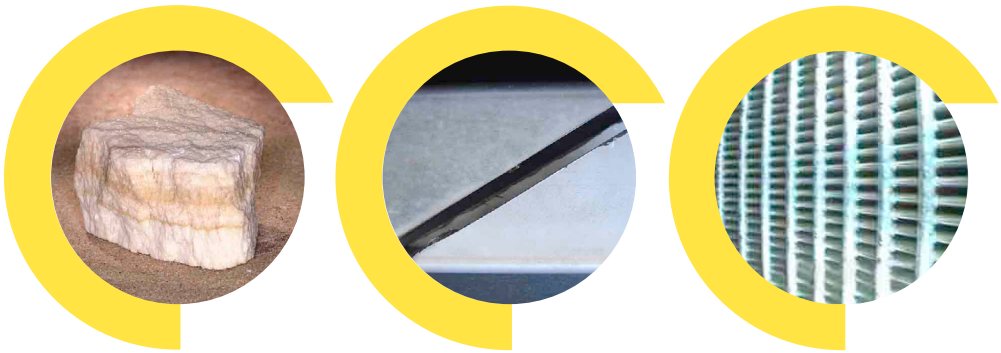
AIX 5.0

REHABILITATION AGENT

inorganic
chloride-free
non-corrosive



pH CONTROLLED

AIXTRACTOR® 5.0

REMOVAL OF CARBONATES

- Crystalline concentrate ready-to-use
- Protective inbuilt inhibitors
- No corrosive impact on stainless steel, gaskets and synthetic materials
- Faster chemical reaction than by any other proton-assisted dissolution
- Continuous process monitoring and control by pH value
- Inorganic components, no bacterial contamination possible
- Result verification on site as per latest technical standards of DVGW, German Gas and Water Association e.V.
- Dosage and reaction time as per type and volume of incrustation
- Easy handling during workflow (non-liquid consistency)
- Immediate confirmation of restoring original water quality by simple measurements
- Calculation of dissolved incrustation quantities and agent effectiveness by mass balancing
- Water Hazard Category 1 (0 non-existent)
- Successful implementation worldwide since 2005

cleanwells®
REHABILITATION TECHNOLOGY

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1. DESCRIPTION

AIXTRACTOR® 5.0 is an irorganic, highly reactive and efficient chemical agent for the removal of soft and crystalline carbonate incrustations from water wells including the screen, the annular space and the adjacent geological formation. The working principle of the agent combines the effect of an acid with material-friendly inhibitors to transform the poorly soluble carbonates into highly soluble calcium (Ca^{2+}) and carbon dioxide (CO_2). As AIXTRACTOR® 5.0 does not cause any corrosion, it can be applied on most types of screen and well construction materials such as stainless and zinc-coated steel. AIXTRACTOR® 5.0 is classified in Water Hazard Category 1 (0 does not exist).

A thorough mechanical cleaning and/or a hydraulic rehabilitation (gravel wash or high pressure jetting) of the well interior prior to any application of AIXTRACTOR® 5.0 is a prerequisite for the benefit of an effective outcome using the chemical agent. As the spatial distribution of incrustations along the screen is heterogeneous, a CCTV camera inspection is required to identify heavily incrusted areas which then may be treated more intensively.

A successful chemical rehabilitation is always based on a geochemical analysis of well incrustation to identify its exact chemical composition. Subsequently a matching agent can be selected ensuring the highest level of dissolving capacity and the best result will be achieved. AIXTRACTOR® 5.0 is not suitable for the removal of ochre, aluminium hydroxides or biomass due to its chemical characteristics. In any case, the specific electrical conductivity of the groundwater is to be measured and recorded prior to starting the rehabilitation work on site.

2. PREPARATION OF THE REHAB SOLUTION

AIXTRACTOR® 5.0 is delivered as a ready-to-use crystalline concentrate. It is diluted in clean groundwater prior to the injection in the well screen in a concentration of 50 g per liter of the total cylinder volume of the borehole diameter multiplied by the screen length. When mixing AIXTRACTOR® 5.0 with water, a full-body protective suit, a respirator, goggles and safety gloves must be worn at all times. It is also imperative to comply with the requirements of the Material Safety Data Sheet.

The rehab solution is to be prepared and mixed shortly before its actual injection in the chosen screen section. As the agent is very soluble up to a concentration of 100 g/l water (pH 0.5) a mixing ratio of 10 to 12 litres water to 1 kg AIXTRACTOR® 5.0 is recommended.

For safety reasons the preparation using a mixing unit including a small pump, must take place outdoor, preferably with tailwind. The agent is added slowly into the circulating water in order to prevent clumping. As soon as the solution is pumpable (make sure no layer settles on the bottom oft he mixing unit), it is ready to be injected in the screen section. Please note that a slight turbidity and potential odour can occur.

WARNING:
Never dissolve AIXTRACTOR® 5.0 in any kind of reducing substance (AIXTRACTOR® 1.0/2.0) or oxidizing agents (e.g. hydrogen peroxide, hypochlorite, sodium hypochlorite). This would not lead to any increase in effectiveness but cause a decomposition of the agent and as consequence develop toxic gas.

3. INJECTION OF THE REHAB SOLUTION AND PROCESS MONITORING

The most effective chemical rehabilitation is conducted using a multi-chamber gravel washer with a circulation capacity of 30 m^3 to 150 m^3 per hour between the chambers depending on the size of the borehole diameter. The treatment of the screen starts at the top and proceeds, section by section, towards the sump. After its injection in the screen section to be treated, the rehab solution circulates between the chambers of the gravel washer in order to induce the agent as far as possible into the pore channels of the formation. At the same time the continuing circulation prevents its migration in the aquifer.

