sea Water: Vulcan can treat salty water.

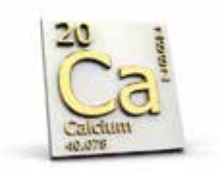
Cooling towers: However, high concentration of salt (all sorts of salts: Cl, PO, NO_3) is a typical cooling tower issue. As cooling towers are half-open circuits with water constantly evaporating, the substances in the water constantly concentrate. Within a short time, the water hardness and the salt level may dramatically increase. In cooling towers the conductivity easily reaches 5000 µ-Siemens and more.

Cl= Clorine, PO= Phosphate, NO_3= Nitrate

Sulfate (SO_4): Visible content of sulfate in the water can badly influence the treatment. Calcium-sulfate compounds cannot be treated by Vulcan.

4.4.4 Very high concentration of calcium (Ca)

The problems with scale deposits start when the water contains large amounts of calcium. Vulcan can be successfully applied to water having a very high to extreme high degrees of hardness. Vulcan has successfully treated cases with water hardness of 900 ppm (~ 53 gpg) or more.



Typical extreme-high hardness degrees occur in cooling towers. Here, even when the conductivity is extremely high (e.g. 5000 µ-Siemens*) Vulcan will show great results. Basically, the harder the water, the more obvious the results. *Conductivity in cooling towers is measured in micro-Siemens which is an indicator but does not give exact hardness degrees.

4.4.5 Swimming pool water

There are no typical substances in pool water that are known to hinder the Vulcan water treatment.

However, the water in a swimming pool demands constant monitoring and several chemicals need to be added. Vulcan significantly reduces the scaling in and around the swimming pool, in the whole piping system and in the filters and pumps. Therefore, once Vulcan is installed, chemicals can usually be reduced:

Disinfection

Chlorine: The disinfection of pool water is mostly secured by adding chlorine (Cl). Products range from granules to liquids, tabs or sticks. The addition of chlorine can often be reduced by up to 10-25 percent. Please cut back step by step (e.g. start with a reduction of 10% and then raise it).
Active oxygen is used as chlorine-free disinfection alternative. The amount can also often be reduced. Please apply the step by step reduction.

pH adjuster products either reduce or raise the pH-level and control the total alkalinity in pool water. This is added in order to rebalance the pH which has been disturbed by the addition of chlorine/oxygen. In line with this, the use of adjustor products can be reduced in the same ratio to which the disinfectant product has been reduced. E.g. if you reduce chlorine by 15% you can usually also reduce the pH-adjustor by 15%.

Pool cleaning

Pool cleaning agents are used to fight scaling on the waterline, in grids, on tiles or the pool´s surrounding surfaces. The Vulcan water treatment minimizes scaling which results in a much easier cleaning process together with a reduction of cleaning agents/chemicals by up to 50%.

Vulcan vs. Water Softeners

Vulcan is an electronic (capacitive) impulse based water treatment system that solves your problems with scale and rust. Vulcan is an eco-friendly solution without salt or chemicals.

Water Softeners

Salt-based water softeners (so-called ion-exchangers) are using salt and chemicals to treat the water. They are installed into the piping system which should only be done by a professional plumber. They exchange the minerals (calcium and magnesium ions) with twice as much sodium (salt) ions. As calcium and magnesium gets deleted, the water is softer afterwards. This way softeners considerably increase the sodium content of the water which can cause considerable health threats and certainly is a threat for the environment.

Burning money: Regular water softeners are not only expensive to purchase but also you will need a specialist to do the installation. Once in place you will have to constantly refill it with salt.

Never-ending maintenance: Maintenance includes the constant refilling with salt, the washing of the granule and the checking of valves and measuring station.

Wasting resources: softeners require large amounts of salt and huge amounts of additional water of up to 30-80 gallons per wash (~110-300 l) to operate.

Water softeners need a lot of manpower as they constantly need to be fine-tuned and controlled. Especially season-related changes of the water quality (summer/ winter) are often simply forgotten to consider for the programming. The human error factor then prevents the unit from performing correctly.

Health issues: Babies, children, elderly people, people with salt-restricted diets or anyone who is health-conscious should consult a physician regarding the sodium intake increase when using a water softener. The water loses its natural taste and may even taste salty. Also you may have to supplement the important minerals calcium and magnesium in your daily diet.

It is important to note that many of the water softeners have a by-pass feature that will allow you to bypass the cold water in the kitchen. This will enable you to use unsoftened water for drinking and cooking. In addition, bypassing the cold water tap in the kitchen will prevent minerals from being removed from the water. However, then only part of your pipes are protected.

Does the Vulcan treatment have a softening effect on the water?

The treatment does **NOT** change the overall water hardness. Unlike in chemical water treatment systems (e.g. a water softener that uses salt) the water treated by Vulcan does not lose minerals, such as calcium and magnesium. The natural composition of the elements in the water remains the same. However, due to a change of the water surface tension your skin will feel remarkably softer. You are sure to feel this effect when taking a shower or even simply washing your hands. Most importantly, scale loses its adhesive characteristic. The treatment does not, however, change the measured water hardness. So on a chemical level you have the same hardness before and after the treatment.

Water softeners make your water softer, but ...

... is that always a good idea?
... is it necessary to have extremely soft water?

The answers are simple: No. and No.
Hard water is a real nightmare as long as the scale builds deposits. The minerals calcium and magnesium in itself are good substances. Once you minimize the adhesivenes of the scale, it no longer bothers you as deposits but you can benefit from the healthy minerals. Very soft water is also not recommended for pipes as is might damage them (the soft water is too acidic).

Legislation and the Environment

The environment

Water resources are a valuable good. We require large amounts of fresh water but only 2.5% of the Earth's water is fresh, and over two thirds of that is frozen in glaciers and ice caps. The use of water softeners contributes to a decrease in the available fresh water on our planet. Therefore, it is important to use eco-friendly technologies and stop harming the environment.

The US government has started to put a ban on water softeners. For the above mentioned reasons and mainly due to the great threat to the environment, the US goverment has started to ban softeners.

Comparison of running costs:

(Example of a German 1-family house)

	Salt-Based Water Softener	Vulcan 5000
Installation costs:	**400 EUR**	No (Vulcan is easy installed by yourself)
Running costs:	Softener salt: **48 EUR / year** 140-150 kg salt (6 bags: 8 EUR / bag)	-
	Waste water: **15 EUR / year** 8,5 m³ (1,80 EUR/m³)	-
	Electricity costs: 26 KWh / year (0,30 EUR/ KWh) **15 EUR / year**	0,2 - 17 W / year (0,30 EUR/ KWh) **0,5 - 5 EUR / year**
	Maintenance costs: 150 - 250 EUR / year	No costs (maintenenace-free)
Running costs per year:	**230 - 330 EUR**	**0,5 - 5 EUR**
Running costs over 10 years:	**2.280 - 3.280 EUR**	**5 - 50 EUR**

Benefits of Vulcan

No Need for Salt: Vulcan reduce or even eliminate the need for purchasing, storing, and adding salt to the system. This saves both time and money, making maintenance hassle-free.

Environmentally Friendly: Using Vulcan without salt means it does not discharge brine into the wastewater. Vulcan is therefore considered more eco-friendly and do not contribute to increased salt levels in the environment.

Retain Essential Minerals: Unlike traditional softeners that remove beneficial minerals along with the hardness-causing ones, salt-free water softeners retain essential minerals like calcium and magnesium, ensuring healthier drinking water.

No Slippery Residue: Softened water from traditional systems can leave a slippery residue on skin and surfaces. With Vulcan, this issue is eliminated, resulting in clean, residue-free water.

Easy Installation: Vulcan is compact and straightforward to install, requiring minimal space and no electricity.

Why Would I Need A Water Softener In The First Place?

When making the decision if a water softener is right for you – salt-free or traditional – it's important to understand why we need water softeners in the first place. Hard water can cause a variety of problems both in your home and health.

Hard water is known to leave a residue of minerals – often referred to as scaling or buildup – on your clothes, appliances, dishes, and even your skin and hair. You may notice water stains, dingey clothing, or dry and flaky skin. Many people often try to combat these issues by increasing the amount of soap and solvents they use in their everyday water routines. This results in increased waste and unnecessary over-exposure to the synthetics often present in household products.

Hard water can also cause damage over time to pipes and other inner workings of your home plumbing system and appliances. Hardness often has a negative effect on the overall taste of your water as well.

Vulcan in combination with a salt-based water softener:

May there is a need of a softener, so you can install Vulcan before your softener to have also benefits of less salt use. With that you can change the setting of the softener to a middle hard hardness. You softener needs less salt then. You will save time, money and effort.

Things to Consider When Choosing a Water Softener

Water Hardness Level: Determine the hardness level of your water supply to choose the appropriate water softener system.

System Capacity: Consider the daily water usage to select a system with adequate capacity.

Space and Installation: Assess the available space and installation requirements to ensure compatibility at your place.

Maintenance: Understand the maintenance needs of the system, including filter replacements or media regeneration.

Warranty and Support: Look for a reputable brand that offers a warranty and reliable customer support.

Why Vulcan Makes the Difference

We are one of the oldest pioneers and manufacturer on the market of physical water treatment systems with an experience for more than 45 years. With our advanced technology and commitment to excellence, you can trust Vulcan to provide you with the best anti-scale solutions, with 25 years warranty.

Vulcan is NOT a magnetic system

Vulcan works exclusively with electric impulses. The energy is simply taken from a power plug. We would like to distance ourselves from those devices that use the force of magnetism to treat water.

Why you should avoid magnetism when treating water

All magnetic-based physical water treatment devices produce electric impulses by induction. This means that the magnet(ism) together with the water that flows through the pipe are supposed to generate complex electric impulses, this sometimes gets achieved. However, the following problems cannot be ignored:

Problem with magnetism: not all pipe materials can be treated equally effectively

As magnets do not penetrate through metal very well, many distributors ask to install their units on plastic pipes. If the installation place is a metal pipe their recommendation is to cut out a piece of pipe and to replace it with a piece of plastic pipe.

- *We believe that this is an unnecessary complication to work with magnetism as it limits the treatment to take place on plastic pipes only.*

Problem with magnetism: magnetism itself

Magnetism is a powerful force indeed. It is attributed with many positive effects on organisms. However, everyone also knows that magnets attract metallic objects, no matter how small. This again leads to a major problem when magnets are used on a piping system because the area where electromagnetic cables or permanent-magnets are installed is of course magnetic. Here, all magnetic particles in the water are firmly connected to the inside of the pipe. This happens on metal and plastic pipes alike. After only a short while, the inside of the pipe is covered with a metal-dirt-particle-film that is a perfect breeding ground (biofilm) for bacteria or other unwanted substances. Many producers of magnetic devices therefore suggest to turn off the unit and "flush" the pipes every six months as a solution to the problem.

- *We believe that building up a potential dangerous biofilm with magnetism in order to treat the piping system is not a smart way to solve the scale-problem. Also, we know the need to clean the pipe with flushing or brushing can be avoided. The answer is not to use magnetism.*

Problem with magnetism: velocity

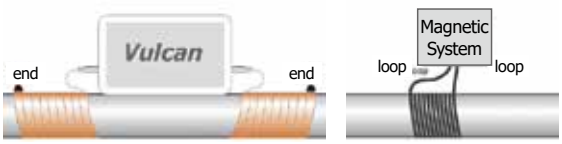
The generation of a complex electric impulse field only works if the water inside the pipe flows by the magnetic field in the exact right speed (velocity).
If the speed is right, then the impulse is generated. However, if the speed of the water is not right (too fast or too slow), the impulses are not generated or worse. the impulses are generated incorrectly.

