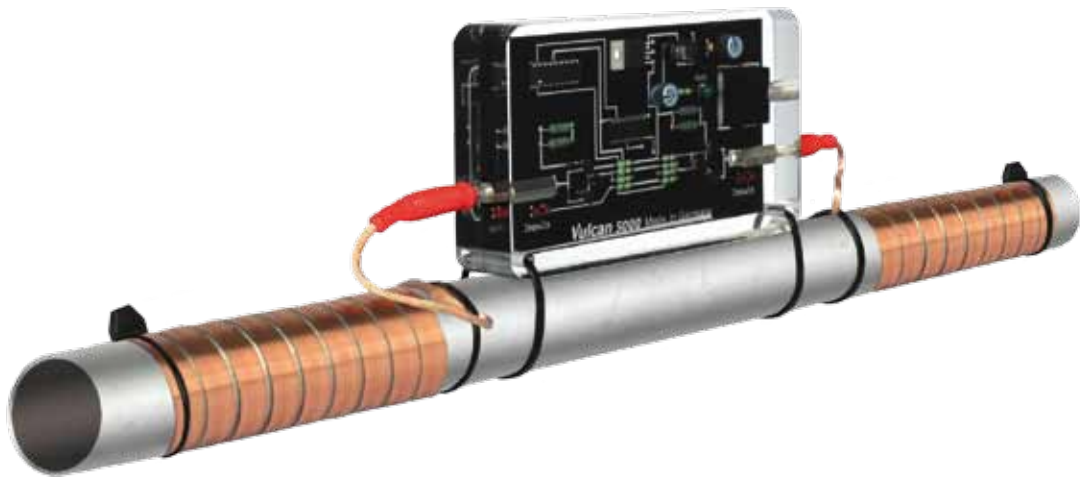


Reference Book



Against Scale and Rust

References / Quality / Studies



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Over 60 Years Christiani Wassertechnik GmbH



1948 - 2011

CWT is a family owned and operated business with its own factory for water treatment technologies in Germany. The production of the highest quality devices with the most advanced technology together with the continual research and commitment led to the success of the product line:

Vulcan – Against Scale and Rust

In this booklet you will find a selection of references by private, commercial and industrial users of the Vulcan anti-scale units. A number of independent studies reflect on the eco-friendly technology of physical water treatment in general and on the Vulcan-Impulse-Technology in specific. You will also find numerous independent studies and scientific papers on the principle of the eco-friendly physical water treatment and on the Vulcan units.

Restaurants and Food



Mövenpick Restaurant

Germany

Bediente Gastronomie

Mövenpick Restaurant Sanssouci, Zur Historischen Mühle 2, D-14469 Potsdam

Firma

Christiani Wassertechnik GmbH

Charlottenstraße 18

10117 Berlin



8. Dezember 2006

Referenzschreiben

Dear Sir,

our Mövenpick Restaurant opened in January 2000. After a short period of time we noticed a high level of limescale developing on the ice-cream makers. These calcifications could only be cleared bit by bit which is a time consuming process. To avoid potential losses a short-term limescale filter was installed. The operating time of this filter is limited however and thus results in high costs.

At a trade fair visit we consulted the company Christiani Wassertechnik GmbH about other possibilities.

We installed the limescale converter Vulcan 5000 and the ice-cream makers have been functioning smoothly for 10 months now.

The limescale, which accumulates especially in the crushed ice makers, can now be easily removed as it is converted into fine-grained structures.

We wish the company Christiani further success with their excellent products.

Yours Sincerely,

Marcel Charrier
Director

Mövenpick Zur Historischen Mühle Sanssouci
Zur Historischen Mühle 2
14469 Potsdam
Tel.: 0331 / 281 49 33
Fax 0331 / 281 49 50

Mövenpick Restaurant Zur Historischen Mühle Sanssouci, Zur Historischen Mühle 2, D-14469 Potsdam,

Phone +49 (0)331 28149-3, Fax +49 (0)331 28149-50, Direktor: Marcel Charrier

E-Mail: restaurant.potsdam-sanssouci@moevenpick.com, www.moevenpick.com

Mövenpick Restaurants Deutschland GmbH - Geschäftsführer: Dr. Hans Peter Rheinheimer, Dietmar Althof Sitz: Leinfelden-Echterdingen, Amtsgericht Nürtingen HRB 5437

Bankverbindung: Commerzbank Villingen-Schwenningen (BLZ 694 400 07), Kto-Nr. 157 949 9 - USt-ID.NR. DE 813471523 - USt. 99005/01679

Mövenpick Restaurant

Germany



Ice Machine



Vulcan 5000



Smooth Grain Structure



Soft Calcification

White Castle Restaurant

USA



Installation of Vulcan water treatment



Installation site: White Castle #49, Indianapolis, USA
Model: Vulcan 1000 (installed on the line after the carbon filters)
 Vulcan 5000 (installed on the main inlet line, before the 5 micron carbon filters)

White Castle #49 – April 14, 2011

The R2D2 had been in service only 3 weeks and you can see the stainless steel is already etched at the water line (Picture 1). The water feeding the R2D2 was changed to being fed after the standard 25 micron but before the 5 micron carbon filters.

The Vulcan 5000 is located in the main line, but before the 25 micron filter. The Vulcan 1000 is located in the line after the carbon filters.

The installation of Vulcan 1000 and Vulcan 5000 solved this hard build-up problem successful.



Picture 1: Etched stainless steel after only 3 weeks in service, without using Vulcan.

Before using Vulcan - April 14, 2011

Hard calcium deposits in the pan.



Without Vulcan

3,5 weeks after installing Vulcan - May 12, 2011

95% less calcium deposits in the pan



With Vulcan treatment

After this very successful using of Vulcan in our White Castle restaurant #49 in Indianapolis, we installed the Vulcan 1000 and Vulcan 5000 device also in the White Castle restaurant #32 in New York and the White Castle restaurant #38 in New Jersey.

McDonald's Ltd.

Ukraine



McDonald's Ukraine Ltd.
7, Gryshka Str., Kyiv, 02140
"МакДональдз Юкрейн Лтд."
вул. Гришка, 7, Київ, 02140

+38 (044) 230-09-00
+38 (044) 230-09-01
www.mcdonalds.ua

Dear Cedric,

Thank you very much for your special attention for "McDonald's Ukraine Ltd".

From our side we're very grateful for your cooperation and support during the 10 years period of time.

Our company began to operate in Ukraine in the year 1987.

And during this period we've already opened 57 restaurants "Mc Donald's". Which is a good result.

In all of these restaurants we installed the equipment by CWT, which is in a good account in Ukrainian Market.

Besides this equipment is easy for installation and very handy in exploitation.

As for me I want to add that support of your company is very important for us.

Best regards,
Eugene Molodid
Equipment Coordinator
McDonald's Ukraine Ltd



Р/р 2500299 в АТБ "Агаль" м. Києва МФО 300335
Account No 2500299 with RUAL Bank Kyiv / bank code 300335

Wolfies Waterfront Grill

Indiana, USA



June 9, 2011

Salt-Free Water Systems, LLC
1429 Casco Bay Circle
Cicero, IN 46034
Attn. Jim Schneider and Dick Van Voorhis

Dear Jim and Dick,

I want to let you know how satisfied I am with the results using the Vulcan 5000 water conditioner in my restaurant, Wolfies Waterfront Grill in Noblesville, IN.

Here are the positive results using the Vulcan system:

- The Vulcan immediately solved a problem with our restroom water fixtures.
- The Vulcan eliminated our water softener, along with the required salt and water consumption.
- The Vulcan drastically reduced our dishwasher soap usage.

With this environmentally friendly product, the above savings resulted in a return on investment within 6 months.

Sincerely,

Scott Wolf
Owner, Wolfies Waterfront Grill



Wolfies WaterFront Grill Restaurant, Noblesville
20999 Hague Road
Noblesville, Indiana 46062
317.219.6521

Eberswalder Wurst GmbH (Sausage Production)

Germany

EWG Eberswalder Wurst GmbH

Eberswalder... Richtig gut die Wurst



Zertifiziert
Qualitätsmanagementsystem
DIN EN ISO 9001:2005-12
IFQA-CERT
Registrier-Nr.: 129 803
ILN 4012371000004

☐ EWG Eberswalder Wurst GmbH - Joachimsthaler Str. 100 - 16230 Britz

Christiani Wassertechnik GmbH
Heinrich-Heine-Str. 15

52249 Eschweiler

Ihr Zeichen:
Ihre Nachricht vom:
Unser Zeichen: HS/GR
Tel. Durchwahl: 03334 / 273448
Telefax: 03334 / 273593
e-mail: technik@eberswalder.de
Datum: 11.12.06

Dear Sir,

We have been using your patented Vulcan-Impulse-Technology for over a year with great success.

Despite the use of chemicals during the pasteurisation of vacuum-packed sausages such as hard water stabilising agents and corrosion inhibitors, heavy scale deposits accumulated in the pipes and the holding tanks which could only be cleared through intensive chemical purification several times throughout the year.

Six months following an intensive purification and the application of your „Vulcan“ technology and without the use of chemicals, only very few deposits in the warming zone and none at all in the cooling zone could be found. These deposits need now only to be cleared once a year at a considerably lower cost.

We wish you further success with your technology against scale and rust.

Yours Sincerely,



Heimit Schwendler
Director of Engineering

EWG Eberswalder Wurst GmbH
Sitz der Gesellschaft: Britz
Amtsgericht Frankfurt (Oder) HRB 808377
Ust. Id. Nr.: DE 219617354 - St. Nr.: 065/108/00887
Geschäftsführer: Dr. Eckhard Krone, Patricia Benz

Bankverbindung:
HSN Nordbank AG Hamburg/Kiel
BLZ: 210 500 00
Konto Nr.: 0063063181

Anschrift:
Joachimsthaler Str. 100
16230 Britz
Telefon: 03334 273 -0

Eberswalder Wurst GmbH (Sausage Production)

Germany



Fritz Häcker - Gelatine Production

Germany

Fritz Häcker GmbH + Co. KG · Postfach 1265 · D-71655 Vaihingen/Enz

To
 Christiani Wassertechnik GmbH (CWT)
 Attn. Mr. Cedire Christiani
 Köpenicker Strasse 154
 10997 Berlin

30th July, 2009
 -- / bo

Water Treatment System VULCAN

Dear Mr. Christiani,

We are a company in the adhesives industry originating from the gelatine production. Traditionally a high amount of water is required for the extraction process related to the production of gelatine. For this we have our own deep wells from which the required water is drawn. Due to the geology of the Enztales the water is relatively hard which inevitably results in thick layers of adherent limestone in the tanks some of which only were removable by chemically substances. The water heater as well calcified relatively quickly.

To remedy this, we have already taken one of your Vulcan systems into operation in the central hot water supply in 2003. We were stunned by its results, especially as the opinion about this kind of water treatment systems is very much divided.

The physical treatment of the water by VULCAN caused a significant reduction of adherent limestone in the tanks and piping surfaces. Decalcification actions had to be executed in considerably larger intervalls.

We are convinced of the viability of these systems and can only find words of praise for the service given should a defect occur. On this basis, we will certainly continue to work together.

Best regards

Fritz Häcker GmbH+Co.KG
 General Management
 Klaus Böhne

Kommanditgesellschaft Sitz Vaihingen/Enz
 Registergericht: AG Vaihingen/Enz HRB 24
 Handelsregister: Fritz Häcker Verwaltungsgesellschaft mbH
 Sitz: Vaihingen/Enz
 Registergericht: AG Vaihingen/Enz HRB 89
 Geschäftsführer: Gerd B. Clemens

Volksbank Ludwigsburg eG
 BIC: GENODE33HAN
 Kto.: 432 009 000, BLZ 604 901 50
 IBAN: DE 31 6049 0150 0432 0090 00

Kreissparkasse Ludwigsburg
 BIC: SKSL33HAN
 Kto.: 8 800 350, BLZ 604 900 50
 IBAN: DE 12 6045 0050 0008 800350

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 Internet: www.haecker-gel.de

Steuer Nr.: 55092/10451, Ust-Nr. DE 145092179

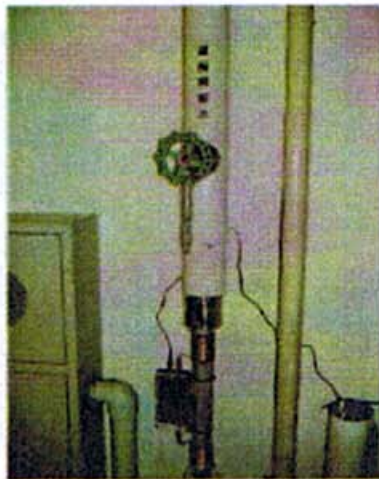
Grease Trap in a Food Factory

Japan

Grease trap measures in a food factory Installation example

Installation: February 2007

Type: Vulcan 5000



Free-from-trouble structure and easy installation
LED always blinks dependably as it shows processing conditions.