The pH value is kept between 3.0 and 4.0 by additional dosages of the agent and monitored by taking samples via a by-pass from the upper chamber of the washer in regular intervals of 15 minutes. A constant pH is crucial in order to prevent any re-precipitation of the already dissolved particles. As soon as the pH does not exceed 4.0, the dissolution process has been completed and the treated screen section is pumped clear. A longer duration in the screen does not increase the effectiveness of the agent. Instead, it might only drift off and lengthen the clear pumping at the end. The process of dissolution is monitored by the pH value and the concentration of the reaction product calcium (Ca2+) in the return flow of of the depleted rehab solution. Simple measuring equipment and analytical test strips have proven sufficient.

Monitoring the pH value also allows the detection of any significant migration of the rehab solution in the aquifer during the reaction time. The power consumption of the gravel washer changes during the reaction time due to the increase of the circulated water volume (s. pump curves), which can be used as an additional monitoring tool. Both the quantity of the dissolved incrustations and the effectiveness of AIXTRACTOR® 5.0 can be determined precisely by means of mass balancing. The quantities of incrustations are calculated based on their concentrations at the sampling time multiplied by the quantity of the depleted rehab solution during the measuring period. Providing that the quantity of the rehabilitation agent is known, its efficiency can be calculated precisely as explained.

4. DISCHARGE OF THE DEPLETED REHAB SOLUTION

The discharge of the depleted rehab solution takes place immediately after the completion of the chemical reation. The pump should be placed as low as possible in each treated screen section and operated at a rate corresponding approximately to the maximum capacity of the well. Both the duration and the rate of the pumping are to be recorded. The pH value and the specific electrical conductivity are measured and documented during the discharge in regular intervals of 15 minutes. Analytical test strips (colour tests) for the former are delivered with AIXTRACTOR® 5.0. This clear pumping is completed by cleaning the well sump as some rehab solution may have settled due to its higher density.

The duration of the clear pumping varies from well to well and therefore can only be estimated. However, the pumping is finished when the pH value and the specific electrical conductivity have reached their initial values and the test strips for the reaction product show zero for at least 30 minutes. It is recommended to pump the well overnight at the highest possible rate.

5. DISPOSAL OF THE DEPLETED REHAB SOLUTION

There is no formation of chemically or microbiologically critical secondary substances or reaction products during the dissolution process. The depleted rehab solution contains dissolved well incrustations including calcium (Ca^{2+}) and carbon dioxide (CO_2) in addition to released organic compounds. AIXTRACTOR® 5.0 is a combination of substances which supports the dissolution of carbonates and allows for a simultaneous protection of well construction materials by the inhibitors.

The exhausted application solution may only be disposed after being neutralised. If the pH of the solution is less than 6.5, it must be adjusted to pH 6.5 - 8.5 before its disposal (neutralisation = pH 7). It has proven useful to collect the solution in a container and neutralise it there in batches. Compliance with the target pH value must be documented by continuous measurements. The neutralisation takes place by adding bases (caustic solutions) in the container with the depleted rehab solution. Easily soluble hydroxides such as caustic soda (NaOH) or milk of lime (Ca (OH) 2), both of which are also available in crystalline form, are particularly suitable because they are easy to handle. Instead of easily dosed, but corrosive hydroxides, limestone ($CaCO_3$) can also be used by adding it as a granular solid in the neutralisation container. The reaction time is significantly longer than with the hydroxides.

One of the reaction products produced is carbon dioxide (CO_2), which means that the neutralisation container may only be set up outdoor – never in closed spaces. The dissolved substances will re-precipitate creating the same amount of acid that was originally used to dissolve them, which has to be treated as well. The waste water can be coloured and cloudy due to the re-precipitation of particles. They should be separated by settling before the disposal. The quantity depends on the respective input volume and the delivery rate (dilution).

Any impairment described above may effectively be counteracted by dilution and sedimentation before disposal of the depleted rehab solution in a sensitive aquatic environment. Prior to any rehabilitation measure and irrespective of the technique and agent it is imperative to clarify with the local water authority whether the depleted rehab solution can be disposed via seepage, irrigation, sprinkling or sewage.

WARNING:
Intense development of foam combined with discharge of acid can occur. Sufficient ventilation is imperative since carbon dioxide (CO_2) is suffocating.

6. CONTROL OF RESULTS

Well yield:
When evaluating step-discharge tests the original yield of the new well at commissioning should be taken as the 100% value for an objective comparison. Intermediate step-discharge tests allow the verification the effectiveness of individual working steps.

Condition of well interior:
As the structural condition of a well is often revealed after the removal of incrustations only, it is recommended to carry out a second CCTV camera inspection following the mechanical cleaning or hydraulic rehabilitation. A clean well interior is not necessarily proof of successful treatment – decisive and the main factor is the cleanliness of the pore channels in the gravel pack and in the annular space.

Condition of well outside screen:
Comparative examinations by means of borehole geophysics extend the success control including the otherwise invisible gravel pack, annular space and adjacent geological formation. As oxide incrustations reduce the pore volume and increase the density of the gravel pack, geophysical methods have proven to be particularly accurate as they provide valuable data on the porosity and the degree of density.

Quantity of dissolved incrustations:
Concentrations of dissolved and/or suspended iron and manganese can be determined by mass balancing on site. The quantity of dissolved incrustations is calculated by multiplying their concentrations (e.g. mg/l) at the time of the sampling with the pumped volume of depleted rehab solution (e.g. litres) during the measurement period.

Effectiveness of rehabilitation agent:
As the total amount of rehabilitation agent is known, its effectiveness can be determined by mass balancing also, i.e. which percentage reacted with incrustations and which did not.