



FILTERSORB[®]

CT

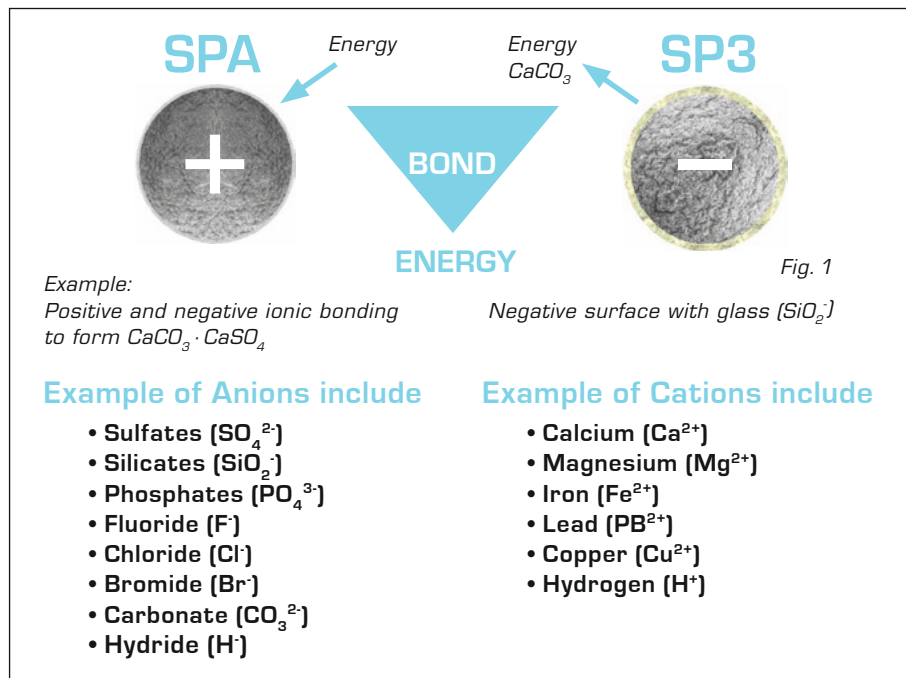
COMBINED TREATMENT
 OF CATIONIC AND ANIONIC SCALE

Water softening and scale prevention

The goal of **Watch-Water[®]** is to guide all customers in designing an accurate combined treatment system.

There are a number of different technologies which are described as **combined treatment (CT)** used avoid scaling including the **Watch-Water[®] FILTERSORB[®] SP3**.

The goal of the designer of a CT combined treatment system is to ensure that the correct **water quality and quantity** is delivered with optimized tank and head and distributors. The optimum design depends on the relating Importance of water parameters.



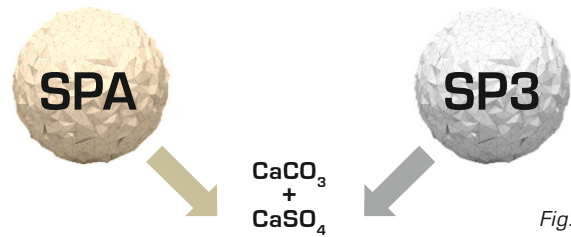


Fig. 2

Combined treatment (CT) as a result of being negatively (SP3) and positively (SPA) charged anions and cations form bonds. These bonds are known as IONIC BONDS and exist due to the mutual attraction of opposite charged ions. These bonds always form a crystal chape in which anions and cations are bound to each other.

FILTERSORB[®] CT IS A NUCLEATION AND EXOTHERMIC COMBINATION

Problem

The formation of heavy deposits of calcium and magnesium, silicate and sulfate scale has become a major operational problem for domestic, industrial and all commercial applications. Scale formation combined with silicate and sulfate ions in the well water, seawater is resistant to removal with acid. The scales formed are of such low solubility that occurred deposition cannot be cleaned. If not treated with FILTERSORB[®] CT, this scale can rapidly lead to severe productivity impairment.



Fig. 3

CT = Combined Treatment of

- Carbonate scales
- Silicate and sulfate scales

FILTERSORB[®] CT ist the best way to treat both anions as well as cations in hard water which can provide safe treatment of scale with 100 times more power.

Nucleation

FILTERSORB[®] SP3 works in a process of nucleation in which the media absorbs cations from its surroundings in the form of crystal and release CO₂ in the form of gas → splitting a gas molecule. Example: photosynthesis.

Result:

Calcium and Magnesium is absorbed from hard water on the surface and released into the form of CaCO₃ crystals. Example: Evaporation or melting ice.