Before Vulcan installation



3 months after Vulcan installation



Comments by a person in charge of the food company

It seems that an effect as the water treatment system appears in view of the result from the last three months, based on only the phenomenon, because the test itself is not a comparison with the last year.

When I opened a manhole in the first 2nd month, I noticed strong odor in spite of the low temperature outside.

On the contrary, no sensible odor attacked me when opened it in May.

As for the cleaning interval, monthly cleaning may not be required if the current condition continues though I used to do it monthly in the summer season.

The effect and cleaning interval of Vulcan will require an annual observation, however, I think the cleaning work can be reduced remarkably.

Personally, Vulcan is one of the attractive instruments.

Marcel SINAI "Les Aires"- (olive oil production)

France

Marcel SINAI
" Les Aires "

Route du Destet - Quartier des Calans
13520 MAUSSANE LES ALPILLES

Téléphone : 04 90 54 30 86
Portable : 06 87 89 54 52
email : marcelsinai@wanadoo.fr

CWT
Köpenicker Str. 154
10997 BERLIN
Germany

Reference: 12102680 Vulcan 5000



30th October, 2012

Dear Sirs,

I purchased this unit at the BATIMAT 2007 in Paris under the reference 21623.

The new model is installed and seems to work satisfactorily because we have no traces of limestone on our ro-binneterie GROHE stainless steel. The water in our region (la Provence) is particularly limestone.

With thanks for your service, I beg you to believe the assurance of my best wishes.

Marcel SINAI

A handwritten signature in black ink, appearing to read 'Marcel Sinai', written over a light blue horizontal line.

Producer of olive oil



Cheese Dairy K & P Zimmermann

Switzerland

K & P. Zimmermann
Fromagerie
2333 La Ferrière
032 961 11 53

CWT-International
W. Kurt
4103 Bottmingen

La Ferrière 24.Feb.2011

CWT Vulcan S25 - 3 months-test in the cheese dairy and apartments of K & P Zimmermann in La Ferrière in Switzerland

The chrome pipes have visible less scale deposits and it is easier to clean them - just with a damp cloth. Also in the pans the scale doesn't attach so much and it is easy to remove.

One month after the installation of Vulcan S25, we made a test with a rusty nail. After two weeks the nail was clean.

Summary: For us is Vulcan the easy solution against scale and rust and keeps our piping system and appliances clean. We need less maintenance and save money with it.



Le Vulcan testé durant 3 mois dans les locaux de fabrication de la fromagerie ainsi qu'au ménage.

Observations faites durant les 3 mois: les tuyaux en inox ont moins de taches blanches, voir même plus du tout. Un coup de chiffon et l'on ne voit plus rien.

Au ménage, les casseroles sont moins encrassées, le peu de calcaire déposé s'enlève facilement.

Autre teste effectué un mois après l'installation de l'appareil: Pose d'un clou rouillé dans un verre d'eau. Au bout d'une à deux semaines, le clou est devenu noir et la rouille s'est déposée au fond du verre.

Conclusion: Nous sommes d'avis que cet appareil est simple d'utilisation et contribue à protéger les appareils ménagers et autres du calcaire. Un nettoyage plus aisé de la tuyauterie est aussi agréable.

Hotels / Apartment Buildings / Spa and Wellness



Hotel Q!

Germany



Q! Knesebeckstr. 67 D-10623 Berlin

CHRISTIANI Wassertechnik GmbH
Heinrich-Heine-Str. 15
D-52249 Eschweiler

Re: Letter of recommendation from Hotel Q!

May, 10th 2005

Dear Mr Christiani,

It is a pleasure for us to inform you that we have been very satisfied with the Vulkan-S-50 lime-scale conversion-unit with which you have supplied us.

As we are engaged in the hotel business and committed to cleanness, doing our best endeavours to combat lime-scale is all the more important to us. In respect with the daily cleaning of the guest rooms as well as the hotel facilities in general it is of paramount importance to maintain everything clean, and the unit you have provided us with helps us a lot to attain this goal.

The "Vulkan S 50"-unit makes the daily cleaning of our hotel facilities easier and also allows us to save a lot on cleansing agents for it is no longer necessary to use as much of them as we used to before.

I would like to single out for praise the fact that the chalk converted by this device no longer settles on fittings and panes of glass as it usually did before, which enables us to maintain showers and fittings free of lime-scale without any trouble.

Therefore, our hotel will gladly recommend this unit to other clients. We would also like to thank you for granting us a trial period to test your device.

Yours sincerely

Gordon Deckelmann
Technical Director / Maintenance

Q!
Knesebeckstr. 67
D-10623 Berlin
tel. +49 (30) 81 00 66 - 0
fax +49 (30) 81 00 66 - 666
www.lock-hotels.com
q-berlin@lock-hotels.com

Hackescher Markt
Betriebsgesellschaft mbH
Amstergasse 11, Charlottenburg
10557 Berlin

Hotel Mercure

Germany



Leopoldstr. 120 • 80802 MUENCHEN • GERMANY

Christiani Wassertechnik GmbH
Heinrich-Heine-Straße 15
52249 Eschweiler

Re: physical water treatment unit Vulcan S 100

Munich, November, 9th 1995

Dear Mr. Christiani,

We are pleased to inform you that the water treatment unit has been working perfectly and to our full satisfaction ever since its installation in July 1995.

Only a short time after that we observed that we no longer needed acetic or asorbic acid in order to clean the perlators and shower heads in our hotel, which has more than 65 guests rooms, since the chalk that builds up now is no more than a layer which is easy to wipe off. Due to the fact that the efforts employed at maintaining the sanitary facilities can be kept to a minimum, and resulting from the smaller electricity consumption, we are able to economise. Simultaneously, we also make an active contribution to environmental protection by renouncing on aggressive cleansing agents.

We are glad to own a water treatment unit that is compatible with the environment and which renders the optimum output at low running costs (approx. 10 € on electricity costs/year). Moreover, this unit has finally provided us the solution to a problem we had been confronted with day by day and which was difficult to put up with.

Given our satisfaction it will always be a pleasure for us to recommend your company and your product to other clients.

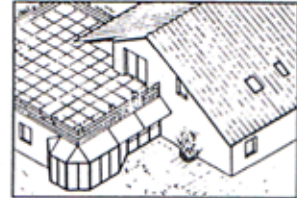
Sincerely yours

Horst Schneider
Director

Hotel Cadolzburg

Germany

HOTEL-KURBAD ZUM WASSERHAUS CADOLZBURG



Firma
Christiani Wassertechnik GmbH
Heinrich-Heine-Str. 15

52249 Eschweiler

14th June 1994

Your Water Treatment Device Vulcan 5000 Four week test

With this letter I would like to give you some insight into our experience with your water treatment system.

As we have a water hardness level of around 16 °e in Cadolzburg and as a spa have to use a great deal of water, we have always had problems with calcification of all kinds.

To get rid of this problem, we have already used two different types of devices from other manufacturers whose systems work according to a design similar to yours. As these both failed, we had to take out both products.

When we saw how simple your system is, we were honestly fairly skeptical and even more so when we saw how your technician installed the product on our entry pipe in minutes with no tools. Still after only a few days we noticed a clear difference in the calcium levels. Where there was previously hard calcium deposits that had to be removed with cleaning fluids, now we saw just a light white film that could easily be removed. We also saw that shower heads and water pearling devices no longer showed signs of calcification.

We will, without a doubt, keep the Vulcan 5000 and attached is our check. Furthermore, I wish you great success in convincing others and wish your company all the best.

Sincerely




Mitglied im
Verband Physikalische Therapie,
staatl. gepr. Masseure und med.
Bademeister



**BAYERISCHER
HOTEL-UND GASTSTÄTTEN
VERBAND E.V.**

Bankverbindung: Raiffeisenbank Zirndorf · BLZ 760 696 69 · Konto-Nr. 305 553
8501 Cadolzburg · Zum Wasserhaus 2 · Inhaber: S. R. Heidig · Telefon 09103/2575

Hotel Meridien N'Fis

Morocco



Avenue Mohamed VI
40000 Marrakech
Maroc
Tel : 212 (0) 5 24 33 94 13
Fax : 212 (0) 5 33 94 02 / 05 44 76 79

abderrahmane.moursil@lemeridien.com

www.lemeridien.com

Marrakech, 31st of March, 2010

Subject: Certificate of Reference

I, the undersigned Moursil Abderrahmane, Chief technical officer of the Hotel: “Le Meridian N’Fis” located on Avenue Mohammed VI, in Marrakech, certified by the presence of:

- Mr. Karim BELGNAOUI, Managing director of the Company: “MPK TRADE” located in Casablanca, Residence the Manor house 4, Rue Mustapha Al Manfalouti (Gauthier District)

In collaboration with our hotel in February 2010 for the supply and the installation of an electronic device to treat a pipe diameter of 4” of the: “VULCAN” brand for the prevention and the elimination of scale deposits upstream of our hydraulic installations.

With sight of the very satisfactory result of this product, we thus plan to entrust to this company future projects in the aim of protecting our installations of scale. In witness thereof, this certificate of reference is delivered following the request of the interested party.

Dated: Marrakech, March 31, 2010.

A. Moursil
Directeur Technique.

Apartment House

Tokyo

Example of installation for Vulcan (pulsed water treatment system)



Installation site

: The roof of an apartment building in Tokyo prefecture.
(an apartment building built 20 years ago with 46 houses)

Water supply system: Tank at top of roof

Piping diameter : 80 mm

Model : vulcan S25 (external box type)

Water treatment capacity : 25 m³/hour



Before installation:

The cover and the lagging material on the piping are removed for installation.



[cable winding completed]



installation to cables and the Vulcan S25 with in box.



The piping with cable would has been covered with each new the lagging material and the cover.
Installation for the vulcan completed.

Apartment House

Tokyo

Example of installation for Vulcan (pulsed water treatment system)



Installation site
: An apartment building in Tokyo prefecture.
(an apartment building built 12 years ago with 23 houses)

Water supply system: Direct & multiply pump system

Piping diameter : 65 mm

Model : vulcan S25 (external box type)

Water treatment capacity : 25 m³/hour



Before installation:
The cover and the lagging material on the piping are removed for installation.



[cable winding completed]



The piping with cable would has been covered with each new the lagging material and the cover.
Installation for the vulcan completed.

MeridienSpa Berlin

Germany

Vulcan S250 Installation
MeridianSpa in Berlin, Germany



Other References



HARTWALL Ice Hockey Arena

Finland



HARTWALL AREENA
Helsinki Halli Oy
Areenankuja 1, FIN-00240 Helsinki
Tel. +358 (0)204 1997, Fax +358 (0)204 1994
Internet: <http://www.hartwall-arena.com>

Hartwall - Areena
Areenankuja 1
FI-00240 Helsinki,
Finland

CWT-Christiani Wassertechnik GmbH
Herr Rolf Christiani
Köpenicker Str. 154
10997 Berlin



Dear Sir

We have been using CWT-Christiani Wassertechnik GmbH
Vulcanwater treatment equipment in our ice hockey hall Hartwall
Arena since 2003.

We are using many sizes of several heating/cooling equipment
in our water system:

- Vulcan 5000
- Vulcan S 25
- Vulcan S 100.

We have reliability with these systems and have been most satisfied
in using them.

Vulcan is a high-quality and great solution to different kind of
premises.

Yours sincerely,

Hartwall - Areena

A handwritten signature in blue ink, appearing to read "Jari Väänänen".
Jari Väänänen



Pilbara Commercial Laundry Services

Australia

Pilbara Commercial Laundry Services

Unit 5 9 Byass St, South Hedland,
WA, 6722, Australia



Testimonial with Jamie Cavey

June 2011

Hi, my name is Jamie Cavey and I operate the only commercial laundry in the Pilbara - Pilbara Commercial Laundry Services. We are mid-size operation that specializes in the laundering of hotel linen, mine site linen and work clothes.

Living in a hard water area like the Pilbara means we have ongoing problems with calcium build up in our piping and air-conditioning systems. The calcium sticks to the heating elements and the whole internal section of the hot water system becomes completely clogged with calcium.

Twelve months ago we installed a German made CWT Water Treatment System from the team at Southern's Water Technology in Bunbury and immediately we noticed a significant reduction in the build up of calcium.

I believe we have quadrupled the life span of our evaporated air conditioner and we haven't had to replace our hot water system for more three years.

Without the CWT Water Treatment System we would be replacing our hot water system every two years at a cost of more than \$10,000.

There is no doubt the CWT Water Treatment System will prolong the life span of your piping and hot water systems and evaporative air-conditioning units.

