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Blue Earth Products®

Well Cleaning Guidelines

Essential instructions for the planning and implementation of well chemical cleanings

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Note:

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Well Cleaning with Clearitas

What role does Clearitas play in successful well cleaning?

Wells often loose capacity because of biological and mineral buildup. Biofilms often exacerbate the problem by contributing directly to mineral buildup as a biproduct of their life cycle. Clearitas efficiently breaks up these biofilm formations improving fluid flow in the well formation.

In what situation is Clearitas most effective?

Clearitas works best in aquifers that have a moderate to high organic carbon concentration (greater than 0.5 mg/L as C) or if the well has a younger biofilm. In these environments we typically find softer biofilms with high polysaccharide content which Clearitas is good at disrupting. If the well has an old biofilm, or high hardness, high oxygen content and/or low organic carbon in the aquifer, an acid based treatment should be used first to loosen the scale, with a secondary treatment of Clearitas used to remove the softer organic-based biofilm that will be located under the hard outer crust. In situations where the pump can not be removed, Clearitas treatment is ideal because it is not harsh or corrosive to the equipment.

What is involved in a general well cleaning treatment?

In general the following steps will work together or independently to provide improved well performance.

1) An initial mechanical treatment step. Brushing and/or using an air impulse gun depending on the aquifer.
2) A rough scale removal step with or without the use of an air impulse gun. Depending on water quality an acid treatment should be used.
3) Finally, a high dose of Clearitas, Chlorine, and Organic acid treatment for simultaneous biofilm disruption, loosening and disinfection.

Work Site Preparation

Preparation of the Well:

1. Read the "Important Safety Notice" at the end of this manual.
2. If confined space entry is required: check access/escape routes and verify that ladders and hatches are safe and secure.

    - **NOTE: IT IS CRITICAL YOU ALWAYS COMPLY WITH OSHA CONFINED SPACE AND FALL PROTECTION PROCEDURES IF APPLICABLE**

3. Verify that electrical power is available for running a compressor, pumps and safety equipment.

    - Use GFCI (ground fault circuit interrupter) connectors for electrical equipment.

4. Ensure all power cables are clear of standing liquids.
5. Safety Assessment Form finalized and posted if required.
6. Make sure related equipment has been locked out/tagged out if applicable.
7. Ensure run-off from well flushing can be treated or captured if required.

Personal Protective Equipment (depending on work environment)

- Chemical coverall - wear legs and sleeves outside boots and gloves
- Rubber boots - no lace-ups
- Rubber gloves
- Chemical eye protection

Equipment

- Mechanical well cleaning equipment (optional)
- Chemical handling equipment
- Treatment mixing tank and/or chemical pumping equipment
- Confined space and/or fall protection equipment if needed

Well Cleaning Procedure

Initial Mechanical Treatment Step (optional)

This step is optional, and can be employed using any common and effective mechanical cleaning technique available. An example would be wire brushing of the casing and screen to remove loose scale for a couple of hours. Followed by bailing to remove the infill and debris from brushing.

Rough Scale Removal Step (optional)

In cases where the well has an old biofilm, or high hardness, high oxygen content and/or low organic carbon in the aquifer, an acid based treatment should be used first to loosen the scale prior to a Clearitas treatment. An example of a successful acid treatment is as follows:

For each 100 gal of bore hole volume, premix 275 gal of chemical solution (water plus 2.5 gal of 70% Glycolic Acid and 40 lbs of sulfamic acid powder – stir with plastic pipe until sulfamic is dissolved). Using a clean IBC tote is ideal for this. Introduce premixed treatment into well from the top to displace borehole fluid and nearby aquifer water. Water used for this treatment should be from the well prior to pulling the well pump.

After introducing the chemical run a surge block repeatedly through the screened area to agitate and loosen the scale and biofilm. Initial pH should be 1 to 1.5. Let well sit for 24 hours. After 24 hours, mix the well with a surge block for 30 min. If pH remains below 4 pH, let sit for an additional 24 hours and repeat process until pH is above 4.0.

Purge chemicals out of well and neutralize as necessary. During the purge, recycle 2 to 5 gpm of flow back into the well to purge chemical from the stagnant area above the pump.

