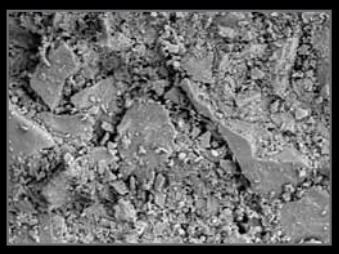
FAIRMOUNT
Water Solutions

ENGINEERING GUIDE FOR MACROLITE® ENGINEERED CERAMIC MEDIA

About Macrolite® Engineered Ceramic Media

For filtration applications that demand high flow rates, increased effluent quality, or removal of fine colloids, Macrolite® Engineered Ceramic Media delivers more performance in a smaller equipment footprint. Available in common filtration sizes, Macrolite media spheres optimize filtration performance with two key features: remarkably uniform physical properties and significantly greater surface area allowing filtration to 3 microns. Macrolite is tough and durable. It's a chemically inert medium that provides excellent resistance to acids, caustics, oxidants, and ferric salts.

This document refers to the use of Macrolite in municipal or industrial applications for the general removal of total suspended solids for granular backwashing media filtration.



Macrolite® media has enhanced surface area that traps more solids below 3 microns

Typical Physical and Chemical Characteristics

	Macrolite M1	Macrolite M2	Macrolite M4	Macrolite M6	Standard Used
Effective Size(mm)	.20	.28	.55	1.2	AWWA B100-01
Uniformity Coefficient	<1.3	<1.4	<1.4	<1.4	AWWA B100-01
Specific Gravity	2.6	2.6	2.6	1.5*	ASTM C128
Krumbien Sphericity	0.9	0.9	0.9	0.9	Krumbien
Krumbien Roundness	0.9	0.9	0.9	0.9	Krumbien
Acid Solubility (%)	<5.0	<5.0	<5.0	<5.0	AWWA B100-01
Bulk Density (lbs/ft^3)	73	73	73	52	

*A small amount of media may float and will need to be removed at time of installation.

SERVICE AND BACKWASH GUIDELINES

1. Pressure Filtration – Service Operation

In service, water is normally pumped down through approximately 24" of media that is retained within a pressure vessel. Loading rates range from 8-12 gpm/ft^2. The vessel has some type of diffusion system at the top and a bottom distribution/collection system. These systems are designed to ensure the feed water passes evenly through the media.

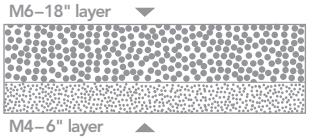
Upper Diffusion System

The top diffuser is generally not designed to retain media because the solids removed by the filter must exit through this diffuser. The primary purpose of this upper diffuser is to modify the flow direction of influent water so it does not drop directly onto the surface of the media and penetrate that surface. If a slot-type distributor is used, the slot opening must be large enough to allow coagulated solids to escape the vessel during backwash.

Media Layering and Depth

In most pressure filtration applications only one grade of Macrolite is required at a depth of 24". Specific applications may require as little as 12" or as much as 36". Typical iron and manganese removal requires 24", as does arsenic removal.

Recommended Macrolite® Media and Depth for Pressure Filtration Applications

Application	Media	Depth (inches)	
Silt / TSS removal	M2	24	
Iron, manganese and arsenic	M2	24	
Surface water and GWUDI < 5 NTU	M1	24-36	
Surface water > 5 NTU	M6 M4	~18 ~6	

Underbedding is usually recommended as follows*:

Macrolite® Media	Recommended Underbedding*
M1 and M2	(From bottom to top) - ½ x ¾ gravel to 4" over lower distributor; then 4" of ¼ x ⅛ gravel; then 4" of #10-#20 garnet; then Macrolite
M4 and M6	(From bottom to top) - ½ x ¼ gravel to 4" over lower distributor; then 4" of ¼ x ⅛ gravel; then Macrolite

*Alternate underbedding configurations may be required depending on the under drain and tank configurations chosen.

Lower Distribution System

Careful distributor design is required for sustained, low pressure drop across the media/distributor interface. Fairmount Water Solutions recommends a stainless steel wedge-wire distributor, although other distributor designs have been used successfully including porous plates, caps and stainless punch designs. Selection of slot size is important because Macrolite is very uniform. This is particularly true for applications without underbedding. Below are recommended ranges for slot sizing for each media:

Recommended Lower Distributor Slot Sizes for Direct Retention Underdrains**

Macrolite® Media	Recommended Slot Size (inches/millimeters)
M1	≤ 0.005" / 0.130mm
M2	≤ 0.0065" / 0.17mm
M4	≤ 0.0120" / 0.30mm
M6	≤ 0.020" / 0.50mm

**Larger slots may be used in conjunction with under bedding.

2. Gravity Filtration – Service Operation

Fairmount Water Solutions recommends piloting gravity filtration applications in order to determine the media combination that provides the best compromise between loading rate, filter run time and water quality. Often even the coarse grades of Macrolite will provide effluent quality superior to other media of smaller screen size.