The CWT Water Treatment emits high frequency electrical impulses into the water which changes the crystal formation of the calcium.

After the treatment, the adhesiveness of the crystals is reduced so that scale is unable to form in the pipes.

You can actually see the calcium slowly breaking down through the drainage system.

Sincerely,

Jamie Cavey

Exhibition Center Cologne - Messe Köln

Germany



c/o Bayer Gastronomie GmbH · Deutz-Mülheimer Straße 30 · 50679 Köln · Deutschland

Christiani Wassertechnik GmbH
Heinrich-Heinestr. 15
52249 Eschweiler

Vulcan 1000 Service Report

Dear Sir,

A few months ago we installed your Vulcan 1000 water treatment system in our catering services at the Cologne trade fair. In recent years we have had problems in particular with the coffee machines and dishwashers due to the hard water in Cologne. The machines had to be maintained frequently and the cleaning costs of the kitchens were very high.

After the installation of your water treatment system in our bistros I noticed a clear improvement of the situation. The limescale deposits are now much easier to remove thus easing the workload of the staff. Less detergents are needed and I am altogether extremely satisfied with your device.

Unfortunately I am unable to give a long-term conclusion over the scale reduction at this point in time as it is not possible to see inside the pipes. I am convinced however by the effects visible outside the pipes and can therefore fully recommend Vulcan.

Yours Sincerely,


Gabor Ernoehazai
Technical Manager Cologne trade fair

Catering managed by


Datum
07.09.2006

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Telefax
+ 49 221 284- 9515

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50679 Köln
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Telefax +49 221 284-9445
koelnmesse@bayer-gastronomie.de
www.bayer-gastronomie.de

Koelnmesse Service GmbH
Messeplatz 1
50679 Köln
Deutschland

Geschäftsführung:
Dr. Stefan Eckert
Vorsitzender des Aufsichtsrates:
Axel Kaske

Sitz der Gesellschaft und
Gerichtsvorstand: Köln
Amtsgericht Köln, HRB 33054

Siemens

Germany

SIEMENS

Christiani Wassertechnik GmbH
Diepenbenden 25

5100 Aachen

Water treatment system

Dear Sirs,

we have installed one of CWT water treatment devices in the Siemens circuit board manufacturing plant.

In order to test the performance of the system we have placed the unit just before a cleaning station (with 50°C. ~ approx. 122 F).
Due to a water hardness we had to de-scale the nozzle pipes on a daily basis and we had to run a full cleaning process once a week. Since we have started your water treatment system approx. five weeks ago, the scale deposits have reduced so much that we did not have to run a single cleaning since then. Furthermore, we noticed that the already existing scale layers are slowly removed.

Sincerely yours



Postanschrift:
Siemens AG, Bereich Kommunikations- und Datentechnik
Werk für Systeme

Lp/Fe Verf/masch. Anlagen

Postfach 11 18 09, D-8900 Augsburg 11

Bearbeiter:
Hr. Neumann

Fernwahl 08 21

Ttx

(Tg)

Fax

Vermittlung

Siemens Aktiengesellschaft Bereich Kommunikations- und Datentechnik
Werk für Systeme - Werkleitung: Hartwig Rogge

Vorsitzender des Aufsichtsrats: Bernhard Plettner - Vorstand: Karlheinz Kaske, Vorsitzender - Mitglieder: Hans Baer, Gerhard Bönecke, Hermann Franz, Hermann R. Franz, Ernst Gerhardt, Max Günther, Heinz Gumin, Erwin Harß, Gisela Kadegge, Claus Kessler, Eberhard Kell, Gerhard Kühne, Friedrich Kuhl, Heino Nägele, Hans-Gerd Naglein, Werner Poschennieder, Konrad Samberger, Hans H. Schlitzberger, Carl Heiner Thomas, Hans Günter Vogelsang - Sitz der Gesellschaft: Berlin und München - Registergericht: Berlin-Charlottenburg, HRB 12300, München, HRB 6684

BOSCH und Siemens Hausgeräte GmbH

Germany

B/S/H/

BSH BOSCH UND SIEMENS HAUSGERÄTE GMBH

BSH Bosch und Siemens Hausgeräte GmbH, Postfach, 13623 Berlin

Fa. Christiani Wassertechnik GmbH
Herr Zahn
Heinrich-Heine Str. 15
52249 Eschweiler

Ihre Zeichen/Nachricht vom:
 Unsere Abteilung/Kurzzeichen: TD/schm/vw

Telefon: 030 388 26301
 Telefax: 030 388 26394

E-Mail:
 Berlin, 20.02.2001

Dear Mr. Zahn

We have installed the Vulcan S100 water treatment on May 17th, 2000 and are fully satisfied with the performance.

The unit treats the water that refills the cooling towers which consists of public water (50%), de-calcified water (30%) and VE-water (20%). It is installed directly on the main pipe (DN100).

This water refills the gap water of 8 cooling towers. Right after installation the usual problems with scale build up of the sensitive conductive sensors stopped. Before that we had to clean them on a 4-week interval.

The maintenance work is no longer needed.

If we need more water treatment any time in the future, we will contact you again.

Sincerely yours

BSH Bosch und Siemens Hausgeräte GmbH

Produktbereich Wäschepflege

Technische Dienste Instandhaltung

H. Schmidt

Postanschrift: BSH Bosch und Siemens Hausgeräte GmbH, Postfach, 13623 Berlin

Besucher: Gartenfelder Straße 28, 13559 Berlin

Vermittlung: (0 30) 3 88-0; Fax (Zentrale): (0 30) 3 88-2 62 96

Vorsitzender des Aufsichtsrats: Jürgen Radonski

Geschäftsführung: Dr. Kurt-Ludwig Gutermiet (Vors.), Dr. Wolfgang Colberg, Dr. Wolfgang Dowle, Hans-Peter Hzaan, Dr. Robert Kugler

Sitz: München; Registergericht: Amtsgericht München, HRB 75534

H. Zahn

Garden Shop (Agriculture)

Greece



Dimitrios Vasileiadis
Garden shop
Papad-Vasileiadis-Loizidou OE.
Aerodromiou Sedes str & Aerodromiou Makedonia str.
570 01Thermi-Thessaloniki
Greece

Christiani Wassertechnik GmbH
Köpenicker Str. 154
10997 Berlin
Germany

24. November 2008

Dear CWT,

I am a professional cultivator of decorative plants and trees for more than 30 years. I have always hard water quality problems. This water, I irrigate with it, comes from a bore. This water is brackish, which means of course, it is very bad for the plants. Actually, I have been burning my plants all these years because of too much salt.

I also have to emphasize on the fact that all these years the leaves of the plants had a white colour and not the well known green colour. That is of course because of too much salt of the water.

Installing the Vulcan S 25 device, I found out that there are not any more white sedimentation on the leaves and soil. Most of all I realize that there is a big improvement in the growth of my plants. I also found out that there is a better and quicker foam creation. Wherever we want to wash our hands or even clothes etc.

Finally, I must say that I really found the solution to my problem, which has been bothering me for all these years, using the Vulcan device.

I really have to thank you from the bottom of my heart.


Δημήτριος Βασιλειάδης



Without treatment



With Vulcan treatment

Gegenbauer Healt Care Services GmbH

Germany

Gegenbauer

Facility Management seit 1925.

Gegenbauer Health Care Services GmbH • c/o St. Joseph Krankenhaus •
Bäumerplan 24 • 12101 Berlin

Firma

Christiani Wassertechnik GmbH
Charlottenstraße 18

10117 Berlin

14. April 2008

Vulcan S 250

Dear Mr. Christiani,

we are as a facility management company responsible for the maintenance and repairs inside the St. Joseph Hospital in Berlin. Due to the hard water in Berlin we used to have very bad problems with scale incrustations on the sanitary equipment. The maintenance and cleaning of the 2.500 shower equipment and bathrooms alone was at very high costs.

Since a couple of months we have the Vulcan S 250 installed inside the hospital. We can identify a considerable benefit of the unit installed. We can barely see any scale deposits on the shower heads for example any more now. This saves manpower and costs of the exchange of sanitary equipment.

We can honestly recommend the unit installed by CWT GmbH.

Mit freundlichen Grüßen

John Behrens
(Servicemanager)

**Gegenbauer
Health Care Services
GmbH**

c/o St. Joseph Krankenhaus
Bäumerplan 24
12101 Berlin

Ihr Ansprechpartner

John Behrens
Gegenbauer Health Care Services
GmbH
im St. Joseph Krankenhaus
Bäumerplan 24
12101 Berlin

Geschäftsführer
Jürgen Betzloff
Hartmut Schwerdt
Wolfgang Wegener

Sitz der Gesellschaft
Paul-Robeson-Str. 37, 10439 Berlin
Amtsgericht Charlottenburg
HRB 67869

Bankverbindungen
Berliner Bank BLZ 100 200 00 Kto. 3167337600
Deutsche Bank AG BLZ 100 700 00 Kto. 0630024800

Ralons Lavandería (laundry service)

Spain



Dear Sirs,

After multiple problems with scale build-up in our irons and laundry equipment we decided to try and solve this situation. After much research, we finally found the solution we were looking for. We chose the innovative line of water treatment, Vulcan. The Vulcan S25 unit was installed in March of last year.

Up until now, the results obtained have been entirely satisfactory; not only because the scale does not stick to surfaces anymore, but also because of the raised quality of the laundry which has a less-abrasive effect on the clothes. This has helped increase our service quality and customer satisfaction.

For the above reasons, we certify the complete effectiveness of the Vulcan S25 device installed in our company.

Sincerely,

LAS PAMAS
C/ Puerto Rico, 2 Pta. 3 – 2º Ofic. 3
35010 – Las Palmas de Gran Canaria
Telf.: 902 226 047 • Fax: 928 226 008

TENERIFE
Subida a El Mayorazgo, 16
38009 – Santa Cruz de Tenerife
Telf.: 922 236 030 • Fax: 922 211 048




Esther Meca Cervera
Jefa Dpto. Sistema Integrado de Gestión
Calidad, Medio Ambiente, PRL y Organización
RALONS LAVANDERÍA, S.L.
GRUPO RALONS

Reg. Merc. de Las Palmas de G.C.
Folio 159 Tomo 1915
Hoja GC-41489 Inscripción 1ª
C.I.F. B-76014554

1 de 1
www.gruporalons.com



Aigües de Vallirana

Spain

AIGÜES DE VALLIRANA

Conca de Tremp, 14

Urb, El Mirador

08759 VALLIRANA (Barcelona)

Tel. 683 07 56 - Fax. 683 22 70

22nd July 2002

CALTRONAQUA

Pasaje Bon Retir, local 5

08759-VALLIRANA

(Prov. de Barcelona)

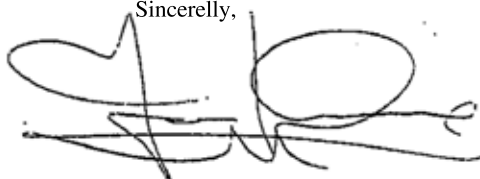
Dear Sirs:

We want to confirm the excellent quality and functionality of the eco-friendly anti-scale system Vulcan 5000.

Vulcan 5000 was installed more than one year ago, in a gravity conduction pipe, from well to deposit, with 63 mm diameter, 500 length and 10 m of bench between both ends, in which we often had to proceed in order to keep it clean and free of scale and incrustations. The truth is, during the last year, since we installed your unit, we could forget completely all kind of maintenance and cleaning process.

We trust in the long-term efficacy of Vulcan 5000, and take this opportunity to send you our best regards.

Sincerely,



Fdo. José Coma y Matute.
Director-Apoderado

Evangelic Hospital Gladbach

Germany

EVANGELISCHES KRANKENHAUS BERGISCH GLADBACH

GEMEINNÜTZIGE GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG
- AKADEMISCHES LEHRKRANKENHAUS -

Firma
CALTRON Wasseraufbereitungs GmbH
Heinrich-Hoerle-Str. 2
Postfach 650150

5000 Köln 60

July 3rd, 1984

Dear Sir or Madam,

in December 1983 installed a water treatment system in our senior citizens residence. The system has been running for six months by now and we are very pleased with the results.

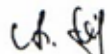
We have a total of 478 water outlets in the building (289 water taps, 97 toilets, 92 showers). When checking the water tap outlets and showers we no longer find the typical scale build up or blockages. We have an indoor swimming pool which we use for all medical therapies. In this area we are also fully content with the effect of the Caltronic water treatment.

For facilities for elderly people like ours it is inevitable to use water treatment that functions without chemicals or additional salt. We face an annual water consumption of 12.000 cubic meters (m3) [equals approx. 75478 gallons US] where a chemical system would cause tremendous costs and maintenance work for us. Compared to that, the annual costs of the Caltronic water treatment system - which has been working without any malfunction and functions without any maintenance work - sum up to 50 DM [approx. 27 USD].