Exothermic

FILTERSORB[®] SPA is an exothermic process in which the media separates the anions [negatively charged] from positively charged cations in the form of ionic bonds on the surface called EXO [outside] on very strong positively charged beads.

Result:

Negatively charged energy is separated from water and released and joined them in a form of electricity. Example: Making ice, rusting iron or chemical bonds. These electrons keep switching directions sometimes going behind the protons [cations] and then going „backwards“.

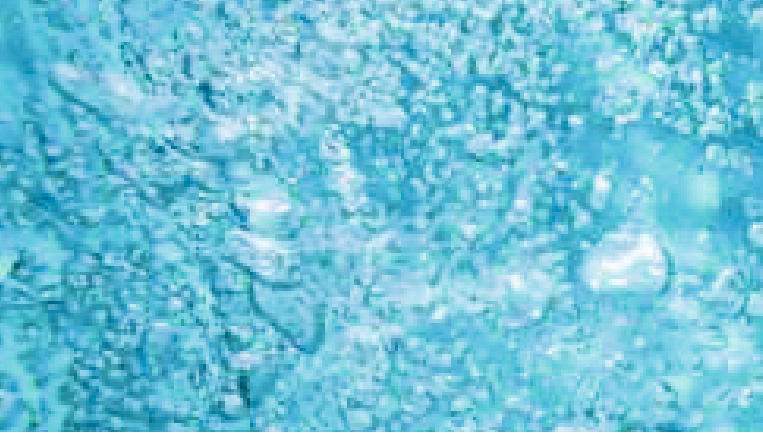
DEFINITIONS:

Negative [-]: When the anion is represented with SO₄²⁻, the charge indicates that it has 2 less protons than that of total number of electrons.

Positive [+]: When the cation or “+” sign is accompanied by a number like +2 then it implies the cation with +2 charge has 2 less electrons than the total number of protons.

Nucleation: a nucleation reaction occurs when a strong negatively charged surface [SiO₂] absorbs positive ions from the surroundings in the form of energy and release them in form of crystals and join them with anions released in the separated form [exothermic reaction] in the surroundings. The FILTERSORB[®] reactions are physical chemistry.





ANIONS IN HARD POTABLE WATER

Scaling including **corrosion** and **biofouling** are all related to each other. See figure 4.

Scaling in water applications takes place mostly in hard potable waters, which contain high concentration of **dissolved calcium and magnesium in carbonic acid** forming bicarbonates (HCO_3^-) and carbonates (CO_3^{2-}) with the chemical formula carbonate hardness $\text{Ca}(\text{HCO}_3)_2$ also known as temporary hardness.

Although calcium carbonate (CaCO_3) is the most common type of scale and can be easily treated with **FILTERSORB[®] SP3**, calcium sulfate and all other anions present in **permanent hardness** including silicates and phosphates. These are very serious problems as with the presence of phosphate ions (PO_4^{3-}) all water sources like ground water and surface water is heavily polluted containing PO_4^{3-} which originates from membrane concentrate discharge, household detergents and agriculture run off. The drinking water produced from mostly 98 % of the world carries a dosing of phosphates (PO_4^{3-}). The concentration of phosphate is a major cause of water related problems like **corrosion and biofouling**. Therefore even a trace concentration of phosphate, phosphonate in water can influence strong hydroxyapatite [$\text{Ca}_5(\text{PO}_4)_3\text{OH}$] or HAP scale, which cannot be cleaned so easily than that of calcium carbonate with the same cleaning acid solution.

FILTERSORB[®] SPA split these two ions and join any kind of anions as shown in figure 5.

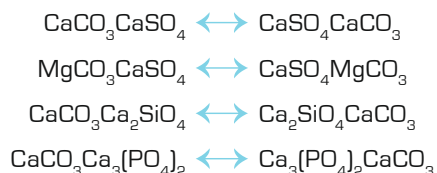


fig. 5

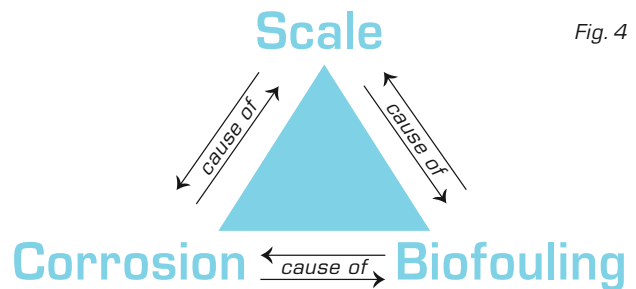


Fig. 4

The precipitation of permanent hardness can only be inhibited by carbonate.
 or

No corrosion can take place if the alkalinity of water is 8 to 8.5. See chapter alkalinity.