Primary Biofilm Removal Treatment

After purging from the well the remnants of the above treatments, treat the well with a solution containing Clearitas 101 at 20,000 mg/L, Glycolic Acid at 750 mg/L and chlorine at 500 mg/L as follows:

For each 100 gal of bore hole volume, premix 275 gal of chemical solution (water plus 5 gal of Cleartias 101, 1.1 gal of 12.5% bleach, and 0.25 gal of 70% Glycolic Acid). Take

care to add the Glycolic Acid last to avoid the evolution of chlorine gas. Be certain to provide adequate ventilation. The final solution should have a pH of around 5.0. Using a clean IBC tote is an ideal mixing container. Introduce premixed treatment into well from the top to displace borehole fluid and nearby aquifer water. Water used for this treatment should be from the well prior to pulling the well pump.

After placement of chemical, run a surge block repeatedly through the screened area to agitate and loosen biofilm (2 hours assumed). Let well sit for 24 hours.

After 24 hours, mix the well with a surge block for 30 minutes. If pH is < 4.0 and chlorine concentration is greater than 100 mg/L, let well sit for another 24 hours. If pH is > 4.0 or chlorine is less than 100 mg/L, supplement chemicals to original levels by adding from the surface, mix with the surge block. Let well sit for and additional 24 hours.

After 48 hours of total contact, mix the well with a surge block for 30 minutes . If the pH is < 4.0 and chlorine is greater than 100 mg/L, let well sit for another 24 hours. If pH is > 4.0 or chlorine is less than 100 mg/L, supplement chemicals to original levels by adding from the surface. Let well sit for and additional 24 hours.

After 72 hours, purge chemicals out of well and neutralize as necessary. Purge well for 24 hours. During purging, recycle 2 to 5 gpm of flow back into the well to purge chemical from the stagnant area above the pump.

Additional Techniques

Rawhiding:
During the final purge, once the color clears, turn off the recycle flow and “rawhide” the well. This is a mechanical method for cleaning the screen and remove loosened material. For this process, slowly close the discharge valve to cut flow to about 20% of previous flow. After a couple minutes at this new flow, when the water level in the well has rebounded, open the valve quickly to surge the well. The rush of flow will loosen material and flush it from the well. Do this until you see no color development. Ideally we’d like to see the surge flow to be about twice the normal flow rate, but this depends upon the actual pump installed and its capabilities. Make note of color changes in the rawhide flush water and the time to color change. If the time for the color change is 30 seconds or more, the water originated in the screen and gravel pack. If the purge water and rawhide water is highly colored and/or takes a long time to diminish, consider treating a second time.

Rawhiding between treatments may help extend capacity, particularly for a well that plugs so quickly and one that sees a low velocity under normal operation.

Direct Pumping:

In cases where a pre-mixing tank is not practical, it is possible to coordinate the pumping of chemicals and water into the well at the proper ratios using either chemical pumps or venture pumps. Caution should be used to ensure proper mixing of the treatment chemistry and to prevent inadvertent acidizing of the bleach which will result in the formation of chlorine gas.

Dosing Tables:

The following tables provide single treatment dosing suggestions according to the Bore Hole Volume to be treated.

Bore Hole Volume	Vol. of Solution to Pre-mix	Clearitas 101	Bleach (12.5%)	Glycolic Acid (70%)
100 gal	250 gal	5.0 gal	1.1 gal	0.25 gal
200 gal	500 gal	10.0 gal	2.1 gal	0.50 gal
400 gal	1,000 gal	20.0 gal	4.3 gal	1.0 gal
600 gal	1,500 gal	30.0 gal	6.4 gal	1.5 gal
800 gal	2,000 gal	40.0 gal	8.6 gal	2.0 gal
1,000 gal	2,500 gal	50.0 gal	10.7 gal	2.5 gal
1,500 gal	3,750 gal	75.0 gal	16.1 gal	3.8 gal
2,000 gal	5,000 gal	100.0 gal	21.5 gal	5.0 gal
3,000 gal	7,500 gal	150.0 gal	32.2 gal	7.5 gal
4,000 gal	10,000 gal	200.0 gal	43.0 gal	10.0 gal
5,000 gal	12,500 gal	250.0 gal	53.7 gal	12.5 gal
10,000 gal	25,000 gal	500.0 gal	107.5 gal	25.0 gal

Table 1 – Dosing suggestions for Clearitas 101

Bore Hole Volume	Vol. of Solution to Pre-mix	Clearitas 110	Bleach (12.5%)	Glycolic Acid (70%)
100 gal	250 gal	1.7 gal	1.1 gal	0.25 gal
200 gal	500 gal	3.3 gal	2.1 gal	0.50 gal
400 gal	1,000 gal	6.7 gal	4.3 gal	1.0 gal
600 gal	1,500 gal	10 gal	6.4 gal	1.5 gal
800 gal	2,000 gal	13 gal	8.6 gal	2.0 gal
1,000 gal	2,500 gal	17 gal	11 gal	2.5 gal
1,500 gal	3,750 gal	25 gal	16 gal	3.8 gal
2,000 gal	5,000 gal	33 gal	21 gal	5.0 gal
3,000 gal	7,500 gal	50 gal	32 gal	7.5 gal
4,000 gal	10,000 gal	67 gal	43 gal	10 gal
5,000 gal	12,500 gal	83 gal	54 gal	13 gal
10,000 gal	25,000 gal	167 gal	107 gal	25 gal

Table 2 – Dosing suggestions for Clearitas 110

Runoff Treatment and Disposal Procedure

In most cases, treatment runoff will be suitable for disposal on the ground provided the runoff is dechlorinated. In special cases, well cleaning treatments using Blue Earth Products' chemical products produce runoffs that may require special handling, this should be performed in compliance with state, local, and federal safety, and environmental requirements. It is very important to discuss the discharge procedures with the customer before scoping or pricing a job. Customers might have their own concerns in addition to regulatory issues, but in most cases operation personnel are helpful in determining the correct procedure.

The runoff consists of the chemicals used, the flush water and the dissolved and suspended solids that are dislodged from the surface and present in any residual sediment.

Discharge of the runoff to the sewer or a sludge lagoon is the preferred method of disposal if runoff treatment is required. Some remediation jobs have sewer manholes close enough to allow for pumping the runoff as a disposal point. If no such option is available, a pump truck can be used to collect the runoff and deliver it to the sewer plant. For discharge to the sewer, the pH of the runoff usually must be adjusted to 6-9.

Discharge to a ground or storm drain is less desirable than discharge to the sewer or sludge lagoon and usually requires approval from the city who must have a National Pollutant Discharge Elimination System (NPDES) permit in accordance with the Clean Water Act. If the customer approves, the runoff has to be neutralized, de-chlorinated and sometimes filtered through a sediment bag before draining or pumping it out of the tank.

Final Well Disinfection

Disinfection according to AWWA Standard C654-13

The biofilm removal step described herein, satisfies the requirements of standard C654-13

1) treating the water in the well casing to provide a chlorine residual of approximately 50 mg/L,
2) circulating the chlorinated water within the well casing and pump column, and
3) pumping the well to waste to remove chlorinated water.

Quality Control Measures

1. Compare specific capacity before and after cleaning.
2. Compare water quality data before and after treatment.
3. Evaluate bacterial data before and after treatment.

Benefits and Results

1. Remove biofilms and deposits on screens and in gravel pack:
    - Imporved flow rates and specific capacity
    - Removes disinfectant demand and contribution to disinfection byproduct (DBP) generation and improves finished water quality
    - Water quality improvement from elimination of water-borne surface contamination
    - Reduction of risk of microbiological corrosion (MIC) and under deposit corrosion
2. Improved biofouling removal and reduced corrosivity to well systems
    - Improves longevity of well
    - Improves immediate and longterm productivity.

Important Safety Notice

You are working with corrosive chemicals. These can be acids, caustics or oxidants. The products used can do harm through contact with the skin and eyes, ingestion and inhalation. The products are certified for use in drinking water facilities under Standard NSF-60. This means that they do not pose a health risk for drinking water customers if applied properly. This does not mean they do not pose a risk for those who apply the products.

Flush immediately if you come in contact with any of the chemicals. The neutralizers other than pHaze can cause long-lasting, slow healing burns and severe eye damage. (The use of pHaze™ can help eliminate the hazards of handling hazardous caustic products). Avoid contact and flush extensively if you get splashed. Do not ignore any small contact even if it does not burn immediately.

1. Review all Safety Data Sheets (SDS) for the products to be used prior to starting.
2. Find out the local emergency phone number that is used at the water plant in case you need medical attention.
3. Install a garden hose equipped with a nozzle as an emergency water supply. Leave water turned on and place nozzle where it can be easily reached. Use this for rinsing if you come in contact with any chemicals.