Sincerely yours,



BR Klein
Managing director



A. Dietz
Facility manager

Postcheckkonto

Köln 501 10 506 (BLZ 370 100 50)

Bankkonten

Kreisbank Bergisch Gladbach 311/001 109 (BLZ 373 502 11)
Deutsche Bank Bergisch Gladbach 630/7524 (BLZ 370 700 60)
Bank für Sozialwirtschaft Köln 41 412/00 (BLZ 370 205 00)

Pfaffrather Radfahrbank eG Berg. Gladbach 5173 (BLZ 370 696 00)
Dresdner Bank Bergisch Gladbach 8583 584 (BLZ 370 800 40)
Bank für Kirche und Diakonie Dursburg 20 354 (BLZ 350 601 90)

Aufsichtsratsvorsitzender: Dipl.-Kfm. Heinz Haffmeyer

Geschäftsführer: Wilfried Wüschel, Dr. Walter Klein

Amtsgemeinschaft Bergisch Gladbach HRB 12

Energetika Ravne d.o.o

Slownia

ENERGETIKA RAVNE, d.o.o.

gord GABERŠEK!

5. VII. 00

Jamšek

Ravne, July 4th 2000
RP 12.00/1029/RJ

**SUBJECT: INSPECTION OF TUBE HEAT EXCHANGER (2X) UHP FURNACE,
OPEN SYSTEM 40/30 °C**

Upon the agreement with Mr Petovar, we have concluded to inspect both tube heat exchangers on the secondary part of the UHP furnace on Tuesday, July 4th 2000. The front and rear covers of both exchangers shall be disassembled.

PRESENT AT INSPECTION:

Petovar – SŽ Metal Ravne, d.o.o. JUH OTO

Oderlap, Vučko, Potočnik, Jamšek, Zapušek – Energetika Ravne, d.o.o.

ESTABLISHMENTS:

The inspected tubes were clean; there were no signs of lime scale accumulation.

The device for electronic softening is functioning well.

CONCLUSION:

We suggest that the device is purchased.

Petovar

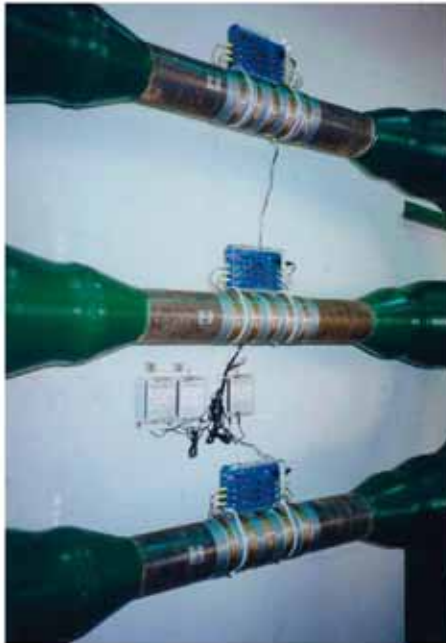
ENERGETIKA RAVNE d.o.o.
RAVNE NA KOROŠKEM
①

Oderlap
Vučko
Jamšek
Zapušek

PRESENTATION OF ASSEMBLY AT SŽ-METAL d.o.o. RAVNE



SITUATION BEFORE INSTALLATION – ADJUSTMENT OF TUBE Ø



SITUATION AFTER INSTALLATION
AND SWITCH-ON



CONTROL OF HONEY COMB
FILL OF COOLING TOWER

Dynamit Nobel

Syria

Dynamit Nobel

AKTIENGESELLSCHAFT

WERK LÜLS DORF

DYNAMIT NOBEL AG, Werk Lültsdorf, 5216 Niederkaassel

Firma
Christiani Wassertechnik GmbH
Diepenbenden 25
5100 Aachen

Water treatment device

Dear CWT-team

Up to now we had five devices from your company in use.

Because of the high degree of hardness of our cooling water, we had to decalcify every few months. After we used the devices, the scale on the heat exchange pipes was drastically reduced. Thus the lifetime of these devices is getting longer.

Kind regards

DYNAMIT NOBEL AG
Werk Lültsdorf
Technical Department



Sitz der Gesellschaft: 5210 5210 Troltsdorf • HRB 23 Amtsgericht Siegburg • Vorsitzender des Aufsichtsrates: Friedrich Karl Flick
Vorstand: Ernst Orasch, Vorsitzender: Peter Hoffmann, Hans E. Holzer, Gerd Krems, Axel Homburg (stellv.)

Philipp Best Plumbing

Australia

Philipp Best Plumbing

All Your Commercial & Industrial Plumbing Needs

Plumbers & Gasfitters - Bunbury, WA

PO Box 1733, Bunbury WA 6231

Southern Water Technology
6 Teede St
PO Box 553
Bunbury WA 6231
Australia

CWT - Physical water treatment system

May 2011

I've been in the plumbing industry for 32 years and currently have five staff working for me at Phillip Best Plumbing in Western Australia.

Since becoming available in Australia, we've purchased a number of CWT water systems to stop calcium deposits building up in a range of different piping systems. These deposits create many unwanted effects such as clogged pipes and irreversible damage to pipes and other plumbing parts.

I found the CWT water treatments to be very effective in high temperature heating systems such as commercial combustion ovens in restaurants and even in a very high temperature heating system at a local abattoir.

There are also huge time savings associated with CWT water systems. Installation time is cut by at least 90% when compared to similar units. The units, which are made in Germany, are also at least 50% cheaper than other units currently on the market.

The units, which allow scale particles to be washed away, are not only proving to be successful in commercial and industrial applications, but in private homes with scale and rust problems. I installed a CWT system to protect the hydraulic heating system, which lies under the cement slab of our home.

CWT has been a great cost saving unit initiative that will protect your piping system from ongoing scale and rust problems.

Your Phillip Best Plumbing Team



Lance Butcher (sprinkler systems)

Western Australia

LANCE BUTCHER,
Western Australia

Water treatment system against scale and rust by CWT

May 2011

I'm Lance Butcher and my wife and I live on a 5 acre property at Gelorup, 20 minutes south of Bunbury in Western Australia. Our local water contains high levels of iron, which was causing enormous problems with our reticulation system. Large quantities of iron sludge and chips would build up in the piping system and block the solenoids and individual sprinklers. The situation was getting us both down. It seemed like the sprinklers were continually blocked and I was replacing the solenoids every six months.

Within three months of installing the CWT water treatment system the iron residual and sludge disappeared. I was staggered by the results. The pipe was completely clear and there were no signs of the iron scale at all.

A reliable and clean sprinkler system is very important for us to maintain a healthy garden which contains more than 200 rose bushes and half an acre of trees and cottage garden. Our horse paddocks are also under reticulation.

The CWT system has saved me an enormous amount of time and money and I'm no longer cleaning sprinkler heads or replacing the solenoids in the reticulation system.

The results have been so successful we are now planning a major expansion of the garden and bird aviary. I would recommend this product for anyone who lives in a hard water area in Australia. They're simple to install and maintenance free.



Lance Butcher from Western Australian enjoying his clean sprinkler system after installing the CWT water treatment system.

HANS KREMPL (Residential Technologies)

Germany



HANS KREMPL · HAUSTECHNIK GMBH

Christiani Wassertechnik GmbH
Herrn Christiani
Heinrich-Heine-Str. 15

52249 Eschweiler

E-Mail: hans.krempel@krempel.de
Koblenz, 23.08.06
ma/gk

Dear Sir,

We have been selling your Vulkan 5000 water treatment system for over ten years. In this time we have successfully sold more than 1000 sets of equipment. We have consistently received positive feedback from our customers in view of the effectiveness of the system - patches of limescale which could previously only be removed by chemical detergents can now simply be wiped away with a cloth. What is more, the use of the system has notably reduced the calcification in the heating of electrical equipment (e.g washing mashines, dishwashers, kettles etc.).

We wish you and your company further success and in the above-mentioned matter would like to thank you for a succesful collaboration.

Yours Sincerely,



- Hans Krempel jun. -

August Horch-Straße 14, 55070 Koblenz, Telefon (0261) 89 09-0
Telefax (0261) 89 09 109
Gesellschafter und Beiratsvorsitzender: Hans Krempel
Gesellschaftsführer: Hans Krempel
Handelsregister Koblenz Nr. HRB 644
Ust-IdNr. DE811182753 bbn 40 16417 5

Independent Studies & Scientific Papers

How can an electric device that uses only very little energy have such a profound influence on scale and rust? Does it work? ... and moreover *how* does it work? These are typical questions.

In the following you will find a number of independent studies on the principles of the Vulcan-physical water treatment:

The Physiological Institute of the University of Munich has proven and evaluated the Vulcan effects and the University of California Davis chose a more practical approach in order to understand the functions of the technology.

Dr. Hartmut Jühnke, German scientist and one of the leading experts on physical water treatment, has written an extensive study on the topic in "Physical Water Treatment: How it works". His paper provides an excellent insight into the topic.

The outcome in a heat-exchanger setting, a typical area for problems with lime scale, was tested by the Steinbeis Institute Transfer Center Applied and Environmental Chemistry, who reported tangible results.

As the topic of environmentally-friendly technology transfer has become a subject of interest, the issue was featured by the US Ashrae in their report on "Pulse-Powered Chemical-Free Water Treatment". The last study listed in the booklet examines the effect in a typical industrial setting and explores the question of how physical water treatment helps prevent scale incrustations in cooling towers.

University of California, Davis

USA

UNIVERSITY OF CALIFORNIA, DAVIS

BERKELEY • DAVIS • IRVINE • LOS ANGELES • RIVERSIDE • SAN DIEGO • SAN FRANCISCO



SANTA BARBARA • SANTA CRUZ

STUDENT HOUSING

ONE SHIELDS AVENUE
DAVIS, CALIFORNIA 95616-8712

October 18, 2008

Jorge Rebagliati
Vulcan Scale Protector
P.O. Box 6662
Santa Rosa, CA 95406

Dear Jorge,

UCDAVIS Student Housing Facilities Services has been actively exploring alternative water treatment/softening systems to traditional sodium exchange brine discharge systems for the last five-plus years. We have been doing so because of environmental and sustainability issues, as well as cost and safety concerns related to traditional systems.

About 5 years ago we began experimenting with magnetic treatment systems. We evolved from there to electro-magnetic systems about two years later. In August of this year we installed the Vulcan system in a 465 bed residence hall complex constructed in 1964 that uses ground water tested at 7 grains per gallon/120 parts per million of hardness that we had never treated before. We now have traditional water treatment systems in some buildings and the three alternatives mentioned above in others.

Although I believe that traditional water softening systems are the most effective, they are also the least environmentally friendly, (they actually contribute to environmental degradation), and the most costly. I have found the three alternate systems to have positive effects and the Vulcan system to have the greatest positive effects of the three. The Vulcan system reduces scale build up, changes the nature of the scale that does remain to a powdery type of scale that it is much more easily removed than typical flaky scale that etches onto tube bundles, pipe and tank surfaces, faucets, aerators, etc., changes the "feel" of the water for the better, and results in soaps, shampoos, and detergents being needed in reduced quantities and lathering better.

I am a believer in the Vulcan system and strongly encourage facilities personnel with water treatment needs who are concerned about the environment, sustainability, costs, and safety to give Vulcan a try.