- *We believe that it is best to always provide the perfect and stable electric impulse field simply by using constant electricity. Therefore, Vulcan is solely electric. The annual power consumption is minimal and amounts to approx. 4-6€ (~ 5-7 USD).*

Differentiation

At first sight, an electromagnetic unit may look similar in principle. However, Vulcan operates differently: it works with an electronic control unit that produces the impulse signals. These signals are transferred onto the impulse bands which are connected to the acrylic electronic control unit.

In comparison, most electromagnetic units also have some sort of plastic box from which there are some cables emerging. The electronics in the box produce electricity which runs in the electric cables and come back *in a loop*. You will easily recognize that the cables run back into the box. This way, the cable acts as an electromagnet. Again, the Vulcan-impulse-bands do not run back, but end on the pipe.



Vulcan offers you a reliable eco-friendly water treatment system against scale and rust – without the drawbacks of magnetism.

III. Application areas

6. Residential applications

6.1 The benefits in your private home - Protection for the piping system

a) Reduction of scale deposits in your piping system Vulcan takes away the adhesive power of scale particles so that scale is simply washed away with your water as a fine powder.

b) New scale-formation is prevented
Vulcan carefully dissolves already existing deposits in the piping system. The scale build-up process is reversed and the pipes gradually become clean again. This removal process will not block up your pipes or drain because the treated crystals are microscopic in size and wash away in the water.

c) Corrosion protection
Metal pipes often suffer from pitting corrosion. The Vulcan electric impulses generate a metal-carbonate protective layer that prevents pitting corrosion.

d) Increased water pressure
Vulcan sanitizes the pipes from scale deposits and can even restore a pipe‘s full diameter. Water can flow freely again and you regain normal water pressure.

e) Vulcan minimizes rust
In most cases whenever there are scale deposits you will find rust shortly thereafter. The rust typically imbeds itself in the scale deposits. Because rust oxides are red, the scale deposits in metal pipes then often appear red in color, too. When the Vulcan treatment reduces scale, it also takes away rust with it.

f) Vulcan minimizes bacterial growth in pipes
Thick scale deposits with their uneven surfaces are the perfect breeding ground for bacteria. Once the scale is gone, there are no more nesting areas where bacteria can grow.

6.2 Kitchens, kitchen appliances, bathroom: dishwashers, washing machines, bathrooms fittings, etc.

Kitchens and kitchen appliances

Kitchen surfaces, sinks, faucets and fixtures stay cleaner: You will quickly notice that scale is visible but acts like a fine ‘dust’ which can be removed easily with a damp cloth. Surfaces and tiles will be smoother and shinier again.

Dishwashers
Operate with less detergent and less additives. The use of detergent can be reduced by up to 25%. Typical spotting on dishware is reduced or no longer apparent.

Washing machines
Cleaning is more effective as Vulcan-treated water lathers noticeably more. The same amount of detergent will give you cleaner clothes. You can often reduce the amount of washing detergents in your daily use or stay away from very aggressive agents. Furthermore, Vulcan extends the life of the machine‘s heating element.

Bathrooms and well-being
Vulcan does not alter the chemical composition of water, and calcium and magnesium remain in the water. You will quickly notice that scale is visible but acts like a fine "dust" which can be removed easily with a damp cloth. Stains on basins, sinks, toilets or fixtures will be easily wiped away. Shower heads stay clean longer. Soap and detergent use can be cut back by up to 25%. The water will feel as if it is "softer" as the treatment causes a decrease in water surface tension. Generally, soap will lather up more. Skin will feel smoother and hair will be much more manageable because the scale particles no longer make it so frizzy.

6.3 Gardening and irrigation

Garden irrigation with sprinklers becomes more reliable as the nozzles stay free of scale. Vulcan-treated water can be absorbed and processed better by plants. As there are less scale spots on the leaves, your plants absorb water and rain water easier and look healthier too.

6.4 A healthier lifestyle

Mineral rich drinking water
Vulcan does not interfere with the natural composition of the drinking water. Important minerals remain in the water for a healthy diet. Young children and elderly people especially benefit from the healthy calcium and magnesium content that naturally is found in tap water.

Water tastes and smells better and gives food and beverages its natural flavor
Vulcan keeps the natural taste of water as it does not change its chemical composition. This gives you the best tasting water possible. Vulcan cleans the piping system once again and therefore cleans it from rust and bacteria particles. The rust and bacteria are gone and can no longer add any unwanted flavor to the water.

6.5 Swimming pools and jacuzzis

Protect your private swimming pool and jacuzzi
Private swimming pools demand constant maintenance and careful monitoring. The circulation pumps process large amounts of water and are sensitive to scaling.

Vulcan makes pool cleaning much easier: Scale on the water line is looser and easier to wipe off. Pool covers and tiles on the floor or walls will show less hard scale stains. Vulcan reduces deposits in the pipes and valves. The sensitive circulation pumps last longer, sand filter need less changing and you can cut down on chlorine tablets.

Jacuzzis: The combination of water, circulating air and pressure in a hot tub tremendously enhances scale build-up. Vulcan makes the cleaning of the tub easier and reduces deposits in the pipes and valves. Covers and tiles on the floor or walls will show less hard scale stains.

6.6 Heating and solar water heating

Heating
When water is heated with oil, gas, electric or solar heating technologies, scale likes to settle on the heating elements and heat exchangers. The loss of energy due to the less efficient heat transfer is tremendous. Vulcan helps to reduce the scaling and extends cleaning intervals. Water tanks in the primary and secondary circuit will need less cleaning and the frequency of cleaning periods will be extended.

When water is heated in a water heater or with a tankless water heater, hard water always leads to deposits on the heating elements. This layer inevitably causes a great reduction in the capability of the heat to transfer. A scale deposit of only 2mm (~0.078 inches) can lead to an energy loss of more than 15%. The increase in heating time leads to a tremendous rise in your power consumption.

Water heaters
Vulcan controls scale build-up in tankless water heaters permanently and reduces constant maintenance as heat exchangers get fewer deposits. Your water heater will work much more efficiently once again, and you can extend the time to your next service maintenance.

Heating systems regain full performance.
When water is heated in a hot water tank the hard water always leads to thick deposits on the heating elements. This layer inevitably causes a great reduction in the capability of the heat to transfer. With Vulcan, deposits are minimized and your heating performs at a much higher capacity again. Service maintenance intervals are extended. Typically, water heating bills will be substantially reduced.

Solar water heating
Using a solar powered water heater for your house is a smart green alternative to traditional heating methods. Vulcan prevents scale-build up in the system. It keeps the heat exchangers and distributor pipes clean. Furthermore, Vulcan reduces scale buildup in collectors, it protects hot water tanks and vacuum tubes and keeps the system from over-heating. There is no more need to circulate acids.

Protection for your solar water heating
The energy savings you took into consideration when purchasing a solar water heater may be drastically reduced due to scale deposits. Here, a scale layer of only 1 mm (~0.04 inches) may result in a decrease of efficiency of up to 40%. With Vulcan you save on energy, cleaning and repairs. This loss has to be compensated with regular fossil fuels or electric power and much of the savings you were planning to achieve will be obsolete.

6.7 Vulcan and reverse osmosis filters (RO)

When Vulcan is installed before a RO-system it helps in two ways:
1. As calcium-crystals are smoother after the Vulcan treatment, this reduces deposits on the sensitive RO-filter membranes. The RO-system runs longer and more effectively.
2. The permeate (leftover water) is difficult to handle as it has a particularly high degree of water hardness after filtration. Here, Vulcan helps that the permeate can be better handled and prevents it from causing damage further down the drain.


RO system

6.8 Vulcan and water softeners

a) Vulcan replaces water softeners

Vulcan is the eco-friendly alternative to regular salt-based water softeners. It is not recommended for young children or older people to drink water that has been treated with a salt-based softener. In addition, the use of softeners is polluting the environment. When installing Vulcan, an old system can easily be circumvented by simply bypassing it.

b) Vulcan as an addition to water softeners

Vulcan is the eco-friendly alternative to regular salt-based water softeners. However, if you want to keep the softener running due to special reasons, you can save large sums of money when using Vulcan as an aid. The use of Vulcan will decrease the amount of salt that you need to add. This cuts down costs for salt, maintenance intervals will be extended, fewer malfunctions with backwash valves etc.

If you would like to use Vulcan in addition to a water softener, then install Vulcan BEFORE the water softener.

Throw out those expensive water softeners

Running a water softener is a costly measure. Large amounts of salt are needed to operate the system. On average, a homeowner faces expenses of 70-140 € (~$ US 100-200) per year in salt alone. Needless to say, nobody likes carrying around bags of salt.
Furthermore, 30-80 gallons (115-300 l) of water are wasted each time the softener granule has to be washed. Malfunctions and repairs are likely with a built-in system. These can easily add up to hundreds of dollars in repair costs. Possible annual savings: 250 € (~$ US 330).

Comparison

The purchase and installation of a water softener alone would cost at least 700 € (~$ US 1000) to buy and another 35-85 € (~$ US 50-120) for the installation by a plumber. Add annual operating costs and maintenance on top.

6.9 Vulcan and well / bore-wells

Wells are taking the water from deep down in the ground which often leads to high contents of calcium, magnesium and other minerals in the water. Therefore, very often the well water hardness is very hard to extremely hard. The Vulcan treatment offers a great solution for this. Typically, Vulcan is installed just before the suction pump - if possible with a distance of approx. 5 ft (1.5m) to the pump's motor. For submersible pumps it is recommended to install Vulcan at the exit of the hydrophore tank. Water quality: Well water quality also might contain other substances such as iron and manganese (see more in section 4.4).

6.10 Saving money with Vulcan

Money savings in your private home

The use of the eco-friendly Vulcan water treatment saves you time and money from day one of its installation. It is a solid purchase for your home with a quick return on your investment.

Vulcan saves money around your home

- It protects the whole piping system in your home
- It reduces aready existing deposits
- It helps to protect appliances such as washing machines, dishwashers, water heaters, heating systems etc.
- You save on maintenance costs and repairs
- Filters, shower heads, fixtures and tiles stay clean
- Vulcan saves on detergents, additives and fabric softeners

Efficiency calculation for your private home

Example of savings potential in an average home with 4 people*

	Annual savings potential	~ in €	~ in $ US
1	Savings in energy (e.g. 1mm of limescale deposit= 15% more energy consumption) e.g.: 1 500 Euro of energy costs p.a.	325.00	430.00
2	De-scaling of water heater every two years by a specialist at 150 Euro/ average	75.00	95.00
3	Savings of up to 50% on laundry detergent (e.g. 9 Euro/month) at a saving rate of 30%	30.00	40.00
4	Savings on softeners for your washing machine	10.00	13.00
5	Minimal use of salt for your dishwasher	10.00	13.00
6	Savings on aggressive cleaning agents	15.00	20.00
7	Savings on shampoo, soap or expensive skin care products	20.00	26.00
8	Less time spent cleaning your house, 10 min/week (e.g. cleaning costs at 8 Euro/h)	70.00	93.00
9	Longer life span of all appliances and pipes (washing machine, coffee machine, iron, water heater, etc.)	250.00	335.00
	Typical annual savings	**735.00**	**980.00**

*The actual savings may vary due to the exact degree of water hardness.

