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Pyrolox[®] Advantage TECHNICAL MANUAL



Capability

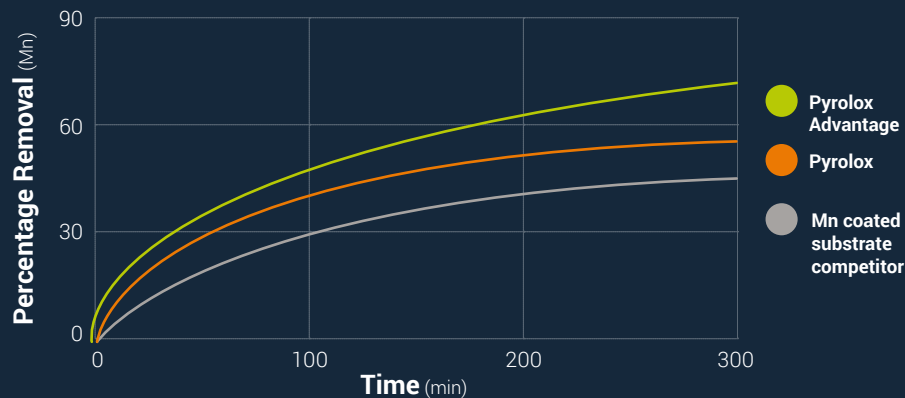
Pyrolox Advantage is the cleanest, lightweight solution for the removal of iron, manganese, arsenic, and/or hydrogen sulphide in water.

Pyrolox Advantage can be used to remove a range of soluble inorganic impurities from raw water by oxidation to insoluble form, precipitation, and flocculation. The media can be used in a catalytic configuration with a supplemental oxidant (eg. OCl⁻ or dissolved O₂) or as a depleted resource requiring regeneration or replacement (eg. cartridge)

Removal of Fe²⁺ & Mn²⁺

The most common application for this media is iron and manganese removal. Manganese minerals have a well-documented record of capability for removal of these species¹. Pyrolox Advantage removes soluble ions by the same mechanism as natural ore products, but faster and with better efficiency at low contaminant concentration. Results of our kinetic measurements are given in the table below.

Kinetics : Rate of Removal



Pyrolox Advantage Value

Features

Customer Benefits

- | | |
|---|--|
| <ul style="list-style-type: none"> • Lightweight
(engineered media with a lower density core and highest purity MnO₂ surface) | <ul style="list-style-type: none"> ✓ Lower backwash rate ✓ Lower transportation costs ✓ Lower cost per cubic foot than competitive Mn coated products |
| <ul style="list-style-type: none"> • Highly porous surface area with durable, high-purity MnO₂ coating | <ul style="list-style-type: none"> ✓ Improved performance in Mn and Fe removal ✓ Allows for a smaller filter footprint ✓ Higher oxidation (higher removal capacity) than competing medias allowing for higher service flow rates |
| <ul style="list-style-type: none"> • True MnO₂ coating • 12.5% MnO₂ (highest Mn content of any lightweight media) | <ul style="list-style-type: none"> ✓ No pre-treatment required ✓ Longer run times between backwash |
| <ul style="list-style-type: none"> • 1,000 microns particle size
(by volume diffraction) | <ul style="list-style-type: none"> ✓ Does not stratify when used with sand in a mixed bed
(stays homogenous/mixed) |
| <ul style="list-style-type: none"> • Engineered, quality-controlled product
(manufactured by Prince) | <ul style="list-style-type: none"> ✓ Cleanest start-up (virtually no start up fines) ✓ Reduced operational time and lower costs at the filter commissioning stage ✓ Directly certified by NSF (not a 3rd party) |
| <ul style="list-style-type: none"> • No regeneration required | <ul style="list-style-type: none"> ✓ Does not require potassium permanganate or other chemicals ✓ Only requires sodium hypochlorite |
| <ul style="list-style-type: none"> • Engineered to be naturally catalytic
(mimicking pure manganese ore) | <ul style="list-style-type: none"> ✓ Provides high performance even without activation ✓ Will continue to perform its function in non-ideal conditions |

¹ Removal of Soluble Manganese by Oxide-coated Filter Media, Knocke et al. (1991)
<https://doi.org/10.1002/j.1551-8833.1991.tb07201.x>

Technical Parameters

Physical Properties

MnO2%	12.5%	
Media Substrate	Silica Sand	
Colour and Form	Black, free-flowing sand	
Bulk Density as packed²	1350 kg/m ³	84 lb/ft ³
True Density (SG)	2700 kg/m ³	170 lb/ft ³
Porosity	50 %	

Sizing

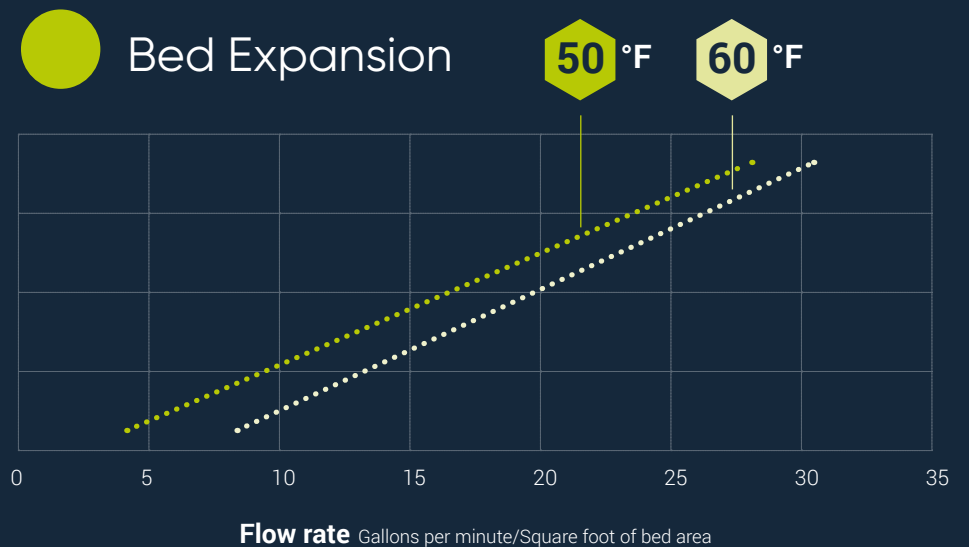
Mesh Size³	16 - 44 (BS/ISO)	18 - 45 (ASTM)
Effective Size	560 µm	
Uniformity Coefficient	1.5	

Pyrolox Advantage

Operating Conditions

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pH Range⁴	5.5 - 10	
Freeboard	40 %	
Service Flow Rate	5 - 25 m/hr	2 - 10 gpm/ft ²
Backwash Rate 20-30% bed expansion	30-45 m/hr	12 - 18 gpm/ft ²
Backwash	Time 5 minutes	
Minimum Bed Depth	300mm	12 in
Minimum Empty Bed Contact Time EBCT	4 minutes	
Adsorption Capacity	Mn 1000 mg / kg	Fe > 10000 mg / kg



² Range of tapped to loose bulk density 1300 - 1500 kg/m³ (81 - 94 lb/ft³)

³ Range represents the 5 % to 95 % retained on mesh

⁴ Mn-based media are not suitable for treating water below pH 6.2 (BS:EN 13752:2012)

Selection

Media depth, volume, and flow rate must be selected to optimise the bed contact time and achieve the desired reduction in contaminant concentration.

Commissioning

Pyrolox Advantage is engineered to be naturally catalytic (mimicking pure manganese ore) so it provides high performance even without activation. We acknowledge that the filter installation will require sterilization prior to use; the use of sodium hypochlorite is recommended and has no detrimental effect on the media. The use of hydrogen peroxide is not recommended at any stage based on the advice of BS:EN 13752:20125; it can lead to increased manganese concentrations if used with any manganese-based media.

Use

Pyrolox Advantage can be used in gravity or pressurized systems. Treated water should be monitored and regular backwashing performed. In catalytic configuration, the incoming raw water requires 60% oxygen saturation for optimum removal of iron and hypochlorite (OCI-) levels commensurate with the manganese concentration.

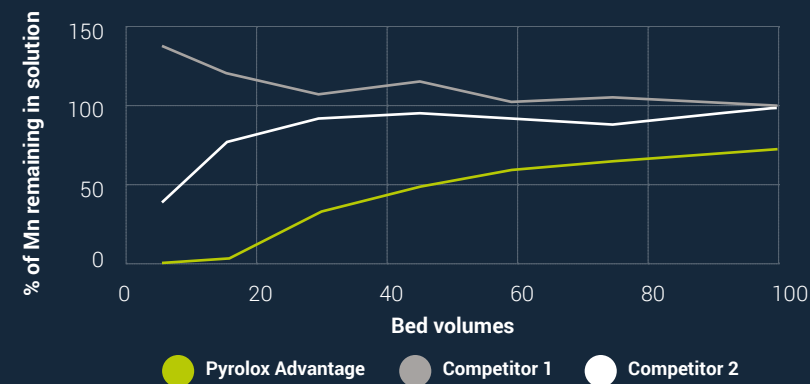
Where the level of dissolved oxygen is insufficient, Cl₂ demand can be estimated from the level of Fe and Mn in the raw water as follows:

Cl₂ 1:1 Fe (mg/L)
Cl₂ 2:1 Mn (mg/L)

Backwash

Iron and manganese are precipitated and retained by the filter media. Periodic backwashing is required to ensure the efficiency of the filter media. Excessive run time without backwashing, or incomplete backwashing, will reduce the filter efficiency and deplete the oxidation capacity of the media surface. Maximum run time should be determined by the filter designer specific to the raw water composition. Typical bed expansion is 20%-30%.

Pyrolox Advantage is the Only Manganese Coated Media that Removes Almost 100% of Mn at Start-up



- Does not depend on activation to perform
- Engineered to be naturally catalytic (out of the box catalytic)
- Does not require potassium permanganate

Regeneration

In catalytic use, the media does not require regeneration. If media is used without sufficient dissolved oxygen or oxidising source (eg. hypochlorite) the surface will become depleted and require regeneration. Regeneration can be achieved using only sodium hypochlorite, but the time and concentration must be determined by the user. Pyrolox Advantage does not require potassium permanganate or other chemicals.

We recommend hypochlorite for compliance with local regulations and optimum performance. Where existing procedures allow for the use of other oxidants with Mn-based media these can be used with our Pyrolox range but care should be taken for pressure relief and monitoring of Mn removal efficacy.

Removal of As³⁺

Pyrolox Advantage can be used to remove soluble arsenic indirectly by co-precipitation with Fe. This requires either the presence of Fe in the raw water or the addition of Fe ahead of the filter system. Pyrolox Advantage has no inherent capacity to remove arsenic ions and should not be used non-catalytically for the treatment of arsenic-contaminated raw water in the absence of soluble iron.

Typical application requires Fe : As ratio of 30:1. Co-precipitation and removal is a function of bed-contact, pH and ion concentration. For this reason, Vibrantz recommends that filter designers pilot a small installation to confirm efficacy for specific situations. When treating water with > 10 ppb As it may be necessary to add a second polishing stage to the process.

Pyrolox Advantage



Vibrantz is the go-to for all manganese dioxide filter media needs

- **World leader in manganese chemicals**
 - ✓ Broadest manganese filter media product range
 - ✓ we have combined our proprietary aggregates coating process with our world class synthetic manganese dioxide production
 - ✓ ISO 9001 certification at all Vibrantz manufacturing locations
- **Technical expertise**
 - ✓ Manganese water treatment lab in the UK
 - ✓ Collaboration with Cranfield University for testing
 - ✓ Product testing & analytical services for manganese media
- **Responsiveness & flexibility of supply**
 - ✓ Not traded - products are manufactured by Vibrantz
 - ✓ Quality, consistency, and availability direct from the manufacturer
 - ✓ Strong production base & backup production locations
 - ✓ NSF Certified
 - ✓ For the European market, we control the specification to BS EN 13752:2012
- **Security of raw material supply**
 - ✓ Only select high quality raw materials from mines with long term reserves
 - ✓ Long term relationships with first and second source suppliers
- **Global distribution**
 - ✓ Regional sales force
 - ✓ Ships internationally

The information and recommendations contained herein are based on data we believe to be reliable and does not imply any warranty or performance guarantee, as conditions and methods of use of our products are beyond our control. The data herein is determined using Vibrantz's standard test methods. Hazard and safety information with respect to this product is available in the applicable SDS. Vibrantz will not be liable under any circumstance for consequential or incidental damages, including but not limited to, lost profits resulting from the use of our products.