Respectfully,

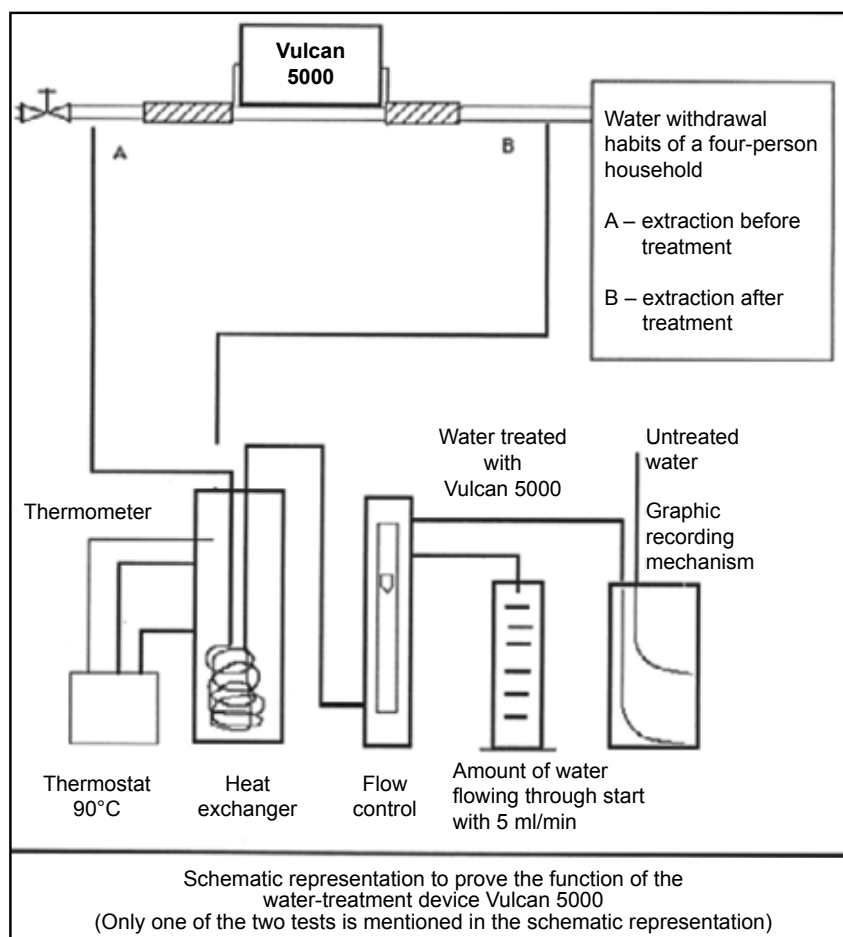
A handwritten signature in dark ink, appearing to read "Clyde W. Froehlich", written over a horizontal line.

Clyde W. Froehlich, Assistant Director – Facilities (530) 752-2495

Steinbeis Institute

Germany

Centre for Environmental Chemistry





**STEINBEIS-STIFTUNG FÜR
WIRTSCHAFTSFÖRDERUNG**
(Foundation of economic promotion Reutlingen)

**TRANSFERZENTRUM REUTLINGEN
ANGEWANDTE UND UMWELTTECHNIK**
(Transfer Centre - Applied and environmental chemistry)

Expertise

Concerning the effect of the water-treatment device "Vulcan 5000"

Test subject: water treatment device "Vulcan 5000"

Manufacturer: Christiani Wassertechnik GmbH (CWT)
Heinrich-Heine-Str. 15
D-52249 Eschweiler

Test instruction:

A test should be carried out to determine whether Vulcan 5000 can reduce lime deposits in water pipes and household equipment in a purely physical manner without altering the water chemically.

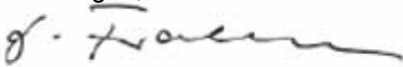
Experimental demonstration of function:

The effect was verified in a heat exchanger arrangement using two identical testing units. Water was withdrawn from the water pipes simultaneously upstream and downstream of the device to be tested and calcium precipitation forced in the heat exchangers.

As lime deposits increase, the flow of water decreases. The more water flows through the experimental arrangement, the smaller tendency there is for the water to form scale on pipes and container walls. The test was carried out on the basis of the practice-related water withdrawal of a four-person household with the additional regular withdrawal of five litres of water at half hourly intervals for a total of six weeks.

This test showed that the tendency to form lime deposits is reduced considerably by the "Vulcan 5000" water-treatment device. In addition, the effect continues for some days after "Vulcan 5000" has been switched off. Seemingly, the effect is not only limited to a certain part of the pipe, but also passed into the water flowing nearby sections of the pipe.

Reutlingen, 14.01.1998


(Prof. Dr.D. Frahne)

Enclosure:
Test diagram

Physiological Institute - University Munich

Germany

PHYSIOLOGICAL INSTITUTE

Medical Faculty
Ludwig-Maximilians-University Munich

Directors: Prof.Dr.G. ten Bruggencate, Prof.Dr.E.Gerlach, Prof.Dr.Dr.h.c.K.Thurau

Dipl.-Phys. Franz Rucker

Physiological Institute Pettenkoferstr.12 80336 München

Pettenkoferstraße 12
80336 München

Christiani Wassertechnik GmbH

z.Hd. Herrn Kleefisch

Heinrich-Heine-Str.15

52249 Eschweiler

18th of December 1996

Test of the electronic water-treatment system VULCAN 5000 for the cooling system of the laser Innova 90-K of the company Coherent GmbH (user report)

Dear Mr. Christiani

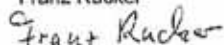
Referring to our telephone call on the 18th of December 1996 I would like to send you a description of our trial of your electronic water-treatment device Vulcan 5000.

The system Vulcan 5000 was installed at the end of March 1996 in the coolant inflow of a crypton gasions laser Innova 90-K manufactured by the company Coherent GmbH, supplied with water from the system of mains, to reduce or even avoid lime deposits on the ceramic covering of the laser tube (see picture, enclosure). Over the past years we constantly had difficulties with laser tubes which were not in working order any more and consequently had to be replaced due to thick lime deposits on the ceramic of the tubes through which the coolant flows with approx. 9 l/min and a pressure of approx.2,5 bar and at the same time heats up to a temperature between 60°C and 70°C depending on the gas discharge electricity (tube electricity) between 30 A and 40 A.

The system Vulcan 5000 is an economic alternative to expensive heat exchangers, i.e. closed circulations of coolant with treated water. These heat exchangers cost about 5.000 €. The device Vulcan 5000 has been used on a trial basis since the end of March 1996 to treat the coolant of our gas laser. On the 12th of December 1996 the company Coherent GmbH checked the laser tubes for lime deposits on the ceramic surface. No lime deposits were detected, therefore it is all in all a positive result (see service report of the company Coherent GmbH, enclosure).

During the test period the laser was in operation approx. 200 hours with a laser tube electricity ranging from medium to maximum and with operation times between four and eight hours. These operation periods and the accomplishment required correspond to the normal use of the laser in our fluorescence microscopic experiments. Laser tubes previously used in a similar way, which worked without a treatment of the coolant, showed considerable lime deposits.

Franz Rucker



Study - Physical Water Treatment as the Solution for Cooling Towers

Japan

Test report on Vulcans (pulsed water treatment systems) installed as a preventive measure against scale buildups causing faulty of the cooling towers

February 24, 2007

Tested field: Factory of a pharmaceutical company
Installation sites: Cooling towers on the rooftop of the second building
2-1 cooling tower **A:** Makeup water piping size is 50A.
2-2 cooling tower **B:** Makeup water piping size is 50A.
1 cooling tower **C:** Makeup water piping size is 50A and circulating piping size is 80A.

Model installed:
Vulcan S25
(water treatment capacity: 25 m3/hour)

Date installed:
For the cooling towers A, B, and C: July 22, 2006
For the cooling tower C: October 6, 2006

Vulcan installed on the
makeup water piping (50A)



Used for cooling towers A, B and C

Vulcan installed on the
circulating piping (80A)



Used for the cooling towers C

Objectives:
1 To prevent scale buildups on the cooling towers.
2 To reduce chemicals used for water treatment
(measure for complying with ISO 14001)
3 To save the energy cost by preventing the deterioration of the heat exchange effectiveness

Verification of the effectiveness:

After installation of the Vulcans, the statuses of the cooling towers A, B, and C were inspected without using any water treatment chemicals. Even after elapse of approximately six months, almost no scale buildups were observed inside the refrigerators and the heat exchanger tubes, and no water pollution warning was displayed. (Usually, without water treatment chemicals, the water quality is deteriorated and water pollution warning is displayed.) Silica adhered on the cooling towers was easily removed with a finger touch. With these results, the effectiveness of the installation of the Vulcans could be confirmed.

Remarks (Summary)

The water treatment system, Vulcan, has the following features: (For details, refer to the brochure attached.)
Vulcan changes only the crystal structure of scales without changing the quality of water. Therefore, nothing is added or reduced to or from the ingredients of water. The water through Vulcan is soft and has an increased permeability. Vulcan makes city water to drinking water and can be used as better cooling water.
(*) The effectiveness of the water treatment in the water supply line will last for 48 hours and for approximately 2 km in distance.

Major features include:

- Prevents buildups of rusts and scales
- Makes cleaning in the kitchen and bathroom much easier (toilets, showers, tiles, joints, etc.)
- Drastically reduces the clogging due to oil balls
- Eliminates the necessity of strong chemicals for removing scales.
- Eliminates the necessity of additives.
- Does not change the water quality.
- Prevents the clogging at the time of drainage

Cooling Tower A



Cooling Tower B



Developments after installation of the Vulcan

Adhesion of silica six month after the installation of the Vulcan



Silica is not removed by hosing, but can be peeled off with a nail.

The installation of the Vulcan in the circulation line seems to create the status equivalent to the cooling tower C.



Cooling Tower C



water is hosed



after the hosing



Silica is removed by simply hosing the water. (The remaining silica is peeled off with a touch of a finger.)

Water quality tests on the cooling tower C

Quality tests of three types of water approximately six months after the installation of the Vulcan:

- (1) Makeup water
- (2) Circulating water
- (3) Makeup water

(raw water)

Pulse-Powered Chemical-Free Water Treatment Report, ASHRAE USA



ASHRAE GreenTip Nr. 14

Pulse-Powered Chemical-Free Water Treatment

TECHNOLOGY DESCRIPTION

Pulse-powered physical water treatment uses pulsed, electric fields (a technology developed by the food industry for pasteurization) to control scaling, biological growth, and corrosion. This chemical-free approach to water treatment eliminates environmental and health-and-safety issues associated with water treatment chemicals.

Pulse-powered systems do not require pumps or chemical tanks. Pulsepowered systems tend to be forgiving of operational upsets and promote cooling tower operation at higher cycles of concentration (therefore, less blowdown and less water usage) than standard chemical treatment. Independent studies have shown not only that the method is effective for cooling towers but that the performance of pulsepowered systems is superior to standard chemical treatment in biological control and water usage. The performance results of pulse-powered technology for chemicalfree water treatment, as documented by various independent evaluations, support the objectives of green buildings and have earned LEED points for certification in a number of projects.

WHEN/WHERE IT'S APPLICABLE

Pulse-powered technology is applicable on the recirculating lines of cooling towers, chillers, heat exchangers, boilers, evaporative condensers, fluid coolers, and fountains.

The technology produces a pulsed, time-varying, induced electric field inside a PVC pipe that is fit into the recirculating water system. The electric signal changes the way minerals in the water precipitate, totally avoiding hard-lime scale by insteadproducing a non-adherent mineral powder in the bulk water. The powder is readily

filterable and easily removed. Bacteria are encapsulated into this mineral powder and cannot reproduce, thereby resulting in low bacteria populations. The water chemistry maintained by pulse-powered technology is noncorrosive, operating at the saturation point of calcium carbonate (a cathodic corrosion-inhibiting environment).

The low bacteria count and reduction or elimination of biofilm reduces concern about microbial influenced corrosion. The absence of aggressive oxidizing biocides eliminates the risk of other forms of corrosion.

PROS AND CONS

Pro

1. The potential for lower bacterial contamination while providing scale and corrosion control.
2. Lower energy and water use than in traditional chemical treatment.
3. Blowdown water is environmentally benign and recyclable.
4. Life-cycle cost savings compared to chemical treatment.
5. Reduction or elimination of biofilm.
6. Removes health and safety concerns about handling chemicals.
7. Eliminates the environmental impact of blowdown, air emissions, and drift from toxic chemicals.

Con

1. It does not work effectively on very soft or distilled water, since the technology is based on changing the way minerals in the water precipitate.
2. Water with high chloride or silica content may limit the cycles of concentration obtainable to ensure optimum water savings since the technology operates at the saturation point of calcium carbonate.
3. Energy usage is still required to operate.



KEY ELEMENTS OF COST

The following economic factors list the various cost elements associated with traditional chemical treatment that are avoided with chemical-free water treatment.

This is a general assessment of what might be likely, but it may not be accurate in all situations. There is no substitute for a detailed cost analysis as part of the design process.

- Direct Cost of Chemicals. This item is the easiest to see and is sometimes considered the only cost. For cooling towers in the US, this direct cost usually runs between \$8.00 and \$20.00 per ton of cooling per year.
- Water Softener. Water softeners have direct additional costs for salt, media, equipment depreciation, maintenance, and direct labor.
- OSHA and General Environmental Requirements. Many chemicals used to treat water systems are OSHA-listed hazardous materials. Employees in this field are required to have documented, annual training on what to do in the event of a chemical release or otherwise exposed contamination.
- General Handling Issues. Chemical tanks, barrels, salt bags, etc., take space. A typical chemical station requires 100 ft (9.3 m) of space.
- Equipment Maintenance. Lower overall maintenance for the systems as a whole may be possible.
- Water Savings. Cooling towers are often a facility's largest consumer of water. Most chemically controlled cooling towers operate at two to four cycles of concentration. Cycles of concentration can often be changed to six to eight cycles with chemical-free technology, with an annual reduction in water usage costs and the associated environmental impacts.
- Energy Savings. Energy is required to operate the pulse-powered system, but overall energy usage can be lower. The reduction or elimination of biofilm (a slime layer in a cooling tower) results in energy savings versus chemical treatment due to improved heat transfer. Biofilm has a heat transfer resistance four times that of scale and is also the breeding ground for Legionella amplification. Preventing this amplification thus saves costs.

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*Source: www.ashrae.org

ASHRAE: American Society of Heating, Refrigerating, and Air-Conditioning Engineers

Newsletter: <http://www.ashrae.org/publications/page/573>

„Physical water treatment – how it works“ by Dr. Ing. Hartmut Jühnke Germany

Physical water treatment - this is how it works!

Dr.-Ing. Hartmut Jünke

1. Introduction

The physical water treatment has been used and discussed for the last two decades. During this time, it has proven its effectiveness that on the other hand is still questioned and denied. Why is that? If we follow the discussions, we can find various reasons that however are not going to be discussed here. It rather seems necessary to examine the physical foundations that can explain the mode of action of these processes and so to free them from the reproach of fraud and to recognize the black sheep that led to this reproach. The following is a try to clear these questions.

Apart from my own positive experience that clearly demonstrates the effectiveness, at least of the device installed on my pipes (1), there is a number of information coming from renowned institutions such as e.g. the Physiological Institute of the Ludwig-Maximilian-University Munich confirming the same. In this institution, the replacement of laser tubes because of furring through the coolant that had been necessary before, could be avoided after the installation of a physical water treatment device. Hotels and instruction companies as well as a lot of conversations with private users confirm the action, although the non- functioning is also often lamented. As in most cases the private users do not know the producer of the device (a lot of times it was said that the product was a cheap one bought in a superstore), we can only draw the conclusion that there are some devices that do not meet the physical conditions to be effective. But we cannot draw the conclusion that the treatment principle itself is useless and does not work.

Unfortunately, this impression is also often given in serious publications, a lot of times without giving any scientific proof or any proof orientated towards the action and that does justice to it.

Before the action of the physical water treatment is explained in a plausibility proof, first we have to clarify why water pipes fur up. Therefore we see the lime as target of the physical water treatment.

2. The Lime

Chemically speaking, lime is calcium carbonate (CaCO_3). This compound is not soluble in water. Question: How can it be dissolved in the water then? Answer: When water that contains carbon

dioxide passes chalky grounds, lime is released and is present in the water as calcium hydrogen carbonate $\text{Ca}(\text{HCO}_3)_2$. This is possible as carbon dioxide CO_2 together with water H_2O forms carbon acid H_2CO_3 . As everybody knows from the everyday household life, acidic cleaning agents are needed to remove lime deposits. It seems like splitting hairs to underline the difference between dissolved and undissolved lime, but this is exactly where the lack of argumentation in favour of the action of these devices lies.

Thereupon the following question is raised: why does lime separate anyway? The dissolved amount of calcium hydrogen carbonate in the drinking water never reaches the saturation limit that if exceeded leads to the separation of the dissolved substance as a crystal.

If we look at the points in the pipes where lime deposits, the answer is already given. Primary spots for lime deposits are pipe bends, branches and the ending points (faucets) and especially the warm water areas. In the last mentioned case we have to differentiate: warm water containers are generally speaking free from deposits; heating bars, heater spirals or heat exchangers, surfaces that transmit the heat to the water, are always affected.

Why these spots? The answer is pretty easy: there has to be an energy gradient that leads to the opening of the water cages (see below) around the dissolved ions so that they can react with each other. At the same time the so called lime -carbonic acid-balance has to be disturbed, this means that it has to come to a local lack of CO_2 . Then the elements look for a crystallization point (nucleus) where to start the crystallization. These spots are always located on the walls of the pipes, these represent the solid base on which the crystals can grow. More and more elements deposit, the lime deposits grow and incrustations, also known as scale, develop. They consist of calcium carbonate mixed with magnesium compounds, gypsum, silicates and iron compounds (therefore the yellowbrownish colour). These sedimentations favour corrosion and worsen the heat transmission of heating bars and heat exchangers.

How is it possible that there are local energy differences in the water? In the case of heating bars it is easy, heat is transmitted to the water. In pipe bends the water is accelerated, the energy for

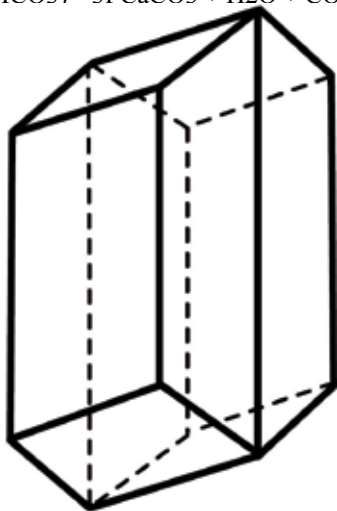
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this process comes from the inner energy of the water, pressure and temperature changes are the consequences. The same goes for branches and ending points. Here, turbulences are caused, also with the inner energy of the water and with the same consequences.

If we take a look at pipes that have been used over years, we can see that incrustations always start in pipe bends or branches and from there grow into the straight areas. When a pipe clogs up, the affected areas are normally these areas, while the predominant part of the pipe system is still completely in working order and able to let the water flow through.

What happens chemically during the crystallization? The following formula (1) explains it:

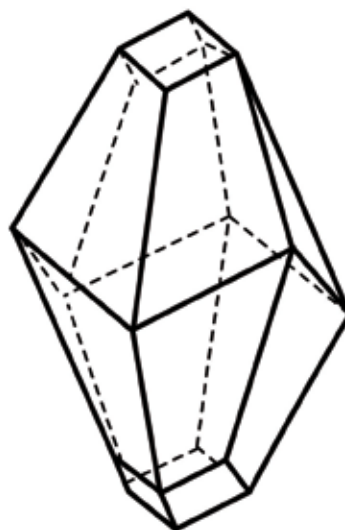


Picture 1: Unit cell of an aragonite (Rhombic system)

In the first place it is remarkable that the described reactions towards a lime formation can also take place the other way round, i.e. the lime can also dissolve again (see above). Which of the two reactions takes place depends on the lime- carbonic acid- balance. If there is a surplus of CO₂, lime is dissolved, if not, lime is secreted. These processes are also dependent on pressure and temperature changes, therefore on physical parameters.

At this point, it is appropriate to say something about the lime crystal. It is known that almost all substances defined as solid are crystalline.

Crystals are divided in 7 crystal systems and 32 crystal classes, which differ from each other through their lattice structure.



Picture 2: Unit cell of a calcite (Trigonal system)

Lime can crystallize in two different structures which are chemically completely identical. The lattice structures are different but related. Afterwards, the lattice type Aragonite (picture 1) or Calcite (picture 2) is formed. When the chemical structure is the same, it depends on thermodynamic circumstances (pressure, temperature) which modification is produced. As the pictures show, in both unit cells, one axis is longer than the others. This means that a crystal grows faster in this direction than in the others. The grow velocity is anisotropic, i.e. dependent on the direction.

That means that crystals that grow undisturbed develop a needle-shaped form. If the grow velocity was the same in all axis directions, globular crystals would develop. In the lattice type Calcite, there is also a crystallization of magnesium carbonate MgCO₃ and FeCO₃, and that is why these substances are also incorporated in the scale formation. On the other side, Anhydrite (dried gypsum or

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gypsum [$\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$] corresponds to the lattice type Calcite. In similar lattice types phosphates and sulphates such as silicates of calcium and magnesium also crystallize. This favours their incorporation in the deposits. Also for them present crystallization nuclei serve as a starting point for a segregation in the water and not for a deposit on the walls of the pipes or on heating bars, especially in warm water – in which these water companions often dissolve first.

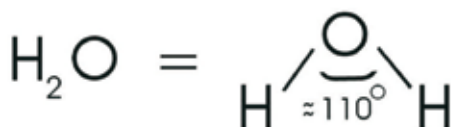
So what do devices do when they show the promised effects?

1. They do not convert lime. Into what should they? The devices cause that Calcium hydrogen carbonate $\text{Ca}(\text{HCO}_3)_2$ turns out as Calcium carbonate CaCO_3 , which is electrically and chemically neutral in water. And this is a solid with the special concomitant that the crystal does not crystallize on an already existing solid but is formed in the flowing water. Such a crystal forms according to laws of nature with typical parameters valid for every substance and it takes on a form according to the law of nature.

2. The result is that these crystals do not have special characteristics but special forms that do not attach to each other any more and therefore prevent calcification. At this point the described mechanism is effective.

3. Water

To understand the following processes, now some information about water are given. It is way more than what the formula H_2O says. The two hydrogen atoms and the oxygen atom form an equilateral triangular and incircle a $\sim 110^\circ$ angle, as shown in picture 3.



Picture 3:

Angle structure of a water molecule

This is the reason for a lot of characteristics that distinguish water from other, similar molecules. Two gases that react with each other form a liquid

and not a gas, as it is e.g. with carbon dioxide CO_2 (solid substance and gas!), a molecule a lot heavier. Because of this angle position water molecules form chains and clusters that cause the fluid state.

This is possibly the reason why water may have a “memory” in which it adopts structures in the chains and clusters that do not change even when the water moves. These chains and clusters are held together by Van de Waals powers or dispersion powers or hydrogen bridges. The bond is based on the attraction of electric dipoles present in molecules with polarized bonds or angled structure.

At the University of Stuttgart, scientific researches are conducted concerning this problem and first results show that the behaviour of water is influenced by electric and magnetic fields. Such phenomenon have been known for a long time but have never been investigated scientifically.

This molecule form leads to a further special characteristic. Water shows a dipole character. Through the bond, both elements strive for an inert gas configuration in their outer electrons shells. In the case of hydrogen there are two electrons, in the case of oxygen eight. Oxygen is missing two and each hydrogen one electron. In the molecule the total of two bonding electrons is available for all three atoms, so that an inert gas configuration can be reached by all molecules.

In all homeopolar bonds of diverse atoms, the bond is polarized, i.e. the bonding electrons pair is moved towards the direction of the bonding partner with the higher electron affinity, in this case the oxygen atom. If the water molecule is put in an electric field, it lines up so that the oxygen shows towards the positive electric side and the hydrogen molecules towards the negative electric side. So the water molecule is charged a little bit more negatively on the side of the oxygen and a little bit more positively on the side of the hydrogen.

This fact, together with the molecule form, plays an important role for the dissolving ability of water and for the physical water treatment. At this point further anomalies are only briefly mentioned: when water passes to a solid state (ice) its density decreases. If the ice is put under pressure, it liquefies again. Normally, liquids under pressure pass to a solid, crystalline state. These few indication already show that there is probably a lot more about water than today's modern research has discovered so far and

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that it surely contains up to now incomprehensible effects of the so called Plocher and Grander water. We should not rashly blame the water if we do not know anything about it.

4. Physics and chemistry

What happens physically and chemically when a physical water treatment device is used? As there are a lot of different application principles, from magnets introduced in the water pipes to the injection of seed crystals in the water, around which lime particles attach, in the following only one principle often offered and often controversially discussed is going to be examined.

The processes are described on the basis of a device with an appearance often found and which effects are questioned. The test explained here is based on the functioning and mode of action of this device. It is a blackbox from which two cables exit and are wound around the pipe. These cables transmit oscillations to the water that are supposed to “convert” the dissolved lime and render it harmless.

This formulation has been chosen intentionally because it essentially corresponds to the description of the function of offered devices and therefore already puts in doubt the repute and seriousness. What kind of oscillations are transmitted? Some descriptions do not even talk about calcium being converted, the producers seem to come from the times of the alchemist. Some say that the pipe material does not matter and that the device can even remove already existing lime incrustations. How can oscillations achieve all this? Seriously, who thinks to understand just a little bit of physics and chemistry already finds enough apparently scientific arguments to question the functioning.

What does a device do that really prevents lime deposits in pipes? At this point the first question has to be what it has to do to fulfil this demand? The answer is easy: It has to create the conditions under which the calcium hydrogen carbonate $\text{Ca}(\text{HCO}_3)_2$ is washed away with the water as a crystal and does not attach to the pipe walls as calcium carbonate crystal CaCO_3 .

In the following, the physical and electrical possi-

ilities that an effective physical water treatment system has to offer are examined. This simply means that it has to cause the effect that the dissolved lime does not attach in crystalline form to the walls or contact points with the pipes, to devices and fittings in contact with water. This is only possible if the dissolved lime crystallizes in the water before the contact with these areas. Therefore two conditions in the water have to be fulfilled:

1. Crystallization nuclei have to be present or created.

2. The lime- carbonic acid- balance has to be changed so that dissolved lime becomes solid.

Experience has shown that the introduction of magnetic or electric fields in the water can have such effects, even if with different success. In the following, only the effects of electric fields are examined, but from these the conditions under which magnetic fields can also be effective can be derived.