Savings in installation costs

Vulcan saves you installation costs. Most water treatments need to be built in the piping system and therefore require a professional plumber to do the installation. Vulcan is installed without any tools, within only a few minutes by yourself. You save money as you do not need to hire anyone.

Return on investment (ROI): amortization of purchase

Depending on the savings rate and the size of unit that gets purchased the amortization of Vulcan will be achieved after approx. 1.5 years on average. Vulcan will protect your house for the next 20 years and longer.

Increase the value of your home

Installing an eco-friendly maintenance-free water treatment that conditions all the water running in your home will increase the value of the house for you, your children or for the potential buyer in case you want to put it on the market.

7. Applications areas

To see the benefits of using Vulcan at commercial and industrial applications, please read the application flyers and bundle broschures.


Agriculture


Boilers


Condominiums


Cooling Towers


Farming


Golf Courses


Hospitality


Ice Rinks


Industry

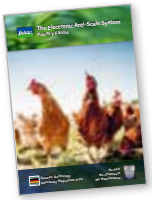

Large Buildings


Maritime


Medical


Naval Ships


Pools and Spas


Poultry


Residential Houses


Restaurants and Kitchens


Schools


Snow Production


Solar


Supermarkets


Water Works


Well Water


Wineries


Yachts

8. Commercial and industrial applications: benefits

8.1 Facility management

Managing a building, hotel or business demands constant observation of all technical equipment, sanitary stations, outdoor areas, etc. Vulcan helps to improve manageability, sustainability and profitability in many areas. Vulcan helps water-fed appliances to reach their maximum life expectancy and keeps their maintenance to a minimum.

8.2 The piping system

a) Reduction of scale deposits in the piping system

Vulcan takes away the adhesive power of scale particles so that scale is simply washed away with your water as a fine powder.

b) New scale-formation is prevented

Vulcan carefully dissolves already existing deposits in the piping system. The scale build-up process is reversed and the pipes gradually become clean again. This removal process will not block up your pipes or drain because the treated crystals are microscopic in size and wash away in the water.

c) Corrosion protection

Metal pipes often suffer from pitting corrosion. The electric Vulcan impulses generate a metal-carbonate protective layer that prevents pitting corrosion.

d) Increased water pressure

Vulcan sanitizes the pipes from scale deposits and can even restore a pipe‘s full diameter. Water can flow freely again and you regain normal water pressure.

e) Vulcan minimizes rust

In most cases whenever there are scale deposits you will find rust shortly thereafter. The rust typically imbeds itself in the scale deposits. Because rust oxides are red, the scale deposits in metal pipes then often appear red in color too. When the Vulcan treatment reduces scale, it also takes away rust with it.

f) Vulcan minimizes bacterial growth in pipes

Thick scale deposits with their uneven surfaces are the perfect breeding ground for bacteria. Once the scale is gone, there are no more nesting areas where bacteria can grow.

8.3 Technical appliances

Water heaters

Vulcan controls scale build-up in tankless water heaters permanently and reduces maintenance as heat exchangers get fewer deposits. Your water heater will work much more efficiently once again, and you can extend the time to your next service maintenance. Typically, the water heating bills will be substantially reduced.

Heating systems regain full performance

When water is heated in a hot water tank or with a tankless water heater the hard water always leads to thick deposits on the heating elements. This layer inevitably causes a great reduction in the capability of the heat to transfer. With Vulcan, deposits are minimized and your heating performs at a much higher capacity again.

Solar water heating

Vulcan prevents scale build-up in the system. It keeps heat exchangers and distributor pipes clean. Furthermore, Vulcan reduces scale build-up in collectors, it protects hot water tanks and vacuum tubes, and keeps the system from over-heating. There is no more need to circulate acids.

Cooling towers

Vulcan significantly reduces scale deposits. Bleed water is no longer toxic and bacterial contamination is minimized. With Vulcan, the cooling tower can be operated at higher cycles of scale concentration which minimizes water usage.

8.4 Vulcan in hotels & restaurants

Cleaner bathrooms

Shinier, smoother surfaces in the bathroom again on baths, sinks, fixtures, shower heads, etc. You will quickly notice that scale is still visible but acts like a fine "dust" which can be removed easily with a damp cloth. Notably less cleaning agents are needed and the use of

harsh detergents can now be avoided. This saves many hours when cleaning the rooms.

Kitchen and kitchen appliances

Kitchen surfaces, sinks, faucets and fixtures stay cleaner. You will quickly notice that scale is visible but acts like a fine 'dust' which can be removed easily with a damp cloth. Surfaces and tiles will be smoother and shinier again.

Cleaner dishwashers

Dishwashers operate with less detergent and less additives. The use of dishwasher detergent can be reduced by up to 25%. Typical spotting on dishware is reduced or no longer apparent.

Laundry and washing machines

Cleaning is more effective as Vulcan-treated water lathers noticeably more. The same amount of detergent will give you better cleaning results. You can often reduce the amount of washing detergents in your daily use or stay away from very aggressive agents. Furthermore, Vulcan extends the life of the machine's heating element.

Grease traps

Vulcan improves the handling of grease separators in two ways: The grease that is collected on top forms less clusters and is more consistent which makes it easier to pump it into an external tank. The Vulcan-treatment also prevents the remaining water from scaling in the tank; pipes, valves and pumps stay cleaner.

Gardening and irrigation

Garden irrigation with sprinklers becomes more reliable as the nozzles stay free of scale longer. Vulcan-treated water can be absorbed and processed better by plants. As there are less scale spots on the leaves your plants take up water and rain water better and look healthier.

Reverse osmosis filters

Reverse osmosis filters for your tap drinking water last longer. Water filters and RO-membranes will work more efficiently and the permeate is easier to handle.

Spas, swimming pools and jacuzzis

Swimming pools: Vulcan makes pool cleaning much easier: scale on the water line is looser and easier to wipe off. Pool covers and tiles on the floor or walls will show less hard csale stains. Vulcan reduces deposits in the pipes and valves. The sensitive circulation pumps last longer, sand filter need less changing and you can cut down on chlorine tablets.

Jacuzzis: The combination of water, circulating air and pressure in a hot tub tremendously enhances scale build-up. Vulcan makes the cleaning of the tub easier. Vulcan reduces deposits in the pipes and valves. Covers and tiles on the floor or walls will show less hard scale stains.

Spa Treatment Areas & Wellness: Shower heads stay clean longer. Soap and detergent use can be cut back by up to 25%. The water will feel as if it is "softer" (due to a decrease in water surface tension). Generally, soap will lather up more. Skin will feel smoother and hair will be much more manageable because the scale particles no longer makes it so frizzy.

8.5 A healthier lifestyle

Mineral rich drinking water

Vulcan does not interfere with the natural composition of drinking water. Important minerals remain in the water for a healthy diet. Especially young children and elderly people benefit from the healthy calcium and magnesium content that naturally is found in tap water.

Water tastes and smells better and gives food and beverages its natural flavor

Vulcan keeps the natural taste of water as it does not change its chemical composition. This gives you the best tasting water possible. Vulcan cleans the piping system once again and therefore cleans it from rust particles. Rust is gone and can no longer add any unwanted flavor.

9. The commercial and industrial applications: savings potential

Financial payback in commercial and industrial applications

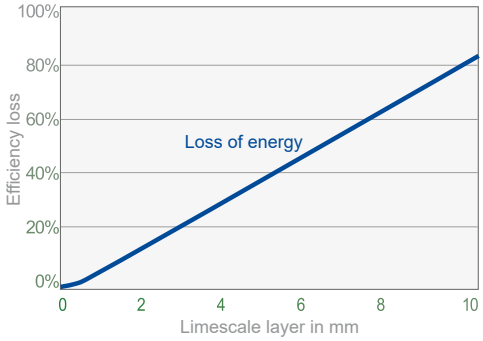
The use of the eco-friendly Vulcan water treatment saves you time and money from day one of the installations. It is a solid purchase for your operation with a quick return on investment.

9.1 Monthly savings in large buildings

- Pipes and appliances stay cleaner
- Increased efficiency of heating systems
- Minimized cleaning costs
- Less repairs of equipment
- No more maintenance or salt purchases for water softeners
- The monthly savings can amount up to 15-20% on your current costs

9.2 Increase the efficiency of the heating system

When water is heated in a water heater or with a tank-less water heater, hard water always leads to deposits on the heating elements. This layer inevitably causes a great reduction in the capability of the heat to transfer. A scale deposit of only 2mm (~0.078 inches) can lead to an energy loss of more than 15%. The increase in heating time leads to a tremendous rise in your power consumption.



9.3 Your hotel operation – some cost saving factors

The analysis of the cost saving potential for your hotel includes factors such as:

- Number of rooms
- Number of bathrooms/toilets
- Number of restaurant kitchens - and size of them
- Size of pool and spa area
- Daily laundry volume
- Type and dimensions of the heating system
- Number of cooling towers and dimensions
- Garden area that needs irrigation
- Daily use of water
- etc.

These factors quickly multiply and add up to a considerable cost saving potential. Please contact your local distributor for a detailed cost analysis.

9.4 Throw out those expensive water softeners

Owning and operating a water softener is a costly exercise. Large amounts of salt are needed to operate the system. Hundreds of gallons of water are wasted each time the softener granule has to be washed. Malfunctions and repairs are likely with an built-in system which can easily add up to hundreds of dollars in repair costs.

9.5 Savings in machinery operations

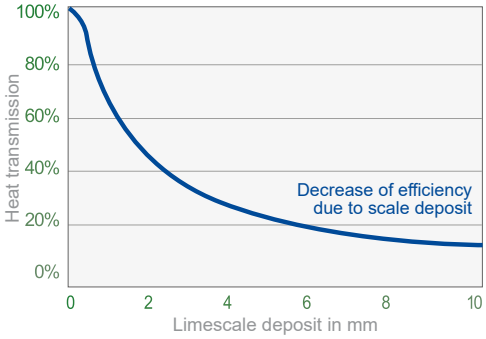
Running costs for machinery

Vulcan improves the performance and efficiency of many machines that operate with water. The use of Vulcan saves you time and money from day one of the installation.

10. Vulcan and its effect on machinery and equipment

10.1 Heating and heat exchangers

When water is heated, scale forms on the heating elements and heat exchangers. This happens with oil, gas, electric or solar heating technologies alike. The loss of energy due to the less efficient or blocked heat transfer is tremendous and the heat transmission coefficient decreases. Vulcan helps to reduce the scaling, and water tanks in the primary and secondary circuits will need less cleaning. The frequency of cleaning periods can be extended. Vulcan is effective on all types of exchangers: tube bundle heat exchangers, spiral tube heat exchangers, plate heat exchangers, ripped recuperators, etc.



Background knowledge on water heating systems

Water heater in private houses and buildings

Regulations for water temperature in houses or buildings state that the warm water pipes shall not carry water hotter than 64°C (147°F). Any temperature above this point would create a risk of serious skin burn. Furthermore, the water should be heated to meet a minimum of 60°C (140°F) to control legionella.
Therefore: water is normally heated to 60°-64°C (140°-147°F).


