

**pH neutral
Rehabilitation Agent**

- acid-free
- chloride-free
- non corrosive

**for Removal of
Drilling muds**



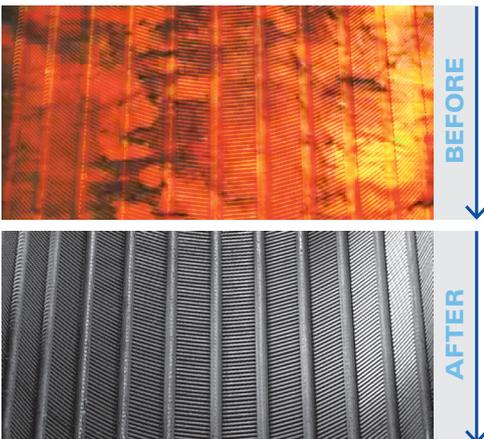
REHABILITATION AGENT AS PER GEOCHEMICAL ANALYSIS

AIXTRACTOR® 4.0

Drilling muds – pH neutral

- Dissolution of hardest residues containing bentonite
- Continuous process control and immediate result verification on site according to latest German technical standards of DVGW
- Non-corrosive impact, applicable on all screen materials
- Short reaction time of 60 minutes per screen section
- Easy and environmentally friendly handling on site
- Re-establishment and confirmation of original water quality by means of easy measurements on site
- Possibility of direct quantity calculation of dissolved incrustations and determination of agent effectiveness on site
- Successful implementation on well sites since 2000

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INCRUSTATION PROBLEMS!**



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1. DESCRIPTION

AIXTRACTOR® 4.0 is a fast reacting effective chemical agent for removing drilling mud residues containing bentonites from wells. AIXTRACTOR® 4.0 has no corrosive side effects and can therefore be used on all types of filter screen and well lining material. AIXTRACTOR® 4.0 may be used on site as a well rehabilitation agent without any environmental concerns. It is classified as environmentally harmless when compared to the relevant German Environmental Standard.

Drilling muds containing bentonite are often applied for drilling boreholes. Due to insufficient mud circulation or incomplete well development residues of drilling mud can remain in the well reducing the well yield severely.

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. In this process the particles of clay particles build up a voluminous house of cards structure. Through adding AIXTRACTOR® 4.0 this formation is destroyed and the shearing force between the clay minerals is reduced in order to create an extractable solution with low viscosity.

In all cases, the specific electrical conductivity of the groundwater is to be measured and recorded prior to the commencement of the rehabilitation procedure.

2. PREPARATION OF THE WORKING SOLUTION

AIXTRACTOR® 4.0 is supplied as a ready-to-use powdered concentrate and should be mixed immediately prior to application.

The agent should be completely dissolved in clean (ground) water with a concentration of 50 g AIXTRACTOR® 4.0 per litre volume of borehole to be treated. AIXTRACTOR® 4.0 is very soluble up to a concentration of about 1000 g/l water. A mixing ratio of 2 to 3 litres water to 1 kg AIXTRACTOR® 4.0 is recommended. Mixing chambers equipped with a lid and a circulation pump have proven useful for the preparation of the working solution.

In order to completely dissolve the agent and prevent coagulation of the agent, the powder should be added slowly to continuously stirred or circulated water. The solid material will dissolve in less than 30 minutes. A slight turbidity is normal, but no residue should be visible at the bottom of the mixing chamber prior to application. While mixing the working solution a good ventilation is necessary (mixing outside is the best). The development of a slight odour during the mixing process is normal.

When mixing AIXTRACTOR® 4.0 with water, it is highly recommended to wear protective clothing such as safety gloves, goggles and a filtering half mask. In all cases, the guidelines set out on the ECU Safety Data Sheet are to be considered.

3. ON SITE USE AND MONITORING

The rehabilitation of the well screen is conducted in sections at various depth intervals using an injection technique such as a gravel washer. The process of removing the bentonite begins at the top of the well and continues downwards towards the sump.

The reaction time of dissolving fresh drilling mud residues is 60 minutes per screen section. In order to optimise the effectiveness of the process and to the prevent discharge of the working solution into the aquifer, the working solution should be kept in motion by means of a circulation pump.

When removing aged and hardened drilling mud residues, the reaction time can be up to 24 hours depending on the quality and quantity of the residues to be dissolved. It is recommended to repeatedly circulate the working solution in the well for 15 minutes and then let it react for 45 minutes. The success of the treatment can be controlled by turbidity measurements of the abstracted water.

The rehabilitation process may be observed and regulated through continual measurement of the process parameters during the course of the reaction. The prepared working solution of AIXTRACTOR® 4.0 is applied in 2 to 3 equal portions into the screen section to be treated. The amount of the rehabilitation agent can then be minimised during the treatment depending on the condition of the well.

The parameters which need to be monitored to determine the effectiveness of the rehabilitation process are the electrical conductivity and the turbidity of the abstracted solution. These need to be recorded throughout and after the reaction process. Simple measuring equipment has proven sufficient in measuring these parameters.