If we take a look at picture 4, we can see the two windings through which impulses are transmitted. A lot of producers call these windings “coils” because they look like coils, but electrically speaking they are not. So an “inductive” coupling is not possible and if it was inductance, the device would fail in the case of iron pipes, but it does not. The winding represents a part of a capacity, it is one capacitor surface, the other one is the water. This winding is a technological compromise, a metal foil placed around the pipe on the same length would have a slightly higher capacity, but would also have to be custom made for every pipe diameter. Normal loudspeaker cables instead are sold in metres and adapt to the different pipe diameters without any problems.



Picture 5: Charge separation through influence

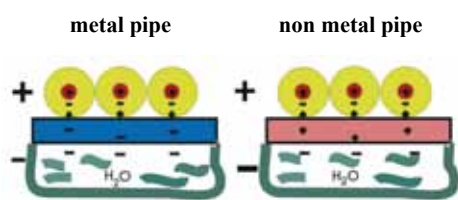
How can, with this arrangement, an electric field be caused in the water even through every pipe

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material? This is the point where most doubts begin. With this arrangement, it comes to a physical effect widely spread in the electric everyday life but not well known: the influence. In picture 5 the principle of the process is shown on the basis of a capacitor. When voltage is transmitted to the two capacitor plates, a charge displacement in the dielectric (insulator) is caused, which is the opposite of the charge of the plates. When the plates are discharged, the polarisation of the insulator also disappears as in the insulator electrons cannot move but only bound electrons are displaced. But if on the other hand e.g. two metal sheets laid on top of each other (electric conductor) are put into the electric field between the capacitor plates, the charge separation is the following: the surface of one metal sheet gets a negative charge (opposite of the positive capacitor plate) and the other one gets an equivalent negative charge. This phenomenon is called influence. If the two plates in the electrical field are separated, one of the plates shows a negative charge (surplus of electrons) and the other one a positive charge (shortage of electrons).

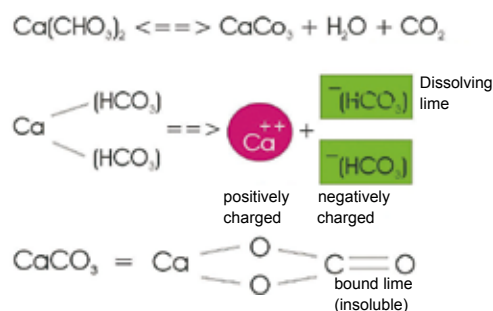
A capacitor is impermeable for direct voltage but not for alternating voltage. This fact is used when it comes to introduce electric alternating fields in the pipes. Picture 6 is an instant photograph of this process. You can see that the pipe material does not have any influence on the capacitor effect in the arrangement.



If the winding wire is charged by a pole of a power source, the same electric charge of the opposite sign is bound in the water pipe through influence (as the water comes from the earth).

If it is a temporal periodic charge transfer, or, respectively, a charge and discharge, a so called displacement current is produced - like in a capacitor (apparently) influenced by alternating current - bet-

ween the insulated winding wire and the pipe wall (this can be calculated with the Maxwell equation). This is the continuation of an alternating (+-+-+...) or pulsating (0+0+0+0...or 0-0-0-...) conduction current which develops between the pipe (including the water) and the ground. This results on the one hand from an alternating or pulsating electric field orientated in the longitudinal direction of the pipe and on the other hand from a magnetic eddy field centrically wound around the pipe. Measurements have shown that an effective voltage of $\sim 3\text{fI}$ volt is produced between the winding and the water and that there is a displacement current of, $3\text{f} \cdot 5\text{A}$.



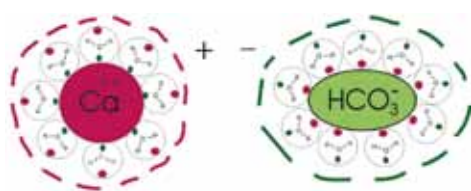
Picture 7: Schematic representation of dissolved and bound lime

At this point, some more attention has to be paid to the lime dissolved in the water. Picture 7 shows the connections. The dissolved lime – calcium hydrogen carbonate – dissociates in one double positively charged calcium ion and two negatively charged hydrogen carbonate ions. These ions are surrounded by a water cage. The water molecules settle around the calcium so that the oxygen points towards the calcium and the hydrogen towards the outside. Electrostatic powers hold these clusters together. The carbonate remnants are surrounded in the same way only that the oxygen atoms of the water molecules point to the outside. These clusters altogether show a positive or respectively negative charge. A schematic representation is given in picture 8, the clusters just have to be imagined as minute spheres. They have a diameter of 1 to 2 nanometers (nm), assuming that about 100 to 200 water molecules are involved. If the mass of these clusters is calculated, it results that the mass of the Ca- clusters as well as the mass of the

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bicarbonate remnants is of $30 \times 10^{-22} \text{g}$ up to $60 \times 10^{-22} \text{g}$. These results are interesting for the water treatment.



Picture 8: State of lime dissolved in water (schematic)

Coming back to the inducted electric alternating field, it is to say that that the periodically alternating field in the inside of the pipe influences the ions or dipolar molecules closed in water cages in the water in a way that they move from the one direction of the pipe to the other to the beat of the alternating field. The electric oscillation has lead to an oscillation of matter which spreads axially. Physically, this is a mechanical (acoustic) longitudinal wave or shock wave. Areas with overpressure and negative pressure alternate. In atomic and molecular fields, this locally causes an adhering of the CO_2 . If the oscillation frequency is suitable, the water cages disintegrate and this also leads to a local decrease of the CO_2 concentration. The lime- carbonic acid-balance is locally disturbed and at the same time the dissolved lime ions that are freed from the water cage can meet and react with each other: a lime molecule has been produced which now serves as crystallization nucleus.*) Other molecules are taken up by this nucleus and form a lime crystal in the water. This lime crystal is electronically neutral and does not react in tap water any more. Therefore, this lime crystal is not taken up by existing lime deposits on the pipe walls anymore.

To cause these processes, the electric alternating field has to contain frequencies that if possible lead to resonance oscillations of the water cages. Since all tap waters that correspond to the German drinking water decree are different regarding the quantity of dissolved minerals, the pH-value and the conductivity, the formation of the electric alternating field is also influenced. Besides, there is the changing flow velocity. Devices that work with

only one frequency can also successfully set off this cycle by chance, but most of the times they do not show any success.

A couple of technical data about the device examined here are known as well as positive experiences about the effect. Therefore, it makes sense to theoretically and (as far as possible) practically assess the effectiveness of the device by means of these information.

The device is provided with two windings. Each winding receives impulses with a clock frequency of 10 Hz, 50 ms pulse duration, 50 ms rest and de-energize. When one has the rest and de-energize, the other one receives the impulses. Each impulse has a frequency response of ca. 3 to 15 kHz, spread on 50 ms. As there was no suitable measuring technique, the frequency response could not be measured. If 10 oscillations are counted per kHz, the pulse duration is approximately reached. At this point it has to be particularly emphasized one more time that this is only an attempt to generally explain the effectiveness. The complexity of the excited oscillations including the overlapping of different waveforms (overtones) cannot be taken into consideration.

The device is supposed to safely treat 5000 litres of water per hour. In the case of a half inch pipe this means the flow of a water column of 11,3mm/ms, in the case of a one inch pipe it would be 2,8mm/ms and in the case of a two inch pipe 0,7mm/ms. As the length of the effect of an electric alternating field is of $\bullet 98500 \text{ mm}$ (the producer indicates $\bullet 981000 \text{ mm}$), this means that this distance is just covered. Every ion water cage has enough time to fall apart.

What about the reaction velocity of the chemical components? The Max-Born-Institute for nonlinear optics and transient spectroscopy in Berlin has examined the velocity of the formation of molecules on the basis of water molecules with a special laser array. The result was a time between 10 and 20 femto seconds ($1 \text{ fs} = 10^{-15} \text{ second}$). This time is as inconceivably short as the universe is inconceivably big. The distance light travels in 1 fs gives us an approximate idea of how short this time is: $\bullet 300,3 \text{ m}$. In the time light travels 6 mm, 1000 molecules can be formed. Therefore, it is very probable that the molecule formation and the formation of nucleus crystals take place in the section treated.

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5. Protective layers and incrustations

At this point the formation of incrustations is only briefly mentioned for the processes in pipe bends. The flowing water accelerates in the pipe bends. The water flowing in the outer radius is faster than the water in the inner radius. According to the simplified Bernoulli's equation (2), the sum of the static and the dynamic pressure is constant:

$$P_{dyn} + P_{stat} = \text{const.}$$

In the water that flows faster, the dynamic pressure increases and the static pressure decreases. This means that CO₂ escapes from the inner radius towards the outer radius and the lime- carbonic acid- balance is disturbed. Lime is set free, looks for a crystallization point and finds this point on the walls of the inner radius. Little by little, a layer of lime epitaxially grows in which other minerals also deposit. On this irregular surface turbulences develop, the same happens in pipe branches because of pressure fluctuations, so that in both cases lime deposits develop. As water, and therefore also the CO₂, evaporates in faucets and shower heads, also here lime deposits develop. On heated surfaces the CO₂ is also removed from the closer surrounding area, so that these surfaces are also favourite crystallization points for the lime. For two reasons, the presence of lime in drinking water is important and therefore a minimal amount that corresponds to a water hardness of 8,4°d is stipulated by the German drinking water decree. Firstly, the drinking water provides a big part of calcium the body needs and secondly, the bicarbonate remnants of the dissolved lime reacts with the metal of the pipe and so forms a metal carbonate protective layer. This is especially important in the case of copper pipes (see below). Picture 9 shows a detail of such a protection layer. You can see how the crystals grow on the metal surface. Such bundles of crystals cover the surface and protect the pipe against corrosion.

Picture 10 shows this even better. It is an electron microscopic picture of an artificially produced phosphate protective layer against corrosion. Phosphates crystallize in a similar crystal system as carbonates. In time, this desirable quality of lime becomes a disadvantage as more and more lime deposits grow in these protective layers since they are ideal crystallization points. Slowly, a pipe clogs



Picture 9
Lime protective
layer

Picture 10
phosphate
protective layer

Picture 11
Lime dust
deposits

up, starting in the pipe bends and branches. As indicated above, from here the incrustations grow into the straight sections of the pipe. This process takes place as long as there is dissolved lime in the water. But most of the lime transported in the water is washed out of the pipe without depositing. After all, with a water consumption of 100 m³ per year and a water hardness of 28°d, about 45 kg of lime are transported through the pipes. If the lime has been transformed into crystals in the water as described above, the lime is washed out of the pipe with the water in form of a fine submicroscopic crystal, a crystallization on the walls of the pipes is not possible anymore. The lime crystals deposit irregularly, as shown in picture 11. This condition stays the same also in warm water. Applications have shown that further dissolved minerals deposit on the nuclei build of the lime crystals and sink to the bottom of e.g. water boilers in form of dust without growing on the heating bars. This way, 2 kg of lime dust deposits could be removed from a 150 litre water boiler after a year of operation, the heating bars were absolutely scale free. User report that the heat exchangers for the hot-water supply in the case of district heating also stay lime free on the secondary side. Since the installation of the examined device four years ago, no cleaning has been necessary. The lime has been made harmless but has not been removed and is still physiologically present. Another consequence of this is that water drops that dry on surfaces leave lime dust which can be removed with a humid cloth. But if it is left in a humid surrounding for a while, it can locally dissolve under the influence of the CO₂ in the air and if it dries again, a crystallization on the surface is possible: This incrustation can only be removed with a decalcifier.

But these devices are also supposed to remove existing deposits and to prevent rust or corrosion. Is this possible? And if it is possible, how does it work?

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6. Removal of deposits and protection against corrosion

First of all, some information about the removal of lime deposits: If we take a closer look at the equation (1) we can see that the chemical reaction can not only take place from the left to right side (lime segregation) but also from the right to the left (lime dissolution). Here again, the lime- carbonic acid-balance plays a crucial role. If there is a surplus of carbonic acid, lime is dissolved. With each dissolved lime molecule crystallized in the water one carbonic acid molecule is produced. This carbonic acid gradually attacks and dissolves the lime deposits on the pipe walls and so removes the lime. Depending on the level of the incrustations in the pipe (water hardness, working life), this process can take between half a year and two years. During this time, light lime deposits outside the water develop again. When this process is finished, no more incrustations develop. The lime is removed, but the carbonate protective layer is maintained.