On-demand heater

a) Standard water heaters: electric, gas, oil (with a tank)

Standard water heaters operate with a heating element temperature anywhere from 65°C (149°F) in order to reach the water temperature of min. 60° (147°F) and max. 64°C (147°F). The water is slowly and economically heated in a tank where the water is stored for usage. Often heating element peak temperatures range around 85°C (185°F).

b) On-demand (instant) water heaters: electric, gas, oil

On-demand water heaters do not have a tank. They quickly heat the water from cold water to warm/hot the moment warm water is needed. The cold water needs to be heated within a few seconds which demands higher heating element temperatures. These instant water heaters may operate with higher heating element temperatures than 95°C (203°F).

c) Under 95°C (203°F) – the Vulcan effect in your water heater

The general rule for water heater systems is: if the *heating element surface temperature* is less than 95°C (203°F), you will see very good results with the Vulcan water treatment.

d) Above 95°C (203°F) – the Vulcan effect in your water heater

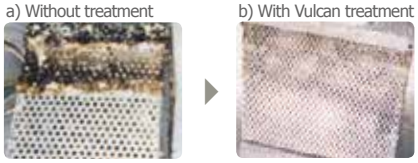
What does it mean for the success of the Vulcan water treatment if the heating element temperature is higher than 95°C (203°F)?

At home: The Vulcan water treatment is highly recommended even if you operate a water heater with an heating element temperature above 95°C (203°F) because Vulcan will be effective in all areas around your house.
What will you see? In a water heater you will notice that the scale that typically lines the inside walls of your heater will be significantly reduced. Even if some scale forms on the walls after some weeks, the scale can be easily removed by wiping it. The heating element will also show less scale deposits as Vulcan reduces this scaling to a certain degree but maybe not as significantly as in all the other areas. The Vulcan water treatment protects all areas. However, a heating element that operates above 95°C (203°F) is the one part that will show some signs scaling.

In a factory setting: If you are operating a large sized water heating system (e.g. with a large water tank) which has to be cleaned frequently by professional services, the scaling on walls will be reduced significantly. This way maintenance intervals are reduced. Furthermore, the few scale deposits that may have formed can be more easily removed. The typical experience shows that use of chemicals can be limited to a minimum and may even be discontinued. The Vulcan water treatment protects all areas. The heating element will show less scale but not as significantly as in other areas. Results are very good up to 95°C (203°F) but will diminish somewhat if temperatures rise above that (e.g. 130°C (266°F)).

10.2 Grease traps

Many businesses in the food processing industry, in kitchens, restaurants, carwashes, and many other companies need to operate a grease separator. Vulcan improves the handling of grease traps in two ways: The grease that is collected on top forms fewer clusters and is more consistent which makes it easier to pump it into an external tank. Vulcan also prevents the remaining water from scaling in the tank and pipes, and valves and pumps stay cleaner.



10.3 Ice machines

Processing water into ice cubes consumes high amounts of energy. The ice cube´s quality largely depends on the water quality which is improved by Vulcan just before the actual ice-making process.
The benefit: Ice machines build less deposits during production which keeps machines running more reliably.

10.4 Solar water heating

Using a solar powered water heater is a smart green alternative to traditional heating methods. Vulcan prevents scale build-up in the system. It keeps the heat exchangers and distributor pipes clean. Furthermore, Vulcan reduces scale build-up in collectors, it protects hot water tanks and vacuum tubes and keeps the system from over-heating. There is no more need to circulate acids.

10.5 Snow production

The quality and quantity of snow in snow production is largely affected by the water quality. The Vulcan Electronic - Impulse - Technology changes the typical crystal structure of scale - from a chaotic clutter into a well aligned monocrystal. The water droplets are finer, which allows you to produce more snow with a better snow crystal structure that will last longer.

10.6 Cooling towers

As scale does not evaporate with water, it quickly accumulates in the towers and clogs up the system. This causes malfunctioning and high expenses for maintenance. Vulcan achieves a significant reduction of scale deposits. Bleed water is no longer toxic and bacterial contamination is minimized. In addition, with Vulcan, the cooling tower can be operated at higher cycles of scale concentration, minimizing water usage.

10.7 Reverse osmosis systems (RO)

When Vulcan is installed before a RO-system it helps in two ways:
1. As calcium-crystals are smoother after the Vulcan treatment, this reduces deposits on the sensitive RO-filter membranes. The RO-system runs longer and more effectively.
2. The permeate (leftover water) is difficult to handle as it has a particularly high degree of water hardness after filtration. Here, Vulcan helps that the reject water can be better handled and prevents it from causing damage further down the drain.


RO system

10.8 Vulcan and water softeners

In production and industrial settings, you may need a softener when there is no (zero) tolerance for any calcium in the water. However, in numerous cases, you can eliminate your softener and replace it with a Vulcan system. If you need to operate a softener, Vulcan can be installed as an addition which helps the softener's performance:

a) Vulcan replaces water softeners

Vulcan is the eco-friendly alternative to regular salt-based water softeners. The salt that is added to the water is polluting the environment and is not recommended for young children or older people to drink. The old system can usually easily be put out of use by simply bypassing it.

b) Vulcan as an addition to water softeners

Vulcan is the eco-friendly alternative to regular salt-based water softeners. However, if you want to keep the softener running due to special reasons, you can save large sums of money when using Vulcan as an aid. The use of Vulcan will decrease the amount of salt that you need to add. This cuts down costs for salt, maintenance intervals will be extended, less malfunctioning in the backwash valves etc.

Vulcan installation with a water softener

10.9 Savings potential in machinery operation

Vulcan improves the performance and efficiency of many machines that operate with water. The use of Vulcan saves you time and money from day one of the installation.

Six typical money saving areas

1. Scaling inside the machine is minimized.
2. If additives are used they are often more effective and last longer.
3. The machine can run longer before it needs to be serviced again. Often cleaning of the parts is much easier.
4. Less repairs and less need to replace individual parts.
5. Tanks that carry water or other liquids need less maintenance and cleaning thereof. Most of the time it is much easier and faster. This reduced service time results in fewer production breaks.
6. Less biofilm and bacterial growth allows a reduction of control measures and chemicals to combat this.

IV. Installation and FAQs

11. Vulcan installation

11.1 Choosing the right Vulcan size

When choosing the size please consider these two factors:
Pipe diameter and water capacity.

11.1.1 The pipe diameter

Where to look: Check the pipe diameter in the area where you want to install Vulcan. It does not matter if the pipe material changes (bigger or smaller) somewhere later on the piping system.

The Vulcan impulses treat the water as it flows by. It is important to submit the right impulse strength everywhere in the pipe so that all the water is treated correctly. The impulse should neither be too weak nor too strong. In order to provide exactly the right impulse strength for your pipe, Vulcan comes in several sizes. This ensures that the same strength of impulse is present throughout each individual pipe diameter. The impulse needs to reach equally to the outside rim of the pipe (A) as well as to the center (B) (pic. 1).

If you got it right:
Each Vulcan is designed so that the cleaning process is set to dismantle a fine layer of scale at a time. This ”powder” is washed away by the water and ensures a gentle, secure cleaning.

If you got it wrong:
The problem of underperformance/overperformance
If the Vulcan impulse is too weak: An insufficient (too weak) impulse will result in too little treatment. Therefore **Do NOT undersize the unit.**

If the Vulcan impulse is too strong: A too strong Vulcan impulse strength is not recommended. If an oversized Vulcan unit were installed to get an accelerated cleaning process (e.g. Vulcan S25 on a 1” pipe), the treatment would dismantle too much scale. This would lead to bigger pieces of scale being taken off the deposit which will potentially block your piping system overall. **Do NOT oversize the unit.**

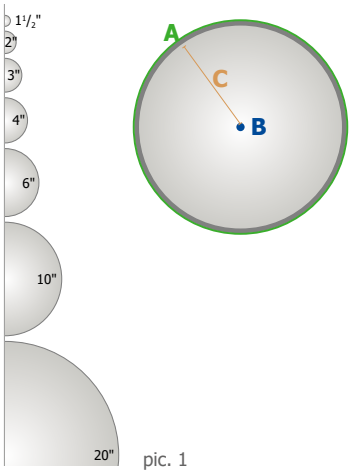
The problem with substitution
You can not take two small units to substitute *one* big unit (e.g. two Vulcan 5000 do *not* replace one Vulcan S25). **Do NOT combine many small units instead of one large unit.**

Vulcan unit sizes

max. 1 1/2”	-	Vulcan 3000
max. 2”	-	Vulcan 5000
max. 3”	-	Vulcan S10
max. 4”	-	Vulcan S25
max. 5”	-	Vulcan S50
max. 6”	-	Vulcan S100
max. 8”	-	Vulcan S150
max. 10”	-	Vulcan S250
max. 14”	-	Vulcan S350
max. 20”	-	Vulcan S500
max. 30”	-	Vulcan X-Pro 1
max. 40”	-	Vulcan X-Pro 2

Impulse penetration area

A outside rim
B pipe center
C A to B: distance penetrated by impulses



pic. 1

11.1.2 The water capacity

The maximum water capacity per hour (l/h, m³/h, gph or gpm) is the amount of water that Vulcan is capable of treating within one hour. This number is largely determined by the pipe diameter itself: The diameter of the pipe together with the maximal amount of water pressure (usually 20 bar) determines the maximum capacity of each specific pipe size. Vulcan X-Pro series work independently from water capacity.

unit size	Vulcan 3000	Vulcan 5000	Vulcan S10	Vulcan S25	Vulcan S50	Vulcan S100
max. capacity	3000 l/h 13 gpm	8000 l/h 35 gpm	15 m³/h 65 gpm	30 m³/h 130 gpm	70 m³/h 300 gpm	120 m³/h 530 gpm

unit size	Vulcan S150	Vulcan S250	Vulcan S350	Vulcan S500	Vulcan X-Pro 1	Vulcan X-Pro 2
max. capacity	180 m³/h 790 gpm	350 m³/h 1540 gpm	500 m³/h 2200 gpm	800 m³/h 3520 gpm	unlimited	

Most of the times - especially in private installations your client will probably not consume the possible max. capacity (eg. Vulcan 5000 with the max. of 8000 l/h). However, in certain peak times, this will be the hourly usage for a short period. The maximum capacity is reached at the moment of *simultaneous consumption* (peak consumption). For example, a peak moment is reached when the kitchen water is running, someone is taking a shower and the the washing machine is in operation. As production processes are carefully designed to meet exact requirements, it is more common for industrial production lines to consume the maximum of their pipe diameter capacity over long periods. For example, in a production it is more likely that a 4” pipe is constantly transporting the maximum amount of water – simply because it has been exactly designed for that.

How to choose the right Vulcan size

Hotels / Apartment Buildings / Condominiums

For buildings with peak times of high water capacities, you have to choose the following Vulcan size. To choose the right Vulcan model, check the pipe diameter at the main water pipe.

Pipe Diameter	Model
max. 2"	Vulcan S10
2½" - 3"	Vulcan S25
3½" - 4"	Vulcan S50
4½" - 5"	Vulcan S100
5½" - 6"	Vulcan S150
7" - 8"	Vulcan S250
9" - 10"	Vulcan S350
11" - 16"	Vulcan S500

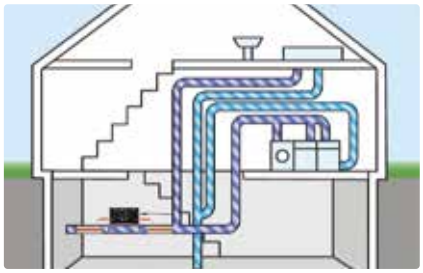
Application examples

- Hotels & resorts
- Apartment houses
- Condominiums
- Dormitories
- Hospitals
- Retirement homes
- Large living buildings
- etc.

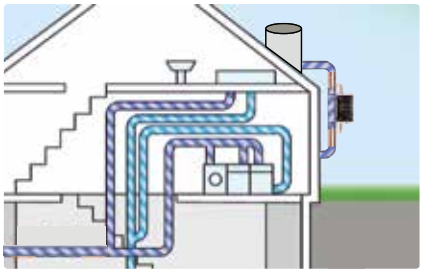
11.2 Choosing the right installation location

11.2.1 Installation in a private house

Vulcan is typically installed at the point where the main water supply line enters the building. Most of the time, this is close to the water meter or the main shut-off valve. This way, the Vulcan treatment takes place before the water is distributed into the building.
European homes usually have a basement and the main water pipe is accessible easily. The installation thus is very simple. Many other homes around the world have the water access outside the house. This also is usually where water meter is located. CWT also offers a range of additional equipment such as mounting boxes that can protect the unit from theft and weather.


Basement installation

If the house is equipped with a storage water tank (many times located on the roof), we recommend the installation of Vulcan after the tank outlet. This ensures that the water is treated just before it travels through the piping system. If Vulcan were installed before the tank and the water had been sitting for 2-7 days in the tank before usage, the Vulcan effect might get lost in the tank.


Storage tank installation

11.2.2 Installation in apartment buildings

In general, the same installation guideline for private houses applies to larger buildings: Vulcan is installed at the point where the incoming water supply line is going into the building (typically close to where the water meter is placed). Please also consider other factors such as the construction plan of the water carrying pipes and heating system. If you have an extra system for heating, you may need another unit for the hot water circulation line. The unit size should be according to pipe diameter and water flow.


Vulcan installation in an apartment building

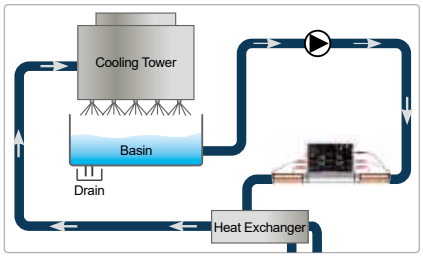
11.2.3 Installation in commercial & industrial settings

Due to the different nature of production sites, there is no standard rule for installation. As a production site typcially consists of a number of buildings, the main building can be treated as any other large building. We recommend the installation of a large unit to treat the main water industrial usage inlet. This is a basic treatment and additional smaller Vulcan units should be installed approx. 3 - 5 m before the worst scale problem generating machinery (heat exchangers, cooling towers, chillers, production lines, …). Please contact us, if you need technical assistance.


Vulcan installation in a factory

11.2.4 Installation in circulation lines

If you have a circulation line either open, semi-closed or closed-loop line, there should be an extra Vulcan unit placed there. The water in circulation travels long distances and the circulation pumps often suffer severely from scale deposits. The Vulcan size needs to be selected according to the pipe size of the circulation.



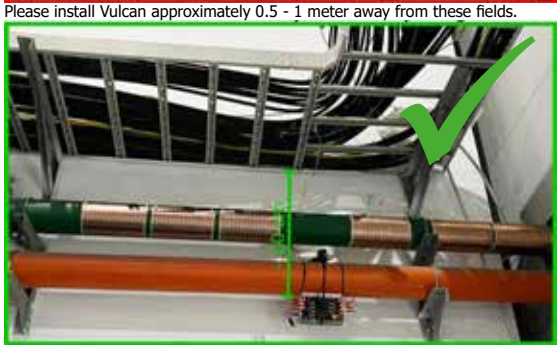
Open loop circulation line

11.3 Factors influencing the installation location

11.3.1 Electric power fields and magnetic fields

Please make sure that there are no strong electrical power lines running close to the installation area. These can create a magnetic field, which may interfere with the Vulcan impulse field. Please install Vulcan and the impulse bands approximately 0.5 - 1 meter away from these fields.

Please install Vulcan approximately 0.5 - 1 meter away from these fields.

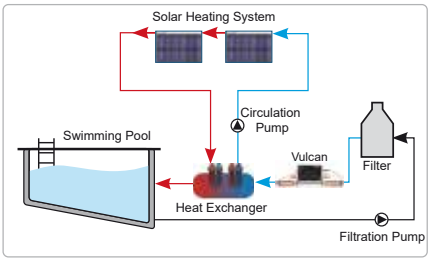


Private houses typically do not have such strong electric lines (except supply for electric ovens); these should run at sufficient distance away from the installation area.

11.3.2 Position of pumps and filters

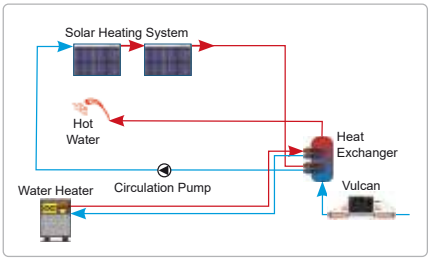
Pumps

Magnetic or electric fields can exist in electric motors or in certain types of water pumps. As a general rule, we therefore recommend to chose an installation area at least 50 cm (20") away (ideally after) electric motors or pumps, if the setting in your installation area allows it. The pump can only affect the Vulcan treatment, if the pump uses plastic impellers inside, because then they can create an electric field. If the pump uses metal impellers inside, Vulcan can be installed before the pump.



Filters

Some filters may block the mono-calcium crystals that are supposed to travel through the piping system. Crude filters (> 50 µ) do not remove the mono-crystals and can be ignored. However, for more sensitive filters (< 50 µ) it is recommended to install Vulcan after the filter.



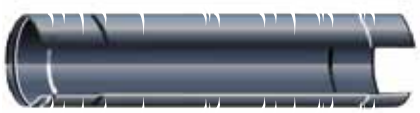
11.3.3 Piping conditions of the installation area

Isolation material

Isolation material should be dismantled before the installation of a Vulcan unit. After the installation it is good to replace the material as an additional protection of the impulse bands.

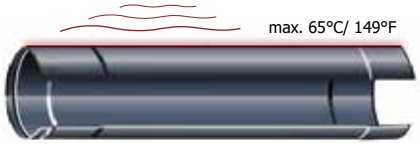
Metallic splinters

Especially in an industrial setting you might be faced with uneven pipe surfaces on the outside of the pipe. Metallic splinters can cause pitting of the impulse bands and splinters should be treated with sand paper prior to the installation.



Piping temperature

If the pipe that Vulcan should be installed on is carrying hot water, please check that the pipe's outside temperature does not exceed 65°C (149°F).



<u>If the pipe temperature is over 65°C/ 149°F</u>

Please place a piece of plastic or wood material (no metal material) under the Vulcan unit in order create a barrier against the pipe's heat. To protect the Vulcan impulse bands from excessive heat, simply place plastic wrap (3 up to 5 layers is enough) on the pipe before installing the impulse bands on top.

11.3.4 Outdoor installation

Vulcan is suitable for outdoor installation. It operates at temperatures between -25°C and +50°C (-13° to 112°F). In any outdoor setting we advise protecting the acrylic main unit from direct sunlight or direct rain. The **Vulcan outdoor box** are available in several sizes and come with either a transparent or an opaque cover. They offer an additional protection against heat, rain and other external factors. *If you build your own protection box, please take care, that the box is **not made of metal** (fixing plate inside can be metal). The metal cage can affect the generated impulses.*

Vulcan outdoor box
IP54 or IP65
available

Caution: The impulse bands must be kept dry, especially on **metal pipes!** If there is **condensation water** on the pipe, or the surrounding **humidity** is high, please do as follow:

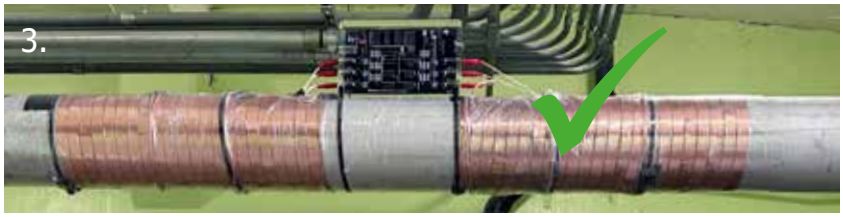
How to protect the impulse bands against moisture?

a) The best and most professional way is to protect the impulse bands with (non-metallic) pipe insulation.

Outdoor pipe insulation to protect the impulse bands.

b) A more easy way to protect the impulse bands against light moisture is to use plastic foil:

1. Wrap tightly few layers (2-3) of plastic foil around the pipe (no metal / if possible anti-static)
2. Wrap the impulse bands on the plastic foil.
3. Wrap another 2-3 layers of plastic foil on top of the impulse bands.

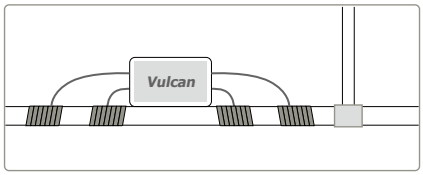


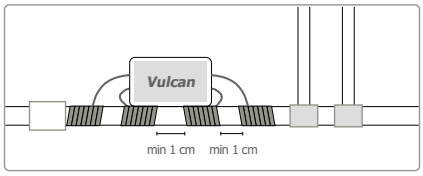
Don't wrap plastic foil around the electronic unit!

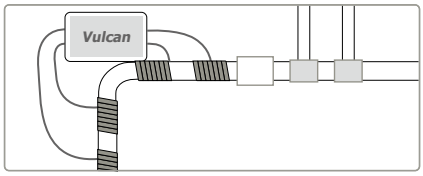
To protect the electronic unit, please use an outdoor box.

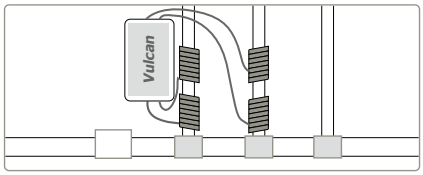
11.4 Quick guide: Do-It-Yourself installation

Vulcan is especially designed so that the installation does not need to be done by a specialized plumber. You can easily install Vulcan in approx. 10-15 minutes. The installation does not require any tools and there is no need to cut the pipe.









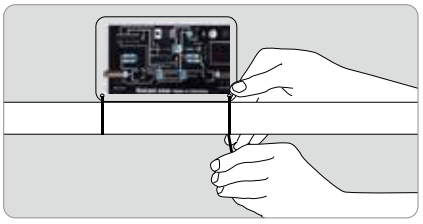
11.4.1 Notes on the installation and examples

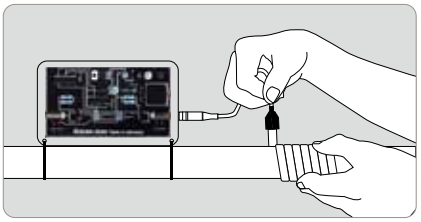
1. For optimal water treatment Vulcan is best installed near the water meter or at the main water supply.
2. The impulse band windings can be placed on the left side, on the right side or underneath the electronic device. Leave a safe distance of at least 1 cm (min. ~$^1/_2$") from the band pairs.
3. Vulcan can be installed vertically, horizontally or at any other angle. If there is no space available on the pipe the device can also be wall-mounted.
4. In case of limited space the windings can be placed partly on the main pipe and partly on the distributor pipe.