Anions (all anions) sulfates or silicates are capable of reacting with the oxidized metal surfaces and the scale which is formed on a surface can be removed by the shear stress exerted by flowing water through a combination of **SP3** and **SPA** in a system of **FILTERSORB[®] CT**. Higher velocity flow exerts greater shear stress on the surface or flow in the pipe. Higher flow rates clean pipes and surfaces faster and easier.

IMPORTANT:

All scale prevention techniques must be very quick and non-damaging to pipes, equipment and drinking water. Selecting the best scale-prevention technique for particular well water depends on knowing the type and quality of scale, its composition of cations and anions.

Nucentration methods are among the most successful methods of scale prevention as well as scale removal. When costs are considered they are very low [e.g. regeneration and waste water costs].





ANION SCALE PREVENTION IN HARD WATER

Introduction

SPA ceramic hydroxyapatite is a spherical macroporous form of very strong hydrophobic, anionic ligand with hydroxyapatite coating. It behaves as an cationic surface for anions in water such as sulfates, silicates and phosphates. It has unique separation properties for cations and anions in hard water. It will separate cations which are homogenous by negatively charged techniques. **SPA** ceramic hydroxyapatite is a chemically pure form of media that has been sintered at high temperatures to yield a physically and chemically robust coating. A nucleation assisted crystallization (NAC) on **SP3** media causes anions to flow in a fluidized direction along with CaCO_3 crystals, because they are created on the strong negative side of media and the temporary hardness problem is solved. This is how **FILTERSORB[®]SP3** scale prevention media treated water changes hardness as follows



SP3 is the safest technology media without releasing any chemicals over the competition media and can provide more power. Instead of using aluminium and calcium on the surface **Watch-Water[®]** used strong glass surface as negatively charged beads. When the total hardness is oriented in up-flow direction, the electrons (SO_4^{2-} , SiO_2 , PO_4^{3-} , OH^- , Cl^-) flowed together with te positive ions (permanent hardness) but when **FILTERSORB[®]SPA** is added as a combined treatment the electrons separated from positive ions.

Uses of FILTERSORB[®] with alternating surfaces

The two types of **FILTERSORB[®]** units are **SP3** scale prevention and **SPA** anion scale prevention. **SP3** units prevent cationic scale based on **positively charged** ions such as calcium and magnesium and with nucleation it changes them into CaCO_3 crystals. **SPA** units prevent scale based on **negatively charged** ions such as sulfates, silicates and phosphates (Calcium phosphate).

FILTERSORB[®]CT: Mixed media. **FILTERSORB[®]CT** units prevent scale of both cations and anions, both positively and negatively charged ions. **Watch-Water[®]** recommends a mix of 50% **SP3** media and 50% **SPA** media.

The **FILTERSORB[®]** systems do not need any regeneration, no chemical feed and no electrical valve head or waste water outlet. **FILTERSORB[®]CT** is a continuous up-flow system.

FILTERSORB[®]CT systems can treat both:

- Point-of-entry (POE)
- Point-of-use (POU)

These systems will reduce the scale of calcium, magnesium, sulfates, silicates including phosphates.

FILTERSORB[®] SPA – a media with unique separation properties and selectivity for anions such as sulfates, phosphates and chlorides.





TREATMENT OF CATIONS AND ANIONS

Total hardness

Due to differences between **temporary hardness** and **permanent hardness** that make up the **total hardness** in water, we have combined **FILTERSORB[®]SP3** and **FILTERSORB[®]SPA** in a 50:50 mix. This configuration is described as **FILTERSORB[®]CT**. The 50% **SP3** was selected to treat for temporary hardness based on carbonate hardness and the 50% **SPA** was selected to treat for permanent hardness which is mostly based on sulfates and silicates.

100% Efficiency

Media volume = throughput liters (1 liter = 0,001 m³)/ct operating capacity (0.250 liter each ct liter)

	Example I	Example II
Throughput liters	1000 liters	100 liters
CT operating capacity	250	250
Media volume (FILTERSORB[®]CT media)	4 liters	0.4 liters
The efficiency is always 100%.		

Organic Carbon

The decision to install **CATALYTIC CARBON[®]** is economic intelligent. Removing organic contaminants before it reaches the **FILTERSORB[®]CT** will help protect the surface of the **CT** bead and this should be always consider to test **Organics** in feed water.

Generally carbon is present in all water, and the total organic carbon (TOC) measures the water quality. TOC in water comes from both natural

organic matter as well as synthetic source which can cause many health related problems. Activated carbon reduces TOC levels but not chloromatic or trihalomethane, (THMs). **CATALYTIC CARBON[®]** reduces both down to 0mgH. In order to have safe water, these values should always be zero.

