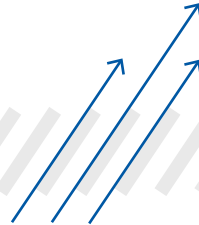


acid-free
chloride-free
non-corrosive



pH NEUTRAL

AIXTRACTOR® 4.0

REMOVAL OF BENTONITE

- Crystalline concentrate ready-to-use
- Dissolution of all residues containing bentonite
- Continuous process control and result verification on site according to latest technical standards of DVGW, German Gas and Water Association e.V.
- Short reaction time of 60 minutes per screen section
- No corrosive impact, applicable on all well construction and screen materials
- No neutralisation or treatment of waste water required
- Safe and environmentally friendly handling during workflow
- Easy disposal by sewage, seepage or irrigation outside water protection zones
- Immediate confirmation of restoring original water quality by simple measurements
- Calculation of dissolved incrustation quantities and agent effectiveness on site
- Water Hazard Category 1 (0 non-existent)
- Successful implementation worldwide since 2000

1. DESCRIPTION

AIXTRACTOR® 4.0 is a fast, highly reactive and efficient chemical agent for the removal of drilling mud residues containing bentonite from water wells including the screen, the annular space and the adjacent geological formation. Drilling muds containing bentonite are often applied during drilling works on site to stabilize borehole walls. Due to insufficient mud circulation or incomplete well development remains of bentonite can still adhere in the exterior of the screen and consequently prevent the flow of groundwater.

Bentonite is a mixture of different clay minerals which swell up upon contact with water. The swelling seals the borehole wall and prevents a loss of the circulated drilling mud. Clay particles build up a voluminous house of cards structure during this process. AIXTRACTOR 4.0® destroys this formation and reduces the shearing force between the clay minerals in order to create a pumpable solution of low viscosity. As AIXTRACTOR® 4.0 reacts in a neutral pH range and does not contain chlorides, it can be applied on all types of screen and well construction materials such as stainless steel, zinc-coated steel, copper, resin bonded preglued gravel and laminated plywood. AIXTRACTOR® 4.0 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® 4.0 is a prerequisite for the benefit of an effective outcome using a chemical agent. As the spatial distribution of incrustations along the screen is heterogeneous, a CCTV camera inspection is required to identify heavily incrustated areas which then may be treated more intensively.

A successful chemical rehabilitation is always based on a geochemical analysis of the 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® 4.0 is not suitable for the removal of ochre, carbonates, 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® 4.0 is delivered as a ready-to-use crystalline concentrate. It is diluted in clean groundwater prior to the injection in the well screen. The concentration varies depending on the type and quantity of incrustations from 50 g to 100 g per liter of the total cylinder volume of the borehole diameter multiplied by the screen length. When mixing AIXTRACTOR® 4.0 with water, protective clothing, 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 1000 g/l water, the mixing ratio of 2 to 3 litres water to 1 kg AIXTRACTOR® 4.0 is recommended. For safety reasons the preparation using a mixing unit including a small pump, must take place outdoor, preferably with tailwind. Specially important is to make sure no chemicals get in contact with skin and eyes. 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 of the mixing unit), it is injected in the screen section. Please note that a slight turbidity and potential odour can occur.

WARNING:

Never dissolve AIXTRACTOR® 4.0 in any kind of acidic substance (e.g. hydrochloric or sulphuric acid) or oxidizing agents (e.g. hypochlorite, hydrogen peroxide). This does not lead to more effectiveness, but would cause the 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 m³ to 150 m³ 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.

When removing fresh drilling muds the rehab solution is circulated between the chambers of the gravel washer with a reaction time of 60 minutes 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 drifting off in the aquifer. Within 60 minutes the chemical reaction is completed and the rehab solution is depleted. A longer duration in the screen section does not increase the effectiveness of the agent. Instead, it might only drift off and lengthen the clear pumping at the end.

When removing aged crystalline drilling mud residues, the chemical reaction takes up to 24 hours depending on the quality and quantity of the remains to be removed. It is recommended to circulate the rehab solution in the screen during 15 minutes, let it react during 45 minutes and repeat the procedure regularly. The process of dissolution in the individual screen sections is controlled and monitored by continuous measurements of the specific electrical conductivity and the turbidity in the return flow of the depleted rehab solution. Simple measuring equipment and analytical test strips have proven sufficient.

The chemical treatment is to be repeated in any screen section showing high remaining concentrations of reaction products until the specific electrical conductivity and the turbidity have reached their initial values. Monitoring the specific electrical conductivity 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.

4. DISCHARGE OF THE DEPLETED REHAB SOLUTION

The discharge of the depleted rehab solution takes place immediately after the reaction time. 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 specific electrical conductivity and the turbidity are measured and documented during the discharge in regular intervals of 15 minutes. 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 specific electrical conductivity and the turbidity have reached their initial values. It is recommended to pump the well overnight at the highest possible rate. As AIXTRACTOR® 4.0 contains eutrophic substances which can theoretically cause a microbiological contamination it is recommended to disinfect the well after the treatment.

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 sodium (Na⁺) and suspended particles of bentonite only. Sodium is a natural and harmless substance in any normal groundwater. The original dissolving substance is completely depleted within the reaction time due to its chemical characteristics. Therefore the discharged waste is free of any remnants.

As with any other type of rehabilitation agent the depleted rehab solution shows an increased salt content. It originates from the ions of sodium which occur here in a higher concentration than in the aquifer. The salt content is not only influenced by the quantity of the rehabilitation agent applied but also by the volume of discharged water (dilution). It is determined by measurements of the specific electrical conductivity.

As the discharged water is neutral with a pH value of around 7, it does not require any neutralisation. It may have a certain turbidity due to loosened particles of sand and dissolved incrustations. The process parameters of specific electrical conductivity and turbidity are measured and documented in regular intervals of 15 minutes.

The depleted rehab solution from potable water wells has to be disposed outside the Source Protection Zones I and II. The first gush from each treated screen section (1 m³) is pumped into a container in order to allow for possible dissolved material to settle on the bottom. The depleted rehab solution from process water wells can be disposed at a distance of at least 50 m from the well beneath the flow direction of the groundwater by seepage, irrigation, sprinkling or sewage and in accordance with the local water authority.

All discharged clear water is disposed untreated either by seepage, irrigation, sprinkling or sewage outside the Source Protection Zones I and II. It is recommended to comply with the FAO limit value of 3000 µS/cm or with the German Drinking Water Ordinance limit of 2790 µS/cm which is considered unproblematic.

As AIXTRACTOR 4.0® contains organic substances which can theoretically cause a microbiological contamination, the untreated rehab solution must not be discharged in surface water as it can a.o. activate blooming of algae.

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.

6. CONTROL OF RESULTS

Well yield:

When evaluating step-charge 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 of 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 hidden 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 reaction products 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