Point-Of-Use / Point-Of-Entry

Removal of Iron, Manganese, Hydrogen Sulfide and Arsenic From Well Water

GREENSAND plus™

Performance Media for Water Filtration

GreensandPlus™ is a black, granular filter medium used in closed pressure-type filtration systems. GreensandPlus will remove iron, manganese, hydrogen sulfide and arsenic to required levels.

Removal Capacities

GreensandPlus

44 lbs. (20 kg.)

Based on total oxidant demand*	10,000 mg/L Cl_2/cu. ft. (28.3 L)
For iron (Fe^{+2}) alone	10,000 mg/L Fe/cu. ft. (28.3 L)
For manganese (Mn^{+2}) alone	5,000 mg/L Mn/cu. ft. (28.3 L)
For hydrogen sulfide (H_2S) alone	2,000 mg/L H_2S/cu. ft. (28.3 L)

Note: removal capacities must be based on the total combined concentration of iron, manganese, and hydrogen sulfide if present. (See example given below).

*The oxidant demand is equivalent to the total quantity of Cl_2 required to oxidize soluble iron, manganese, and hydrogen sulfide in the raw water.

The oxidant demand can be approximated by the following formula:

oxidant demand = [1 x mg/L Fe] + [2 x mg/L Mn] + [5 x mg/L H_2S]

Example for determining number of gallons between regenerations:

Raw Water:

3.0 mg/L Fe x 1.0 = 3.0 mg/L Cl_2 equiv.
0.3 mg/L Mn x 2.0 = 0.6 mg/L Cl_2 equiv.
0.2 mg/L H_2S x 5.0 = 1.0 mg/L Cl_2 equiv.
4.6 mg/L oxidant demand

Capacity:

$$\frac{10{,}000 \text{ mg/L } Cl_2}{\text{cu. ft.}} \times \frac{1}{4.6 \text{ mg/L oxidant demand}} = 2175 \text{ gallons/regeneration/cu. ft.}$$

Intermittent Regeneration Process

Soluble iron and manganese are removed by contact oxidation directly on the GreensandPlus grains. Hydrogen sulfide utilizes the oxidizing capacity of GreensandPlus with the resultant precipitates removed by filtration in the GreensandPlus bed.

At the end of a service cycle (determined by the number of gallons treated), the unit is backwashed and then regenerated downflow (in a manner similar to sodium cycle softening) with a solution of the oxidant selected. This will restore the oxidative capacity of GreensandPlus. Depending on raw water conditions, the regeneration level should be 2-4 ounces/cubic foot (2.12 - 4.24 grs/L) of GreensandPlus. It is recommended that regeneration be initiated prior to complete exhaustion of the GreensandPlus. This is important to extend the service life.

Recommended Operating Procedures

Intermittently Regenerated GreensandPlus

pH	6.2-8.8
Minimum Bed Depth:	30 inches (0.762 m) 15 -18 in. (0.4 - 0.45 m) of each media for dual media beds
Recommended Backwash Rate:	Sufficient rate to expand bed 35-40% Minimum 12 gpm/sq. ft. at 55ºF (30 m/hr at 13ºC)
Recommended Backwash Time:	10 minutes minimum
Service flow rate:	*Continuous Service:* 3-5 gpm/sq. ft. of bed area (7.5 - 12 m/hr) *Intermittent Service:* 2-5 gpm/sq. ft. depending on raw water conditions (5 - 12 m/hr)
Regeneration Level:	2 - 4 ounces Cl_2/cu. ft. (0.13-0.25 lb. Cl_2/cu. ft.) (2.12 -4.24 grs/L)
Regeneration Concentration:	0.2-0.5% Cl_2
Optimum Regeneration Time:	30-40 minutes

Hydrogen Sulfide Removal

For the removal of hydrogen sulfide, GreensandPlus directly oxidizes sulfide and catalyzes the oxidation reaction. Increased run length and service life of GreensandPlus may be realized by pre-feeding a solution of chlorine-containing compounds. Regeneration with chlorine should be initiated before the unit has reached the point of complete exhaustion and sulfide is detected in the treated water.

Arsenic and Radium Removal

GreensandPlus can be used to remove arsenic and radium from ground water in the presence of iron and manganese respectively. Chlorine can serve to keep the media regenerated, and in the case of arsenic removal, it will oxidize any arsenite to arsenate. Arsenic combines with iron and is filtered out in the media. With a sufficient amount of iron in the water, arsenic can be reduced to desired concentrations. If there is not a sufficient amount of iron present, then an iron salt such as ferric chloride can be added to the water to provide the floc needed to remove the arsenic to acceptable levels. A general guideline is 1 mg/L of iron to remove 20 µg/L of arsenic. This can vary greatly depending on pH, silica, and other competing ions in the water.

Radium can be removed by a similar co-precipitation process. In the case of radium, manganese in the raw water is necessary. If there is not a sufficient amount of manganese present, then manganese sources, such as manganese sulfate and potassium permanganate can be added.

Continuous Regeneration Process

In some installations, better performance may be achieved by oxidizing soluble iron, manganese, hydrogen sulfide and arsenic prior to the GreensandPlus filter. This is accomplished by the continual pre-feed of a solution of chlorine. The oxidized precipitates are then filtered out in the GreensandPlus bed with subsequent removal during backwashing. The GeensandPlus allows the chemical reactions to go rapidly to completion and reduces iron and manganese to the required levels. No additional regeneration is required using this method. It is necessary to maintain a Cl_2 residual in the filter effluent. For additional information, see our GreensandPlus general bulletin.

Recommended Operating Procedures

Continuously Regenerated GreensandPlus

Backwash rate:	Minimum 12 gpm/sq. ft. at 55ºF (30 m/hr at 13ºC)
Service rate:	2-5 gpm/sq. ft. (5 -12 m/hr)
Recommended bed depth:	20-24 inches (0.50 - 0.60 m) GreensandPlus; 15 inches (0.38 m) anthracite
Recommended pressure drop:	10 - 18 psi (0.7 - 1.2 Pa)

Physical Characteristics

GreensandPlus

Form: Black nodular granules of manganese dioxide - coated natural silica sand

Apparent Density:	88 lbs. / cu. ft. net (1410 kg/m^3 net)
Shipping Weight:	89 lb. / cu. ft. gross (1426 kg/m^3 net)
Screen Grading:	18 x 60 mesh
Effective Size:	0.30-0.35 mm
Uniformity Coefficient:	Less than 1.60
Specific Gravity:	Approx. 2.4
Packaging:	Shipping 1/2 cu. ft. (20 kgs) bags

Note: Backwash and regenerate GreensandPlus with chlorine before placing in service.

Inversand Company SINCE 1925

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