Pressure Vessels

The pressure vessels used for **FILTERSORB[®]CT** should be made from typical, well known materials of construction such as stainless steel or fiber glass. The pressure vessels should have distributor systems that gives **FILTERSORB[®]** a good distribution, keeping it fluidized during all phases of operation. For this reason the system should be constantly checked for its pressure. For this reason it is advisable to install pressure gauges at both the inlet and outlet of the system.

The design of the vessel should give maximum fluidization and limit the pressure drop across the media's volume to a maximum of 0.5 bars or 7 psi.

The optimum volume of media should be fluidized with 5 to 7 time of pressure vessel volume, the ratio of **FILTERSORB[®]** media multiply by 5 to 7 times. Pressure vessels sizing should be adjusted to high height and less diameter.

Number of Pressure Vessels

Based on the flow rate and throughput, the number of pressure vessels operating at the same time needs no definition. The system should run in parallel with pressure vessels ranging from 2 up to 10 can be used in most cases for large plants (> 400 m³/hr or 1800 gpm). However, it may be more appropriate to have 4 lines (4 x 100 m³ in parallel) in order to reduce the system's height and volume. Optimized flow rates is 100 m³ or 480 gpm.





USE OF SORBEX™ FOR CLEANING AND SANITIZATION OF FILTERSORB® CT MEDIA AND SYSTEM

High Efficacy

SORBEX™ has been shown to be very effective in removing inorganic and organic material as well as most viruses, bacteria yeasts, fungi end toxins. This is very great invention to save any filter media, ion exchange or membranes with a combination of both cleaning and sanitization. The benefits of its use include efficacy, low cost and ease of detection, removal and disposal.

BACTERIA, YEAST AND FUNGI

Large amount of organisms, microorganisms such as yeast and bacteria can destroy the function of resins, membranes and filter media including **FILTERSORB®CT**. These organisms can also have indirect effects, such as clogging of the filter and all other water treatment systems and components as well as produce harmful substances such as end toxins. Only **SORBEX™** is effective at cleaning and sanitizing the different medias and its surfaces.

SORBEX™ cleaner is specially design for fouled media and may clean **FILTERSORB®CT**. **SORBEX™** cleaning is an effective treatment for removing inorganic as well as organic contaminants on **FILTERSORB®SP3** and **FILTERSORB®SPA** media used in scale prevention systems. If organic levels in the inlet water are high, it is advised to carry out an annual cleaning with Sorbex as part of a preventive maintenance program, as fouled media is not good for performance.

Usage of SORBEX™

Cleaning in-organics and organics

SORBEX™ has been used extensively for removal of inorganic scale from ion exchange resins, membranes and different filter medias. Traditional use of organic acids has been restricted because of the biofouling on surfaces. Today **Watch-Water®** has changed that picture with modern, high efficiency cleaners such as **SORBEX™** which with it's stable high alkalinity, designed to both clean and sanitize the surface including bacteria, yeast and fungi.

In order to clean the media in the pressure vessel disassembly of the system is needed. After removing the filter head, using care not to damage the vessel opening, the hub or the lateral assembly inside, carefully vacuum out 5 liters of water out of the pressure vessel. Then pour **SORBEX™** into the vessel, wash the head and vessel treads with clean water and install the system back for service.

1. Be sure that all plumbing and re-assembly is complete.
2. Try to allow at least 2 hours of time before starting system up and resuming normal operation.
3. After allowing proper operation, re-start your system and let the water run for 30 minutes into the drain. Your **FILTERSORB®CT** system should now be back for normal operation.

Dosing of Sorbex is easy:

For each liter of **FILTERSORB®CT**, 200 grams of **SORBEX™** cleaner is needed.

Example:

5 liters of **FILTERSORB®CT** = 1000/1 kg of **SORBEX™**





HOW TO DESIGN A FILTERSORB[®] SYSTEM

Step 1: Scale prevention

Example: Water softener

In an ion exchange system, regeneration is required to exchange calcium and magnesium for **sodium**, resulting in huge salt consumption, waste water discharge, manual labor to fill **sodium chloride** into brine tanks, sodium in water which is treated and huge volumes of salt waste compared to **FILTERSORB[®]SP3**. Traditional ion exchange technology cannot provide water quality better than 20 mg of sodium according to the **World Health Organization (WHO)**. Also, according to the **Environment Protection Agency (EPA)**, for each degree of water hardness treated, there is a need for 25 mg of sodium in exchange.