Of course the lime crystal in the water is also exposed to this influence. But the crystal produced in the water has been able to develop in an almost weightless state and therefore a crystal structure forms that shows only a few lattice defects such as vacancies, interstitial atoms, substitution atoms and molecules, displacement and stacking faults. Therefore, this crystal offers less targets than the incrustation presenting these errors and therefore also a bigger surface and with that a higher inner energy. This is why this incrustation is attacked more, often with a selective dissolution, what leads to the eruption of coarser lime particles which can accumulate in the aerators.

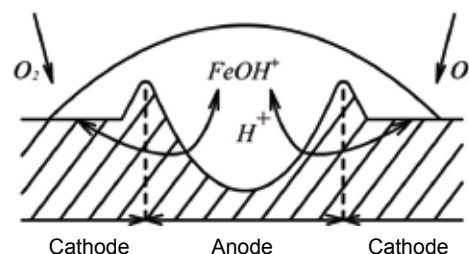
Now the equation (1) represents a balanced stationary state. But in nature fixed equilibria do not exist, only flowing equilibria. At the melting point of water e.g. ice and water exist at the same time, therefore balanced. This means that statistically in one time unit the same amount of water molecules changes from the liquid to the solid state as water molecules melt from the ice.

The equilibrium is flowing. The lime segregation as well as the lime dissolution described in the equation (1) are also subject to this static process, if there is no intervention from the outside. The processes in the section treated will not catch all present mole-

cules. Even if in smaller amounts, there will still be dissolved lime in the pipe which can also segregate but then be dissolved again. But since the physical water treatment intervenes in favour of the dissolution of the lime and the removal of the deposits, new incrustations do not form. Statistically, it is possible that during these processes surfaces that are not yet covered with metal carbonate crystals (see pictures 9 and 10) now form such crystals and so make the corrosion protection layer thicker.

The described mechanism of the formation of a protective layer is not the only effect preventing corrosion. Since there is already a protective layer, normally no corrosion should occur, but as experiences show corrosion does occur, in galvanized iron pipes as well as in copper pipes.

What is the reason?

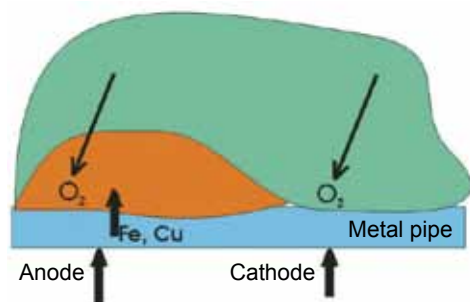


Picture 12: Ventilation element

In technology there is a corrosion process called ventilation element. Picture 12 describes this process. Iron is an electric conductor, water is an electrolyte. When a water drop lies on the iron, an electrolytic element has been formed, the only thing missing is the electric voltage. At the edge of the water drop the oxygen contact towards the metal surface is stronger, the centre of the drop is less ventilated. Thus a potential difference between these two areas develops, the edge of the water drop becomes a cathode (surplus of electrons) and the centre of the drop an anode (shortage of electrons). Being an electrolyte, the water now enables the closed electrical circuit between anode and cathode. At the anode, positively charged ions of the prevailing metal dissolve, react with the water and deposit as rust, while the electrons take the way through the metal to the cathode. In principle, the process is the same in the case of copper.

Physical water treatment - this is how it works!

Dr.-Ing. Hartmut Jünke



Picture 12a: Corrosion through lime deposits with different thickness

In principle, the same process takes place in our pipes, the only difference lies in the reasons for the different oxygen contacts to metallic surfaces. Picture 12a schematically represents this constellation. As long as the water is not physically treated, lime favours to deposit, as described above. Between the areas with strong lime deposits and the lime free areas, this causes that the more or less strong oxygen contact in the water effects the surfaces with a different concentration. This way, the same process as in the ventilation element is caused. As it is generally known, most of the times corrosion occurs in pipe bends, branches and T-pieces which show thick deposits. If these deposits are removed leaving only the protective layer, the oxygen contact is the same everywhere and an electric potential cannot develop anymore. This process is especially important for copper pipes, as with a high oxygen content and pH values lower than 6,5, copper is especially corrosion endangered and specially tends to pitting corrosion. In these cases a thick protective layer is especially important, also because of the impurity of the copper (supplier of cheap products) that favours the formation of local elements. Thus, more and more copper comes into the water and this is unfavourable for the health. According to the recommendations of the Federal Ministry of health, babies should not drink tap water in these cases. Water suppliers call copper the "lead of the 20th century".

The dealt facts show that the effectiveness of the physical water treatment has not only been proven by users but that there are also theoretical and practical physical-chemical proofs. But a precondition is that the device offered more or less fulfils

the described parameters. In general, the electronic-technological demand is pretty high, so that most of the times cheap devices cannot fulfil the demands.

The mode of action of these devices shows that the usual test procedures to determine the effectiveness, especially short tests have to fail and provide false results. A new testing procedure has to be developed which can also provide a quantitative proof of the theoretic connections described here.

I would like to thank Prof. Dr. H. Ungenannt, Magdeburg, for the support during the interpretation of the electric processes, Mr. K. Matthies, Dipl.-Ing., Berlin, for the help concerning the measurement technology, Prof. Dr. W. Morgner, Eichenbarleben, for the critical discussions of the present work and the engineering firm for physical water treatment Helmut Siegmund, Königs- Wusterhausen, for the provision of the device.




Information about the device and the producer can be sought over the author or the engineering firm Siegmund, Herdstr. 7, 15711 Königs Wusterhausen. Pictures:

- Pictures 1 and 2: W. Kleber, Einführung in die Kristallographie, Verlag Technik Berlin, 1956
- Picture 4: Information script from Christiani Wassertechnik GmbH
- Picture 9 and 11: Information script from Christiani Wassertechnik GmbH
- Picture 10: Information script from the BM Wmotorcycle factory Berlin
- Picture 12: W. Schatt (editor), Einführung in die Werkstoffwissenschaft, VEB Deutsche Verlag für Grundstoffindustrie, Leipzig, 1981

*) Coral animals build their coral sticks on the same basis. In their feet area, they have plant cells that contain chlorophyll. This produces organic material (carbohydrates) from water and CO₂ by the means of sunlight. Thus, the lime- carbonic acid- balance is also disturbed (reduction of the CO₂) and this leads to a secretion of lime forming the coral sticks. This is a reason why corals only exist in sun flooded shallow water, as only here there is enough sun energy for the photosynthesis process.

LFU - Laboratory for environmental analysis Ltd. (Research of environmental damage)

Germany

LFU - Labor für Umweltanalytik GmbH Umweltschadenuntersuchung Saatwinkler Damm 24 · 13627 Berlin Tel. (030) 345 91 90 · Fax (030) 345 70 54		
TESTREPORT		5565/02/96
Client	Mr. Wolfgang Krahel Hillmannstraße 16 13467 Berlin	
Trade mark	no details	
Sample material	water	
Place where the samples were taken	no details	
Number of samples	2	
Receipt of the samples	27.02.1996	
Procedure of taking the samples	LFU didn't carry out the procedures of taking the samples. All the details about the identification of the samples (Place where the samples were taken et cetera) were given by the client.	
Extent of the tests	Laboratory research – see page 3-	
Subcontractor	none	
LFU- Labor für Umweltanalytik GmbH  Knut Brauer Manager		Berlin, 11th of March 1996  Dr. H. U. Sommer Director of the laboratory

LFU - Labor für Umweltanalytik GmbH

Umweltschadenuntersuchung

Saatwinkler Damm 24 · 13627 Berlin Tel. (030) 345 91 90 · Fax (030) 345 70 54



TESTREPORT

5565/02/96

List of the results of the analysis:

Sample-Nr.: 5565-001 water before the installation of the water-treatment device
5565-02 water after the installation of the water-treatment device

Task:

To evaluate the effectiveness of a physical ("electrical") water-treatment device the client handed over two water-samples, which, according to him, were taken one before and one after the installation of the treatment device. According to the manufacturer, the influence of electromagnetic fields on the water, that flows through the pipes, changes the structure of the crystals of the depositing substances that are responsible for the hardness of the water (Calcium-hydrogen-carbonate-crystals), so that it is possible to avoid the sedimentation of hard deposits of boiler scale. To verify this effect, the contents of selected heavy metals, alkali and alkaline earth ions, responsible for the hardness of the water, dissolved carbon dioxide, carbonate hydrogen-carbonate, which the two water samples contained, were categorized and the remains after evaporating of the two water samples were also examined under a microscope on a clean glass-surface.

RESULT:

Sample / parameter	dimension	5565-001 water before the installation of the water-treatment device	5565-002 water after the installation of the water-treatment device
Iron	mg/l	0,042	0,44
Copper	mg/l	0,52	0,35
Zinc	mg/l	0,08	0,16
Sodium	mg/l	29,5	28,8
Potassium	mg/l	10,6	10,7
Calcium	mg/l	13,2	13,0
Magnesium	mg/l	11,6	11,3
Cadmium	mg/l	n.n.	n.n.
Cobal	mg/l	n.n.	n.n.
Chrome	mg/l	n.n.	n.n.
Manganese	mg/l	n.n.	n.n.
Nickel	mg/l	n.n.	n.n.
Lead	mg/l	n.n.	n.n.
Dissolved carbon dioxide	mg/l	n.n.	n.n.
Carbonate	mg/l	n.n.	n.n.
Hydrogen-carbonate	mg/l	23,49	22,57
Evaporation-remains	----	grey adhering no crystal-structure discernable	brownish easily removable no crystal-structure discernable

TÜV Nord Certificate

Germany

			
<h2>Zertifikat</h2> <p><i>Certificate</i></p>			
Registrier-Nr. <i>Registered No.</i> 977/06 Rev. 1			
Zeichen des Auftraggebers <i>Customer's reference</i> Herr Christiani	Auftragsdatum <i>Date of order</i> 28.02.2006	Aktenzeichen <i>File reference</i> 2.4-234/94 Men / A27	Prüfbericht Nr. <i>Test report no.</i> 975/06
Name und Anschrift des Auftraggebers	Christiani Wassertechnik GmbH Köpenicker Str. 154 10997 Berlin, Germany		<i>Name and address of the customer</i>
ist berechtigt, das unten genannte Produkt mit dem abgebildeten Zeichen zu kennzeichnen			<i>is authorized to provide the product mentioned below with the mark as illustrated</i>
Fertigungsstätte	Christiani Wassertechnik GmbH Köpenicker Str. 154 10997 Berlin, Germany		<i>Manufacturing plant</i>
Geprüft nach	DIN EN 60335-1: 2005		<i>Tested in accordance with</i>
Das Produkt entspricht den Anforderungen des Geräte- und Produktsicherheitsgesetzes GPSG § 7(1) <i>The product is conform with the requirements of the Equipment and Product Safety Act – GPSG § 7(1)</i>			
Wasserbehandlungsgerät type VULCAN xxxx <i>Water treatment equipment</i> type VULCAN xxxx			
TÜV NORD CERT GmbH Zertifizierungsstelle für Gerätesicherheit und Medizinprodukte			
			Essen, 22.03.2006
Langemarckstr. 20 • 45141 Essen • Fon +49 (0)201 825 5120 • Fax +49 (0)201 825 3209			

CE Certificate

Germany



CE Declaration of Conformity

Issuer's name and address: Christiani Wassertechnik GmbH
Köpenicker Str. 154
10997 Berlin
Germany

Product: Water conditioning appliance

Type designation: Vulcan
3000/ 5000/ S10/ S25/ S100/ S250/ S500

The designated product is in conformity with the European Directive:

**89/336/EEC
including amendments**

**„Council Directive of May 1989 on the approximation of the laws of the Member States
relating to electromagnetic compatibility“.**

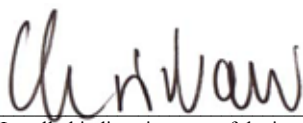
Full compliance with the standards listed below proves the conformity of the designated product with the essential protection requirements of the above-mentioned EC Directive.

**DIN EN 55014-2 (VDE 0875 Teil 14-2): 2002-08; EN 55014-2:1997 + A1:2001
Requirements of category II
DIN EN 55014-1 (VDE 0875 Teil 14-1); 2003-09; EN 55014-1:2000 + A1:2001 + A2:2002
DIN EN 61000-3-2 (VDE 0838 Teil 2): 2001-12; EN 61000-3-2:2000
DIN EN 61000-3-3 (VDE 0838 Teil 3): 2002-05; EN 61000-3-3:1995 + Corr.:1997 + A1:2001**

The VDE Testing and Certification Institute (EU Identification No. 0366), Merianstr. 28, 63069 Offenbach, has tested and certified the product granting the VDE Approval for the mark(s) as displayed.

Certificate No. 94050
File Reference 1898800-4521-0001 / 75684 FG43 / FU

Berlin, 18. July 2011
(Place, Date)


(Legally binding signature of the issuer)



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