Measuring the process parameters will help determine if further treatment of obstinate incrustations may be necessary. By monitoring these parameters it may also be possible to reduce the total amount of working solution during treatment time based on their development during the process.

Any significant migration of the working solution into the aquifer can be observed by monitoring the electrical conductivity of the solution during the reaction time of 60 minutes in each screen section. The quantity of dissolved incrustation as well as the effectiveness of AIXTRACTOR® 4.0 may furthermore be determined by means of mass balancing using the results of the continual measurements during the abstraction of the water and working solution mixture from the well.

Since AIXTRACTOR® 4.0 contains organic substances which can theoretically cause a microbiological contamination, an application of a disinfecting agent is recommended (e.g. hydrogen peroxide, hypochlorite and chlorine bleaching).

4. REMOVAL OF THE WORKING SOLUTION

Following the treatment process the dissolved incrustations should be removed from the well, the surrounding sand and / or gravel pack by abstracting water at a high rate. This also minimises the possibility of a microbiological contamination. The abstraction pump should be placed as low as possible within the treated screen section of the well and be operated at a rate, which roughly corresponds with the capacity of the well development. The rate of abstraction and the duration of pumping to fully remove all dissolved incrustations per treated screen section should be noted.

During the abstraction stage the process parameters, the specific electrical conductivity and the turbidity should be measured and recorded in the abstracted water every 10 minutes. These process parameters in the abstracted water determine when abstraction can end for any one section of screen. When the specific electrical conductivity and the turbidity have reached the pre-rehabilitation level for at least 30 minutes the abstraction procedure for that section of the well may be considered complete. An exact period of time for the duration of the abstraction process can not be given in these instructions, as it varies considerably from well to well.

After completion of the whole rehabilitation procedure for any given well a thorough cleansing of the well sump is recommended. The working solution has a higher density than water and may have accumulated during the rehabilitation process. To ensure the complete removal of reactants from the well, it is recommended that be well be pumped overnight after treatment.

5. DISPOSAL

The reaction products of AIXTRACTOR® 4.0 consist of sodium salts and suspended particles of bentonite, which can cause a turbidity of the abstracted water. The exhausted working solution has to be disposed of after application in an appropriate manner. The salt content is influenced not only by the quantity of the rehabilitation agent applied but also by the volume of the pumped water (dilution). It can be determined by measuring the electrical conductivity of the working solution. When the rehabilitation process is being undertaken on a potable water well the applied and later exhausted working solution should not be disposed of within the Source Protection Zone (SPZ) of the well. After application on any one treated screen section of the well, the initial cubic metre of extracted water is to be collected separately in a container. The dissolved residues of drilling mud will form a sludge at the base of the container. This is to be disposed of in an appropriate manner. The clear waste water portion may be disposed of by spoiling it by raining outside the SPZ of a potable water source or by a soakaway system after permission has been obtained from local authorities.

After a rehabilitation measure on a non-potable water well it is also not recommended to allow the untreated working solution be spoiled by raining or by soakaway directly into the surrounding soil. As already stated, the first (initial) relatively high salt concentrated cubic metre of the extracted water (reactant) is to be collected separately and disposed of accordingly together with the possible sludge at the base of the container. The clear waste water portion may normally be disposed of by soakaway at a distance of 50 m from the treated well after consulting local authorities.

Since AIXTRACTOR® 4.0 contains eutrophating substances which can theoretically cause a microbiological contamination, it is not recommended to discharge the untreated working solution in surface water as it can a.o. activate blooming of algae. A disposal via a sewage plant is more appropriate. Irrespective of the process technology used it is advisable prior to any rehabilitation measure to clarify with the local water authority, if the exhausted working solution may be discharged, soaked away or disposed of via a sewage plant after a treatment on site.

6. MONITORING SUCCESS

Well capacity:

When evaluating pumping tests the original capacity of the newly built well should be taken as 100% to make the results comparable. Intermediate pumping tests enable the determination of the effectiveness of each working step.

Condition of well interior:

It is highly recommended to inspect the insides of the well prior to and after rehabilitation using CCTV as an examination of the structural condition of a water well can only commence once bentonite incrustations have been removed.

Condition of well outside screen:

Comparative examinations by means of borehole geophysics extend the success control down to the otherwise invisible sand and / or gravel pack surrounding the well casing. Incrustations of drilling mud reduce the pore volume and increase the density of the sand and / or gravel pack so geophysical methods providing data on the porosity and the degree of density have proved successful in the past in monitoring success.

Quantity of dissolved incrustations:

Concentrations of dissolved and / or suspended residues of drilling mud can be determined by mass balancing on the well site. The quantity of dissolved incrustations can be calculated by multiplying their concentration (e.g. mg/l) at the time of sampling with the pumped volume of used working solution (e.g. litres) during the period of measurement. The duration of treatment for each screen section can be determined by analytical testing on site finishing at that point where no further drilling mud residues in the working solution are evident.

Effectiveness of rehabilitation agent:

As the total utilised amount of rehabilitation agent is known, the effectiveness of the agent can be determined by mass balancing in each screen section.