Example

20 dh/20 grains of calcium and magnesium is exchanged for 500 mg of sodium. This water has much higher salinity than inlet water, in short it causes a high corrosion rate in pipes, boilers and cooling towers. Water softener will increase the corrosion inhibitors consumption to twice the amount when used, to avoid such disturbances in all equipment, softening is absolutely not the **right choice**.

FILTERSORB[®]SP3

These are the simplest systems, where there is no ion exchange involved, no regeneration needed, no need for manual service or concern of waste water. The system only requires **SP3** and a vessel with a large freeboard to allow for nucleation of the **SP3** beads. This results in the conversion of the minerals in hard water into insoluble crystals of calcium carbonate, incapable of scale formation. This system can run for more than five years without any servicing. The only precaution the designer has to take is to prevent any leakage of toxic inorganic materials like copper and chlorine from occurring. Such leakage can destroy the surface of **SP3**. Since 2004 when this system has been first introduced, there are now more than 2 million systems running worldwide.

Step 2: Configuration

The **FILTERSORB[®]** plant configuration will depend on feed water composition, water quality required, and all other parameters of operation and application. Please follow the general guidelines which will help you in pressure vessel selection and plant configuration. Due to the improved performance of the **FILTERSORB[®]CT** beads it is highly recommended not to use any **sand or gravel**. The media is designed for **up-flow use only**.

FILTERSORB[®]SP3

FILTERSORB[®]SP3 media is used as an alternative to water softeners to prevent scale formation in cases when the temporary hardness of the water is less than 50%. For residential systems, **FILTERSORB[®]SP3** offers a very simple and effective solution to water with less than 40% permanent hardness.

FILTERSORB[®]SP3 is used as a single treatment of calcium and magnesium cations. Temporary hardness is often referred to as carbonate hardness, caused by the presence of dissolved bicarbonates. In the beverage industry this configuration has many advantages such as keeping the CaCO₃ hardness for better taste in coffee and tea.

Conventional treatments using weak acid cation resin for dealkalization of water contains high amount of hydrogen (H⁺) which is the major cause of corrosion and a health hazard in the food grade resin industry.

FILTERSORB[®]SPA

FILTERSORB[®]SPA media is a revolution in the water treatment industry for its ability to solidify high amounts of silica and sulfates. **FILTERSORB[®]SPA** is used when water has high **total hardness** or permanent hardness. The media can be used for crystallization of water with high sulfates and high silica content. It is a unique innovation for treating permanent hardness without the need for regeneration or use of any chemicals.



RED-OXY TREATMENT

FILTRATION

KATALOX LIGHT
CRYSTOLITE

ADSORPTION

CATALYTIC CARBON
TITANSORB
FERROLOX

FILTERSORB

FILTERSORB CT
SORBEX
FILTERSORB SP3
SPECIAL FILTER

INSTANT PRODUCTS

ISOFT CHEMICALS
OXYDES
OXYDES-P
OXYSORB
BIOXIDE
SCALE-OVER
GREEN-ACID



FILTERSORB® CT

The combination of **FILTERSORB® SP3** and **FILTERSORB® SPA** is an excellent choice for all residential, industrial, and commercial applications since it provides optimum scale prevention. The **FILTERSORB® CT** as a combined technology results in very high efficiency and provides additional capacity to the system.

The **FILTERSORB® SP3** and **FILTERSORB® SPA** combination is well suited to treat water with hardness over 15 grains or permanent hardness over 250 mg of (Ca + Mg + SiO₂ + SO₄) is typically over 60% of the total anions.

FILTERSORB® SPA is only available as a combined product with **FILTERSORB® SP3** (i.e. as part of **FILTERSORB® CT**) and cannot be supplied separately.

SORBEX™ Cleaner – Usage and specifications

SORBEX™ has been used extensively for removal of inorganic scale from ion exchange resins, membranes and different filter medias. Traditional use of organic acids has been restricted because of the biofouling on surfaces. Today **Watch-Water®** has changed that picture with modern, high efficiency cleaners such as **SORBEX™** which with it's stable high alkalinity, designed to both clean and sanitize the surface including bacteria, yeast and fungi.

Name	Sorbex™ Granules
Compounds	Salts of alkaline beads
Normal chemistry	200 g of SORBEX™ /l of FILTERSORB® CT
pH of solution	10 – 10.5 mm
Reusability	very good
Storage	Store sealed in cool, dry place
Biodegradable	100 %
Package	1 kg sealed bags or 5 kg bags
Box package	20 x 1 kg bags or 4 x 5 kg bags

Watch-Water® products have set and will continue to push the boundaries of what science can do for water treatment.

To know and learn more about this huge potential of **FILTERSORB® CT** and **SORBEX™** please contact us: