

### GREENSAND<sup>plus</sup>™

**Performance Media for Water Filtration**  
removes iron, manganese, hydrogen sulfide, arsenic and radium

Greensand<sup>Plus</sup>™ is a black filter media used for removing soluble iron, manganese, hydrogen sulfide, arsenic and radium from groundwater supplies.

The manganese dioxide coated surface of **Greensand<sup>Plus</sup>** acts as a catalyst in the oxidation reduction reaction of iron and manganese.

The silica sand core of **Greensand<sup>Plus</sup>** allows it to withstand waters that are low in silica, TDS and hardness without breakdown.

**Greensand<sup>Plus</sup>** is effective at higher operating temperatures and higher differential pressures than standard manganese greensand. Tolerance to higher differential pressure can provide for longer run times between backwashes and a greater margin of safety.

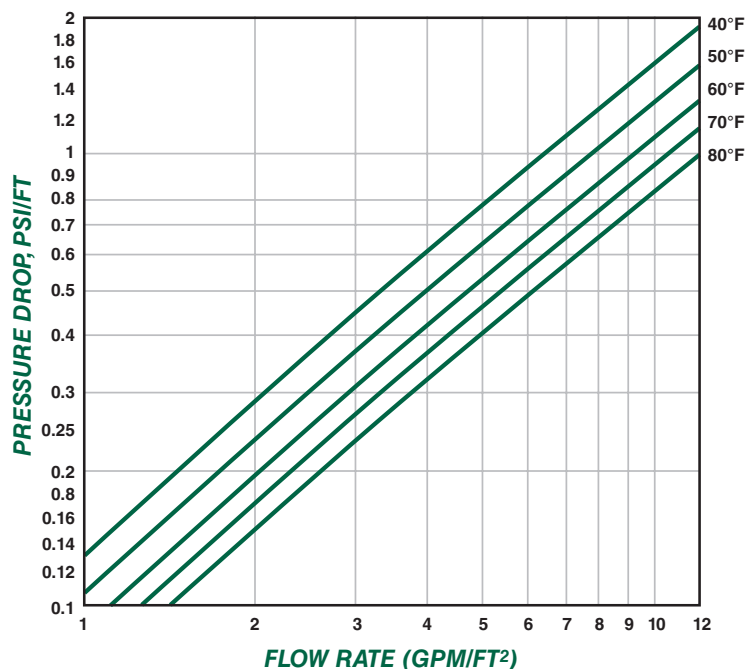
Systems may be designed using either vertical or horizontal pressure filters, as well as gravity filters.

**Greensand<sup>Plus</sup>** is a proven technology for iron, manganese, hydrogen sulfide, arsenic and radium removal. Unlike other media, there is no need for extensive preconditioning of filter media or lengthy startup periods during which required water quality may not be met.

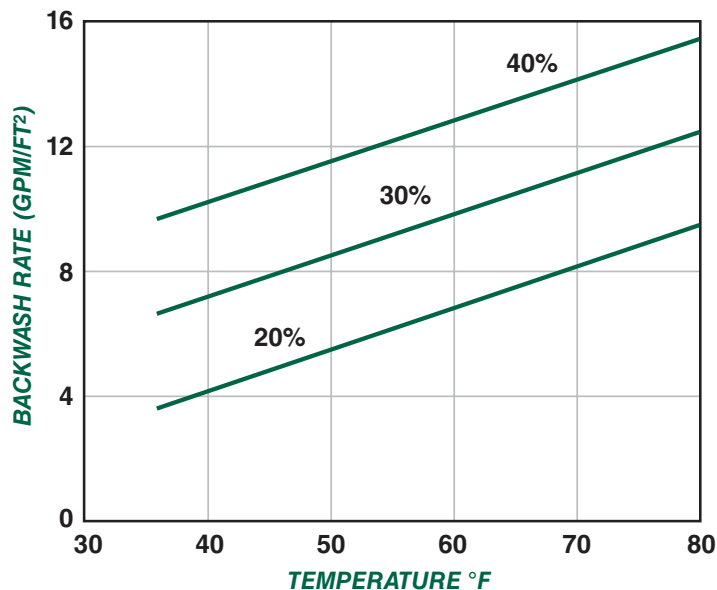
**Greensand<sup>Plus</sup>** is an exact replacement for manganese greensand. It can be used in CO or IR applications and requires no changes in backwash rate or times or chemical feeds.

**Greensand<sup>Plus</sup>** has the WQA Gold Seal Certification for compliance with NSF/ANSI 61. Packaging is available in 1/2 cubic foot bags or 1 metric ton (2,205 lbs) bulk sacks.