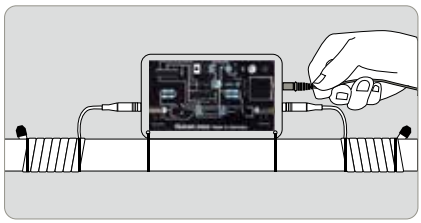
All these different installations are possible because the treatment impulses extend over several meters to either side of the pipes.

11.4.2 General information

1. 1. Protect the electronic unit, the impulse bands and the power supply against humidity and water.
2. Use the included switching power supply unit only.
3. Do not cut the impulse bands nor the 48V power cord of the power supply.
4. Do not remove the end caps or the impulse band insulation.
5. The operating temperature ranges from -25°C to +50°C (-13°F to 122°F).
6. Clean the device with water only.
7. Temperature peaks on heating element surfaces should not exceed 95°C (203°F).





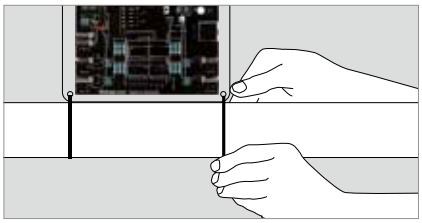


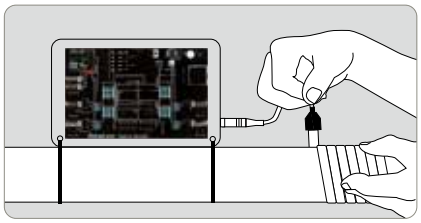
11.4.3 Installation instructions for the Private Line

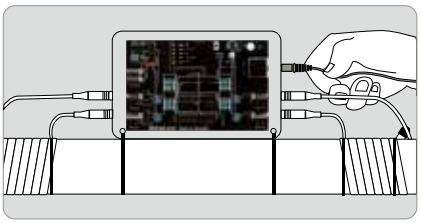
1. Put the two band ties through the fixing holes at the bottom of the electronic device. Now place the device onto the pipe. Use the band ties to latch the device to the pipe.
2. Connect one of the impulse bands to the device and use another band tie to latch it to the pipe.
3. Wind the impulse bands around the pipe producing a coil. Make sure you wind the band tightly to the pipe and place the windings close to each other.
4. Latch the end of the band to the pipe using another band tie. Now repeat the procedure with the second impulse band.
5. First plug the connector into the upper right in-jack of the device and then connect the power supply unit with an electrical outlet.
6. The red pilot lights will illuminate as soon as the device starts to operate. Vulcan works from now on maintenance free.

11.4.4 Installation instructions for the Commercial & Industrial Line

1. Put the two band ties through the fixing holes at the bottom of the electronic device. Now place the device onto the pipe. Use the band ties to latch the device to the pipe.
2. Plug one of the impulse bands into the bottom impulse band in-jack and latch it to the pipe using another band tie.
3. Wind the impulse bands around the pipe producing a coil. Make sure you wind the band tightly to the pipe and place the windings close to each other.
4. Latch the end of the band to the pipe using another band tie. Now plug another impulse band into the in-jack on the opposite side and repeat the procedure.
5. Plug another impulse band into the next impulse band in-jack and, according to the device type, repeat steps 2 - 4 until all impulse bands are in use. All impulse bands must be wound tightly around the pipe and fastened with band ties.
6. **First** plug the connector into the upper right in-jack of the device and **then** connect the power supply unit with an electrical outlet.
7. Programming: Set the programm by touching the twin metal sensors on the left side simultaneously.







See section 12 for program setting.

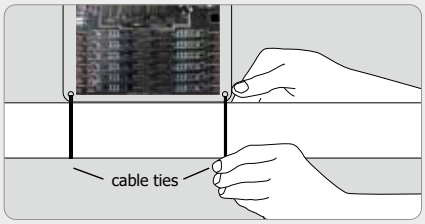
11.4.5 Installation Instructions for the X-Pro Line

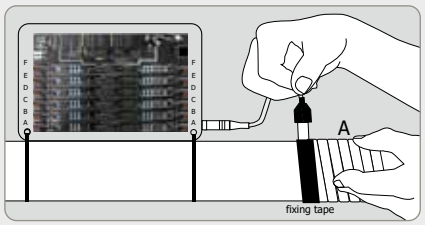
1. Put the **cable ties** through the fixing holes at the bottom of the electronic device. Now place the device onto the pipe. Use the cable ties to fix the device to the pipe.
2. Plug now **impulse band A** into the bottom impulse band in-jack A and latch it to the pipe with the **fixing tape**.
3. Wind the impulse band around the pipe producing a coil. Make sure you wind the band tightly to the pipe and place the windings **close to each other**.
4. Latch the end of the band to the pipe with the fixing tape.

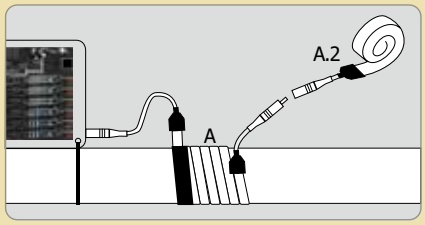
   4.2. Only for Vulcan X-Pro 2

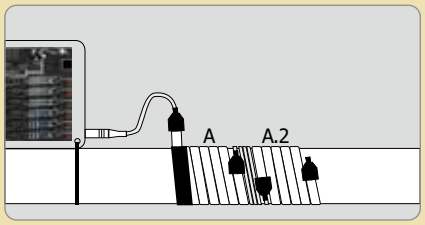
   *Connect the end plug of **impulse band A** with the plug of **impulse band A.2** and wind this impulse band A.2 directly next to the impulse band A and fix it with the fixing tape.*
5. Plug the other **impulse band A** into the in-jack on the opposite side and repeat the procedure 2. to 4.
6. Plug **impulse band B** into the next impulse band in-jack B and repeat step 2 - 5 until all impulse bands are in use. All impulse bands must be wound tightly around the pipe and fixed with the fixing tape.
7. **First** plug the connector into the upper right in-jack of the device **and then** connect the power supply unit with an electrical outlet.
8 Programming: Set the programm by touching the twin metal sensors on the left side simultaneously.

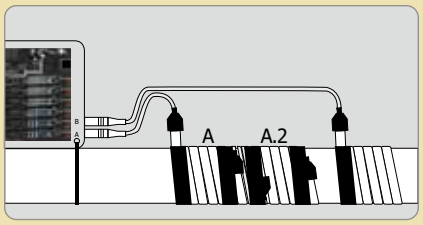
See section 12 for program setting.

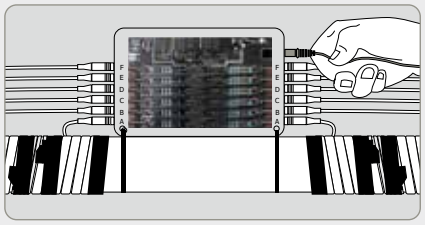








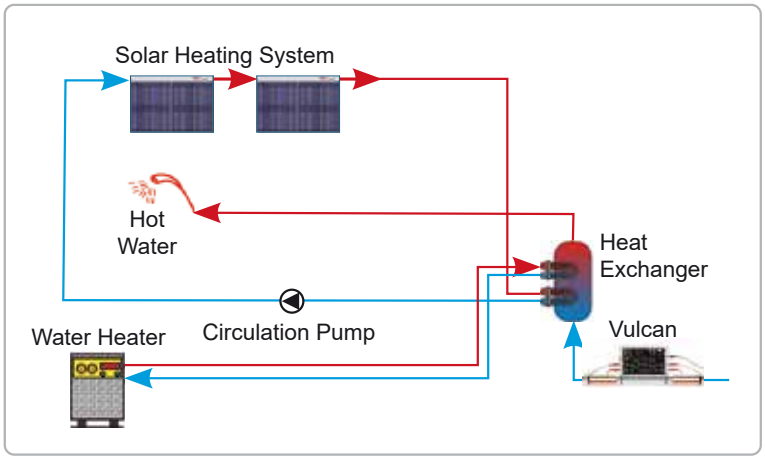




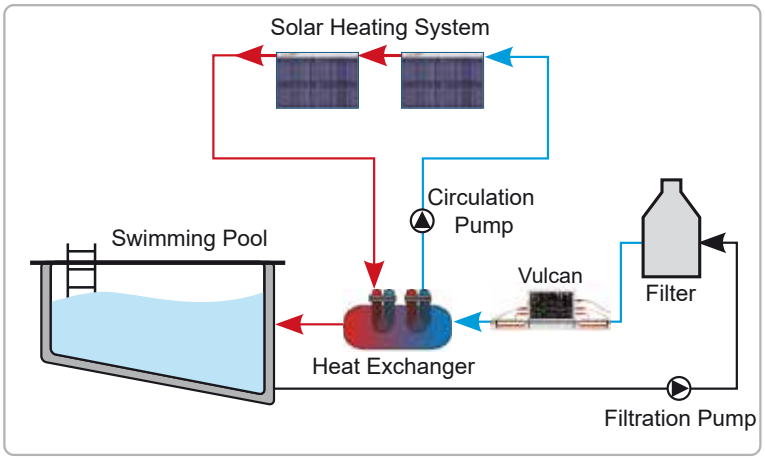
11.4.6 The CWT impulse detector

Show what is going on, if you have a impulse detector with you.
The detector is a good tool when you show Vulcan to new customers. The client gains a better understanding of the impulse treatment.

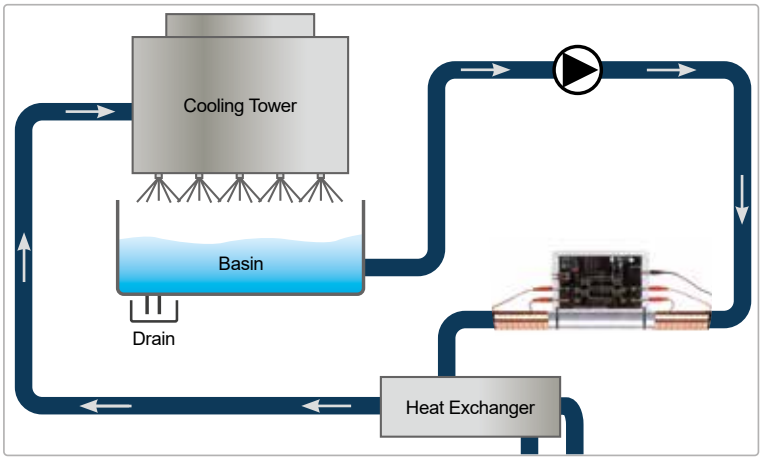
11.4.7 Technical drawings



Solar water heating system
For best results, Vulcan should be placed on the cold water inlet to the heat exchanger.



Solar pool heating and filtration system
For optimal results, Vulcan should be placed between the filter and the heat exchanger.



Cooling towers
Installation example - open circuit
Vulcan should be installed just before the heat exchanger. Please ensure to regularly drain the circuit at the bottom of the basin or use a centrifugal filter to take away remaining solids from the cooling tower water.

On closed loop circuits, Vulcan is located after the pump.

12. Setting the programs

Vulcan provides a selection of programs in the Commercial, Industrial and X-Pro units.
A program is set by touching both metal plates on the left side of the unit. The fingers bridge the gap between the two plates and set the switch. Tap once, the program locks into the next position which is indicated by the green control light. Tap again and the program jumps to the next program and so on.
The pipe material determines how good the electric Vulcan impulses pass through the pipe's wall. As electricity penetrates plastic easier than metal, the impulse signal is stronger for metal pipes than for plastic pipes. This is reflected in the programs. They allow a fine-tuning of the Vulcan impulse which adjusts the impulse strengths according to diameter and pipe material.

Touch both metal plates to set the program

12.1 Commercial Line & Industrial Line & X-Pro Line

Vulcan S10 Programs
- max. 2″
- max. 2 ½″
- max. 3″

Vulcan S25 Programs
- max. 2″
- max. 2 ½″
- max. 3″
- max. 3 ½″
- max. 4″

Vulcan S50 Programs
- max. 3″
- max. 3 ½″
- max. 4″
- max. 4 ½″
- max. 5″

Vulcan S100 Programs

max. 2 ½″ Metal	max. 2 ½″ Plastic
max. 3″ Metal	max. 3″ Plastic
max. 4″ Metal	max. 4″ Plastic
max. 5″ Metal	max. 5″ Plastic
max. 6″ Metal	max. 6″ Plastic

Vulcan S150 Programs

max. 4 ½″ Metal	max. 4 ½″ Plastic
max. 5″ Metal	max. 5″ Plastic
max. 6″ Metal	max. 6″ Plastic
max. 7″ Metal	max. 7″ Plastic
max. 8″ Metal	max. 8″ Plastic

Vulcan S250 Programs

max. 4″ Metal	max. 4″ Plastic
max. 5″ Metal	max. 5″ Plastic
max. 6″ Metal	max. 6″ Plastic
max. 8″ Metal	max. 8″ Plastic
max. 10″ Metal	max. 10″ Plastic

Vulcan S350 Programs

max. 6″ Metal	max. 6″ Plastic
max. 8″ Metal	max. 8″ Plastic
max. 10″ Metal	max. 10″ Plastic
max. 12″ Metal	max. 12″ Plastic
max. 14″ Metal	max. 14″ Plastic

Vulcan S500 Programs

max. 8″ Metal	max. 8″ Plastic
max. 10″ Metal	max. 10″ Plastic
max. 12″ Metal	max. 12″ Plastic
max. 16″ Metal	max. 16″ Plastic
max. 20″ Metal	max. 20″ Plastic

Vulcan X-Pro 1 Programs

max. 20″ Metal	max. 20″ Plastic
max. 24″ Metal	max. 24″ Plastic
max. 26″ Metal	max. 26″ Plastic
max. 28″ Metal	max. 28″ Plastic
max. 30″ Metal	max. 30″ Plastic

Vulcan X-Pro 2 Programs

max. 32″ Metal	max. 32″ Plastic
max. 34″ Metal	max. 34″ Plastic
max. 36″ Metal	max. 36″ Plastic
max. 38″ Metal	max. 38″ Plastic
max. 40″ Metal	max. 40″ Plastic

Installation Check List

Client/ Company _____

Installation date _____

Vulcan:

☐ 3000	☐ S100	☐ X-Pro 1
☐ 5000	☐ S150	☐ X-Pro 2
☐ S10	☐ S250	
☐ S25	☐ S350	
☐ S50	☐ S500	

Pipe diameter _____ **Pipe material** _____ **Water capacity** _____ **m³/h**

1. **Is the installation place chosen with respect to these factors?**
   Time Factor (water in tanks max. 48 h) / Heat Factor (Temperature peaks on heating element surfaces should not exceed ~203°F (~95°C).) / Distance Factor (max. 2 km pipe)
   ☐ OK Note: _____

2. **Are there unusual high levels of certain substances in the water? If yes, have they be taken care of?**
   Iron (Fe) and other metals: The content of iron and other metals in the water should not exceed 1 mg/l (1 ppm).Other metals, for example: copper(Cu), aluminium(Al), lead(Pb), nickel(Ni), Zinc(Zn) can affect the Vulcan treatment.
   Manganese (Mn): The manganese level should not exceed 0.1 mg/l (0.1 ppm)
   Sulfate & silicate: In high concentrations (more than total hardness) it can affect the Vulcan treatment.
   Alkalinity: If the total alkalinity is higher than the total hardness, Vulcan can have problems to treat the limescale.
   ☐ OK Note: _____

3. **Have the location of filters and pumps been taken into consideration?**
   As a general rule it is better to install Vulcan after a pump and after a filter, if the setting in your installation area allows it.
   Filters: Crude filters (> 50 µ) do not remove the mono-crystals and can be ignored. For more sensitive filters (< 50 µ) it is recommended to install Vulcan after the filter.
   Pumps: The pump can only affect the Vulcan treatment, if the pump uses plastic impellers inside, because then they can create an electric field. If the pump uses metal wheels inside, Vulcan can be installed before the pump.
   ☐ OK Note: _____

4. **Have you checked for strong electricity, magnetic fields or electro-motors?**
   Please make sure that there are no strong electrical power lines running close to the installation area. These can create a magnetic field, which may interfere with the Vulcan impulse field. Please install Vulcan approximately 0.5 - 1 meter away from these fields.
   ☐ OK Note: _____

5. **Are paint or cover materials on the pipe taken care of?**
   - Thin coatings such as pipe protection (e.g. corrosion protection paint) are suitable to place the impulse-bands directly on top.
   - Insulation material or other thicker protective layers should be dismantled and can be re-installed over the impulse bands after installation.

   ☐ OK Note: _____

6. **Is the pipe surface temperature suitable?**
   The pipe's outside temperature should not exceed 65°C (~ 149° F). Above this may harm the isolation of the copper impulse bands.
   ☐ OK Note: _____

7. **Is there condensation on the pipe, or is the surrounding humidity high?**
   First, wind three layers of plastic foil (not metal) around the pipe, then wrap the impulse bands around the plastic foil. To finish, wind another 3 - 5 layers of plastic foil around the impulse bands.
   ☐ OK Note: _____

8. **Vulcan works up to a ph level of maximum 9. Please check, if the ph level is less than 9.**
   ☐ OK Note: _____

14. FAQs - frequently asked questions

14.1 The piping system

What type of pipe material does Vulcan treat?

Vulcan is suitable for all pipe materials: iron, galvanized iron, inox, copper, steel, stainless steel, plastic, PVC, PE-X, compound pipes (any material mixture) etc.

Do plastic pipes and copper pipes need scale protection at all?

Yes. Plastic and copper pipes are prone to calcifications, too. The smoother a surface is the longer it can resist the process of calcification. It may take longer until plastic or copper get a first layer of scale. However, once that first layer has built up, the scaling process proceeds just as fast as on any other surface or material.

How long does it take Vulcan to sanitize the pipes?

Vulcan gently removes scale and rust without negatively affecting the pipes. The treatment works within the laws of nature. Therefore, the removal process may take as long as it took the deposits to develop.

Will the scale that is cleaned out block the pipes?

No, the scale is slowly dissolved back into a solution and the calcium and magnesium is washed away in the water as a fine powder.

How long does the effect last?

When mono-crystals are created by the impulse variation, it is important that they grow as long as possible before they start their way through the piping system. The larger the crystals, the longer it takes until the crystals fall apart again and eventually "die". In warm water, these crystals grow faster and therefore are stronger and live longer. This explains why the Vulcan-effect lasts the longest in warm water (up to seven days) and shorter in cold water (approx. two days).

The copper pipes have turned green. Does Vulcan help with this problem? Green colored copper pipes are an indication to oxidized copper or copper rust - similar to rust in iron pipes. The Vulcan treatment produces hydrogen dioxide (H_2O_2) which protects blank copper surfaces against oxidation. This way, Vulcan reduces the green colorization of the water.

14.2 The water quality

How do I know the water hardness of my water?

Your local waterworks provides detailed information on the chemical composition of your water. It lists the calcium and magnesium content and usually provides information on hardness in gpg (grains per gallon) or in ppm (parts per million). More: Hardness classifications in appendix

Up to which degree of water hardness can Vulcan be applied?

Vulcan operates within a high performance frequency range and is the only unit with a 48 Volt technology. It can thus be successfully applied to problems with a very high degree of water hardness. Vulcan has successfully treated cases with a water hardness of 900 ppm (~ 53 gpg) or more.

Does the Vulcan treatment have a softening effect on the water? The treatment does not change the overall water hardness. Unlike in chemical water treatment systems (e.g. a water softener that uses salt) the water treated by Vulcan does not lose minerals, such as calcium and magnesium. The natural composition of the elements in the water remains the same. However, due to a change of the water surface tension your skin will feel remarkably softer. You are sure to feel this effect when taking a shower or even simply washing your hands. Most importantly, scale loses its adhesive characteristic. The treatment does not, however, change the measured water hardness. So on a chemical level you have the same hardness before and after the treatment.

14.3 Installation and operation

Is it difficult to install Vulcan in my home? Vulcan is designed as a do-it-yourself product. It sits outside the pipe and you do not need to cut into the pipe. The installation is very easy and takes approx. 10 minutes. No tools required.

How do I know which Vulcan size is needed for my application?

Please check the pipe diameter in the area where you want to install Vulcan. Then choose the unit that is designed for this size.

Where should I install Vulcan in my home? Vulcan is mounted outside of the pipe with no need to cut the pipe. It should be installed at the point where the incoming water supply line is going into the house. Most of the time this is close to the water meter. This way, a single Vulcan treats all the water pipes in the house.
European homes usually have a basement, so the main water pipe sits somewhere there, inside the house. Many homes allow access only outside the house. This again is usually where the water meter is located. We also offer a range of additional features such as a solar power charger in case that there is no power supply nearby.

How do I know that the Vulcan is operating efficiently?
Red pilot lights at the impulse band outputs indicate that the impulse generator is operating efficiently. In case these lights are not illuminated, please check the power supply voltage or contact your local distributor.

Which voltage ranges are suitable for the electronic power supply unit? All Vulcan power supply units are suitable for voltage ranges between 100 Volt – 240 Volt and 50 Hz – 60 Hz. It can therefore easily caters to all international power plugs. We are glad to supply you with the correct power supply unit in case of an international relocation.

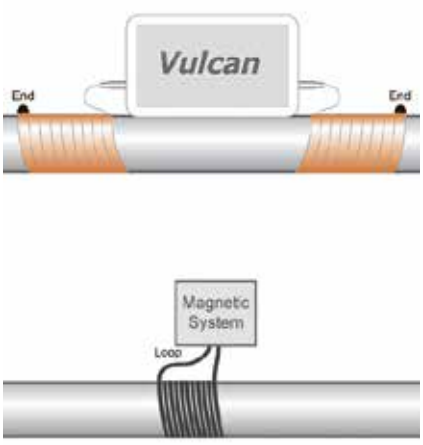
How many units do I need? Private homes are taken care of with one unit that treats the whole house. In larger buildings or industrial settings it depends. Typically, one larger unit gets installed on the incoming water supply line to the building. If you have a cooling tower or closed loop systems, another smaller unit would go there.

What are the power costs of Vulcan per year?
Vulcan is completely maintenance-free. The cost of electric energy per year amounts to approx. 4-6 € (~$ US 5-7).

14.4 Miscellaneous

What kind of warranty do I get on Vulcan?
Vulcan has a full 25-year warranty and has a 30+ year life span. It is German TÜV-certified and is CE, CUL and UL listed. Your Vulcan unit is 100% covered under most circumstances. The units have an expected life of over 30 years and are imbedded in weather proof acrylic casts. By purchasing from the manufacturer and listed distributors, your warranty is well-assured. German quality standards and excellent customer service have been our priority for over 70 years.