#### GREENSAND<sup>Plus</sup> PRESSURE DROP (CLEAN BED)



#### BED EXPANSION DURING BACKWASHING



## PHYSICAL CHARACTERISTICS

### Physical Form

Black, nodular granules shipped in a dry form

### Apparent Density

88 pounds per cu. ft. net (1410.26 kg/m<sub>3</sub>)

### Shipping Weight

90 pounds per cu. ft. gross (1442.31 kg/m<sub>3</sub>)

### Specific Gravity

Approximately 2.4

### Porosity

Approximately 0.45

### Screen Grading (dry)

18 x 60 mesh

### Effective Size

0.30 to 0.35 mm



### Uniformity Coefficient

Less than 1.60

### pH Range

6.2 - 8.5 (see General Notes)

### Maximum Temperature

No limit

### Backwash Rate

Minimum 12 gpm/sq. ft. at 55°F (29.4 m/hr @ 12.78°C) (see expansion chart)

### Service Flow Rate

2 - 12 gpm/sq. ft. (4.9 m/hr - 29.4 m/hr)

### Minimum Bed Depth

15 inches (381 mm) of each media for dual media beds or 30 inches minimum (762 mm) of GreensandPlus alone

## METHODS OF OPERATION (CO)

### GreensandPlus: Catalytic Oxidation (CO)

Catalytic Oxidation (CO) operation is recommended in applications where iron removal is the main objective in well waters with or without the presence of manganese. This method involves the feeding of a predetermined amount of chlorine (Cl<sub>2</sub>) or other strong oxidant directly to the raw water before the GreensandPlus Filter.

**The oxidant demand for regeneration can be calculated for the following conditions:**

**For operation using chlorine, the demand can be estimated:**

$$\text{mg/L Cl}_2 = (1 \times \text{mg/L Fe}) + (3 \times \text{mg/L Mn}) + (6 \times \text{mg/L H}_2\text{S}) + (8 \times \text{mg/L NH}_3)$$

Chlorine should be fed at least 10-20 seconds upstream of the filters, or as far upstream as possible. A recommended 0.5-1.0 mg/L free chlorine residual in the filter effluent will maintain the GreensandPlus in a continuously regenerated state.

**...For operation using permanganate, the demand can be estimated:**

$$\text{mg/L KMnO}_4 = (1 \times \text{mg/L Fe}) + (2 \times \text{mg/L Mn})$$

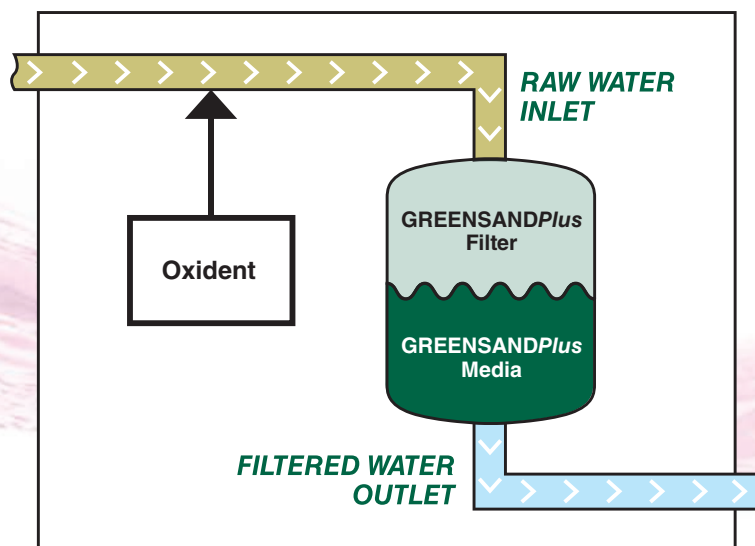
KMnO<sub>4</sub>, if required, should be fed to produce a "just pink" color in the filter inlet. This slight excess of KMnO<sub>4</sub> residual carried through the filter, will maintain the GreensandPlus in a continuously regenerated state.

**...For operation using permanganate & chlorine, the demand can be estimated:**

$$\text{mg/L Cl}_2 = \text{mg/L Fe}$$

$$\text{mg/L KMnO}_4 = (0.2 \times \text{mg/L Fe}) + (2 \times \text{mg/L Mn})$$

Chlorine should be fed at least 10-20 seconds upstream of the KMnO<sub>4</sub>, or as far upstream as possible to produce the desired Cl<sub>2</sub> residual in the filter effluent. KMnO<sub>4</sub>, if required, should be fed to produce a "just pink" color in the filter inlet. This slight excess of KMnO<sub>4</sub>, or a Cl<sub>2</sub> residual carried through the filter, will remain GreensandPlus in a continuously regenerated condition.



## SUGGESTED OPERATING CONDITIONS

### Bed Type

Dual media; anthracite 15-18 in. (381 mm-457 mm) and GreensandPlus 15-24 in. (381 mm - 610 mm)

### Capacity

700-1200 grains of oxidized iron and manganese/sq.ft. of bed area based on oxidant demand and operation to iron break through or dp limitations.

### Backwash

Sufficient rate using treated water to produce 40% bed expansion until waste water is clear, or for 10 minutes, whichever occurs first.

### Air/Water Scour

Optional using 0.8-2.0 cfm/sq. ft. (15 m/hr -37 m/hr) with a simultaneous treated water backwash at 4.0-4.5 gpm/sq. ft. (9.8 m/hr - 11.03 m/hr)

### Raw Water Rinse

At normal service flow rate for 3 minutes or until effluent is acceptable.

### Flow Rate

Recommended flow rates with CO operation are 2-12 gpm/sq. ft. (4.9 m/hr - 29.4 m/hr). High concentrations of iron and manganese usually require lower flow rates for equivalent run lengths. Higher flow rates can be considered with low concentrations of iron and manganese. For optimizing design parameters, pilot plant testing is recommended. The run length between backwashes can be estimated as follows:

What is the run length for a water containing 1.7 mg/L iron and 0.3 mg/L manganese at a 4 gpm/sq. ft. service rate:

### Contaminant loading

$$= (1 \times \text{mg/L Fe}) + (2 \times \text{mg/L Mn})$$

$$= (1 \times 1.7) + (2 \times 0.3)$$

$$= (2.3 \text{ mg/L or } 2.3/17.1 = 0.13 \text{ grains/gal. (gpg)})$$

At 1,200 grains / sq. ft. loading + 0.13 gpg = 9,230 gal./sq. ft.

At 4 gpm / sq. ft. service rate  $9,230/4 = 2,307 \text{ min.}$

The backwash frequency is approximately every 32-38 hours of actual operation.

*The Intermittent regeneration (IR) operation is available for certain applications.  
Contact your Inversand representative for additional information.*

## GENERAL NOTES

### pH

Raw waters having natural pH of 6.2 or above can be filtered through **GreensandPlus** without pH correction. Raw waters with a pH lower than 6.2 should be pH-corrected to 6.5-6.8 before filtration. Additional alkali should be added following the filters if a pH higher than 6.5-6.8 is desired in the treated water. This prevents the possible adverse reaction and formation of a colloidal precipitate that sometimes occurs with iron and alkali at a pH above 6.8.

### Initial Conditioning of GreensandPlus

**GreensandPlus** media must be backwashed prior to adding the anthracite cap. The **GreensandPlus** backwash rate must be a minimum of 12 gpm/sq. ft. @ 55 °F.

After backwashing is complete, the **GreensandPlus** must be conditioned. Mix 0.5 gal. (1.9 L) of 6% household bleach or 0.2 gal (0.75 L) of 12% sodium hypochlorite for every 1 cu. ft. (28.3 L cu. m) of **GreensandPlus** into 6.5 gallons (25 L) of water.

Drain the filter enough to add the diluted chlorine mix. Apply the diluted chlorine to the filter being sure to allow the solution to contact the **GreensandPlus** media. Let soak for a minimum of 4 hours, then rinse to waste until the "free" chlorine residual is less than 0.2 mg/L. The **GreensandPlus** is now ready for service.

## GENERAL NOTES *continued*

### Radium and Arsenic Removal Using Greensand<sup>Plus</sup>

The **Greensand<sup>Plus</sup>** CO process has been found to be successful in removing radium and arsenic from well water. This occurs via adsorption onto the manganese and/or iron precipitates that are formed. For radium removal, soluble manganese must be

present in, or added to, the raw water for removal to occur. Arsenic removal requires iron to be present in, or added to, the raw water to accomplish removal. Pilot plant testing is recommended in either case.

## REFERENCES

### USA

American Water Company, CA  
San Jacinto, CA  
City of Tallahassee, FL  
Adedge Technologies, Inc., Buford, GA  
City of Mason City, IL  
City of Goshen, IN  
City of Hutchinson, KS  
City of Burlington, MA  
Dedham Water Co., MA  
Raynham Center, MA  
Northbrook Farms, MD  
Sykesville, MD  
Tonka Equipment Company, Plymouth, MN

City of New Bern, NC  
Onslow County, NC  
Hungerford & Terry, Inc., Clayton, NJ  
Fort Dix, NJ  
Jackson Twp. MUA, NJ  
Churchill County, NV  
Suffolk County Water Authority, NY  
City of Urbana, OH  
Roberts Filter Group, Darby, PA

### International

PWG – Euraqua ..... Belgium  
PWG – Alamo Water ..... Poland  
Pt Hydromart Utama Ind. .... Indonesia  
Simtech Ltda. .... Chile  
Canature Watergroup ..... Canada  
Brenntag Nordic ..... Sweden  
Dogramaci-Turkey ..... Turkey  
Water Engineering Tech (WETCO) ... Egypt  
Delfin Technologies ..... Mexico  
Filtration Tech LTD. (FILTEC NZL) .... New Zealand  
Endospina Tecnologia ..... Columbia  
ECOTEC, SA ..... Guatemala  
Euro-Clear Hungary ..... Hungary  
Green Filter ..... Poland



**The manufacturing of Greensand<sup>Plus</sup> is an ongoing, 24/7 process to ensure the highest quality water treatment media**

### Certifications

REACH Registration  
01-2119452801-43-0020 for import to the EU  
Certified by the WQA to NSF/ANSI/CAN 61  
for material safety only, and to NSF/ANSI 372  
for Lead Free

**NSF Certified** through the WQA



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**I**nversand Company  
SINCE 1925

**ORIGINAL DEVELOPERS OF MANGANESE GREENSAND & GREENSAND<sup>PLUS</sup>**

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