I heard of similar products which don't work. Can you explain?
There are similar products to Vulcan on the market that claim to do the job, but don't. Almost all other products on the market are working with inductive (electromagnetic) technologies. You can easily recognize them by their cables. Those cables run in a loop from the electronic unit - to the pipe and back into the unit (pic. 1).
In comparison, Vulcan works exclusively with capacitive impulses that guarantee a stable output. Its impulse bands end on the pipes, similar to antennas. Furthermore, regardless of inductive or capacitive impulses: Vulcan utilizes far wider frequencies of 3,000 - 32,000 Hz (= 3-32 kHz) and operates with energy levels at 48V. Read more on the differences in technologies on page 17. Christiani Wassertechnik (CWT) is the oldest German manufacturer of physical water treatment. The product specialization in this field began in 1977 and we are constantly developing new technologies.



pic. 1

14.5 Trouble shooting

green	red
○	○ ○

The green light is off/ the red lights are off
The single green light indicates the correct power supply. If it is off, there is no active power supply and Vulcan can not function. This could be caused by a malfunctioning of the power plug. Please check if the power plug is correctly connected to the power source. Also please check if the impulse bands are without damage. If both are in order, the electric power adaptor may be malfunctioning.

green	red
●	○ ○

Green light is active/ all red pilot lights are off
The flashing of the red pilot lights indicates that the impulse generation is operating correctly. Although the power supply is active, if the red lights are off, the impulse generation may not be performing correctly. In this case, please contact the CWT office.

green	red
○	● ●

The green light is off/ the red lights are on
Although the green light is not illuminated which indicates the absence of power, the red lights approve the correct impulse generation. In this case, the green lamp is simply out of order due to a lamp malfunctioning.

My client installed Vulcan some days or weeks ago and now finds small particles and pieces in the aerator. This is a normal effect. The first layer of scale deposits inside the pipe are quite loose and crumble off easily. It is typical that they can be found within the first weeks of the operation. After that initial loose layer has been dismantled, you will normally not be able to notice any of the deposit removal as the scale is dissolved in the water and washed away.

My client came home after a vacation and when he turned on the water for the first time, it showed a red color. As the water in the house has been sitting in the pipe for some days or weeks it was soaking up the rusty color of the deposit. You will then see the red color until all water in the piping has been flushed out and new water is pumped through after that. This is not at all caused by Vulcan. Rather, the existence of red water in such a case simply proves that there are rusty deposits in the piping system. Vulcan will slowly dissolve them.

The top layer of the acrylic cast looks dull or yellowish. There are several possible reasons for a decolorization of the acrylic surface: Cleaning the Vulcan surface should only be done with a wet cloth and with no cleaning additives. A common mistake is to use a glass cleaner (e.g. windex) which harms the material. Another possible reason is direct exposure to sunlight. This can also discolor the surface. However, this is a cosmetic problem and does not influence the effectiveness of the treatment. CWT offers a repolishing service in such cases for a small fee.

My client tells me that he thinks the unit has been working great for a while (some months/ years) but seems to loose its effectiveness. What could be the reason behind this? And how can I check whether or not it is working? In order to verify results, in such cases, we advise you to provide your client with a new aerator for one of the faucets (e.g. for the bathroom). Please ask your client to send it back to you after a time-period of 12 weeks. How the aerator looks after that time is a very good indicator for the performance of Vulcan.

Furthermore, we advise unplugging Vulcan for a period of 4-8 weeks and then putting it into operation again. A rare but common phenomenon is that people get used to the Vulcan effect in the water after time - they lose their original objectivity. By stopping Vulcan for a while, the "normal", untreated water will show its typical problems again. When Vulcan is then put into operation again, the change will be obvious.

V. Appendix

15. Water hardness classification

Water hardness	**ppm** Parts per million (mg/l)	**GPG** Grains per gallons (US)	**°dH** German hardness
very soft	1-70	1.0 - 4.2	1.0 - 4.0
soft	71-125	4.3 - 7.2	4.1 - 7.9
medium hard	126-250	7.3 - 22	8.0 - 14
hard	251-500	23 - 30	15 - 21
extremely hard	501 and more	31 and more	22 and more

Deutsche Härte: °dH

	°dH	ppm parts per million/ liter	GPG grains per gallon US	°fH French Hardness
very soft	1	18	1,0	1,8
	2	36	2,1	3,6
	3	54	3,1	5,4
	4	71	4,2	7,1
soft	**5**	89	5,2	8,9
	6	107	6,3	10,7
	7	125	7,3	12,5
medium hard	8	143	8,3	14,3
	9	161	9,4	16,1
	10	178	10,4	17,8
	11	196	11,5	19,6
	12	214	12,5	21,4
	13	232	13,6	23,2
	14	250	14,6	25,0
hard	**15**	268	15,6	26,8
	16	285	16,7	28,6
	17	303	17,7	30,3
	18	321	18,8	32,1
	19	339	19,8	33,9
	20	357	20,9	35,7
	21	375	21,9	37,5
	22	392	22,9	39,3
	23	410	24,0	41,1
	24	428	25,0	42,8
	25	446	26,1	44,6
	26	464	27,1	46,4
	27	482	28,2	48,2
	28	500	29,2	50,0
	29	517	30,2	51,8
extremely hard	**30**	535	31,3	53,5
	31	553	32,3	55,3
	32	571	33,4	57,1
	33	589	34,4	58,9
	34	607	35,4	60,7
	35	624	36,5	62,5
	36	642	37,5	64,3
	37	660	38,6	66,0
	38	678	39,6	67,8
	39	696	40,7	69,6
	40	714	41,7	71,4
	41	731	42,7	73,2
	42	749	43,8	75,0
	43	767	44,8	76,7
	44	785	45,9	78,5
	45	803	46,9	80,3

GPG: Grains per Gallon - US

	GPG	ppm parts per million/l	°dH German Hardness	°fH French Hardness
very soft	1	17	1,0	1,7
	2	34	1,9	3,4
	3	51	2,9	5,1
	4	68	3,8	6,8
soft	**5**	86	4,8	8,6
	6	103	5,8	10,3
	7	120	6,7	12,0
medium hard	8	137	7,7	13,7
	9	154	8,6	15,4
	10	171	9,6	17,1
	11	188	10,6	18,8
	12	205	11,5	20,5
	13	223	12,5	22,3
	14	240	13,4	24,0
hard	**15**	257	14,4	25,7
	16	274	15,3	27,4
	17	291	16,3	29,1
	18	308	17,3	30,8
	19	325	18,2	32,5
	20	342	19,2	34,2
	21	359	20,1	35,9
	22	377	21,1	37,7
	23	394	22,1	39,4
	24	411	23,0	41,1
	25	428	24,0	42,8
	26	445	24,9	44,5
	27	462	25,9	46,2
	28	479	26,9	47,9
	29	496	27,8	49,6
extremely hard	**30**	514	28,8	51,4
	31	531	29,7	53,1
	32	548	30,7	54,8
	33	565	31,7	56,5
	34	582	32,6	58,2
	35	599	33,6	59,9
	36	616	34,5	61,6
	37	633	35,5	63,3
	38	650	36,4	65,0
	39	668	37,4	66,8
	40	685	38,4	68,5
	41	702	39,3	70,2
	42	719	40,3	71,9
	43	736	41,2	73,6
	44	753	42,2	75,3
	45	770	43,2	77,0

See: http://www.cactus2000.de/de/unit/masswas.shtml

	Vulcan Model	Max. pipe diameter	Max. capacity	Voltage	Wattage	Impulse Bands	Dimensions	Frequency range	Required Space	Programs
Residential Line	**3000** 	1 1/2″ (~ 38 mm)	3000 l/h (13 gpm)	48 Volt	2.2 Watt	2 x 1 m (~ 2 x 39″) 10 mm (~ 0.4″)	125/80/30 mm (4.9/3.1/1.2″)	3-32 kHz	~ 250 mm (~ 10″)	1
	5000 	2″ (~ 50 mm)	8000 l/h (35 gpm)	48 Volt	2.2 Watt	2 x 2 m (~ 2 x 79″) 10 mm (~ 0.4″)	150/90/30 mm (5.9/3.5/1.2″)	3-32 kHz	~ 350 mm (~ 14″)	1
Commercial Line	**S10** 	3″ (~ 76 mm)	15 m³/h (65 gpm)	48 Volt	2.5 Watt	2 x 3 m (~ 2 x 118″) 20 mm (~ 0.8″)	190/120/40 mm (7.5/4.7/1.6″)	3-32 kHz	~ 500 mm (~ 20″)	3
	S25 	4″ (~ 100 mm)	30 m³/h (130 gpm)	48 Volt	2.5 Watt	4 x 3 m (~ 4 x 118″) 20 mm (~ 0.8″)	200/130/40 mm (7.9/5.1/1.6″)	3-32 kHz	~ 800 mm (~ 32″)	5
	S50 	5″ (~ 125 mm)	70 m³/h (300 gpm)	48 Volt	2.5 Watt	4 x 4 m (~ 4 x 13′ 2″) 20 mm (~ 0.8″)	200/130/40 mm (7.9/5.1/1.6″)	3-32 kHz	~ 900 mm (~ 35″)	5
	S100 	6″ (~ 150 mm)	120 m³/h (530 gpm)	48 Volt	2.7 Watt	6 x 4 m (~ 6 x 13′ 2″) 20 mm (~ 0.8″)	230/150/40 mm (9.1/5.9/1.6″)	3-32 kHz	~ 1200 mm (~ 47″)	10
Industrial Line	**S150** 	8″ (~ 200 mm)	180 m³/h (790 gpm)	48 Volt	2.7 Watt	6 x 8 m (~ 6 x 26′ 3″) 20 mm (~ 0.8″)	230/150/40 mm (9.1/5.9/1.6″)	3-32 kHz	~ 1800 mm (~ 71″)	10
	S250 	10″ (~ 250 mm)	350 m³/h (1540 gpm)	48 Volt	3.0 Watt	8 x 10 m (~ 8 x 32′ 9″) 20 mm (~ 0.8″)	280/200/50 mm (11.0/7.9/2.0″)	3-32 kHz	~ 2500 mm (~ 99″)	10
	S350 	14″ (~ 350 mm)	500 m³/h (2200 gpm)	48 Volt	3.0 Watt	8 x 20 m (~ 8 x 65′ 7″) 20 mm (~ 0.8″)	280/200/50 mm (11.0/7.9/2.0″)	3-32 kHz	~ 3400 mm (~ 11′ 2″)	10
	S500 	20″ (~ 500 mm)	800 m³/h (3520 gpm)	48 Volt	3.5 Watt	10 x 30 m (~ 10 x 98′ 5″) 20 mm (~ 0.8″)	310/220/50 mm (12.2/8.7/2.0″)	3-32 kHz	~ 4500 mm (~ 14′ 9″)	10
X-Pro Line	**X-Pro 1** 	30″ (~ 750 mm)	works independent from capacity	48 Volt	4.0 Watt	12 x 25 m (~ 12 x 82′) 40 mm (~ 1.6″)	340/240/50 mm (13.4/9.4/2.0″)	3-32 kHz	~ 5600 mm (~ 18′ 5″)	10
	X-Pro 2 	40″ (~ 1000 mm)	works independent from capacity	48 Volt	4.0 Watt	12 x 50 m (~ 12 x 164′) 40 mm (~ 1.6″)	340/240/50 mm (13.4/9.4/2.0″)	3-32 kHz	~ 8200 mm (~ 26′ 11″)	10