Gravity filtration loading rates range from 2-10 gpm/ft^2 depending on filter cell depth, associated piping design and permit restrictions.

Influent Gallery Design
Influent gallery should follow standard design criteria taking into account the higher design loading rate of the filter cell.

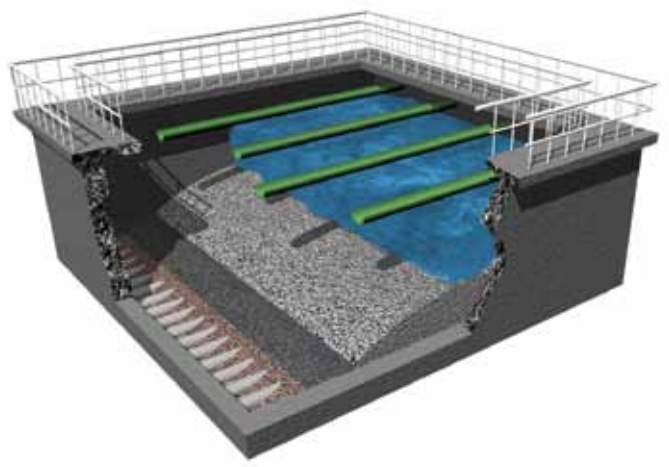
Media Layering and Depth
Many gravity applications require a top layer of coarse, light media. M6 is the media of choice for this top layer. The second layer will depend on the application: solid loading, loading rate and water quality are variables that determine the selection of the lower media layer. M4 is adequate for most applications. Some may only require M6 or M4 for the entire bed depth.

24" of total media depth is recommended. The optimum depth of each layer can be evaluated during the pilot. Fairmount Water Solutions recommends initial testing with 18" of top layer and 6" of bottom layer.

Underbedding may be required in rapid gravity filters to minimize head loss across the media/underdrain interface and to minimize cost by using a lower-cost media in the interstitial space within and below the underdrains. See Underbedding recommendations in pressure filter section.

Underdrains
Macrolite can be used with a variety of underdrains for rapid gravity filtration. However, there are some considerations:

1. Because Macrolite is so uniform and loading rates are higher than standard sand and anthracite, particular attention should be paid to slot size and available open area.
2. Air requirements during air scour range from a minimum of 1.5 cfm/ft^2 to a maximum of 3.0 cfm/ft^2.



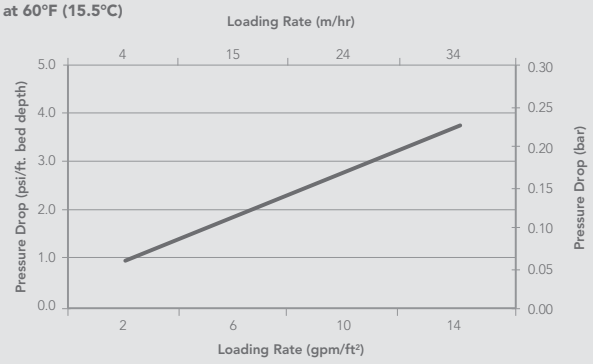
3. Backwash Operation

Typical Operating Conditions During Backwash

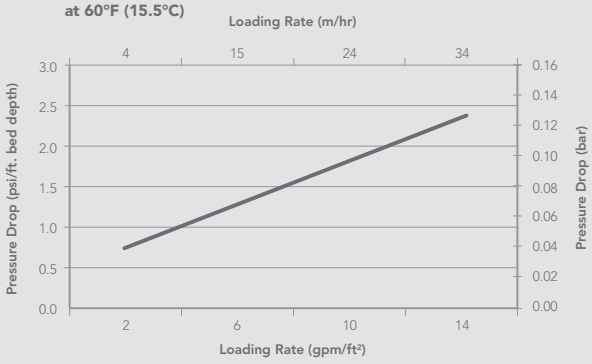
Step	Description	Valve Positions	Notes
1	Off-line; depressurize	Outlet closed Inlet to waste	Depressurize by shutting influent and effluent, then venting influent to atmosphere/drain
2	Tank drain	Outlet to waste Inlet to atmosphere	May need to include short upflow backwash prior to drain to shorten drain time
3	Air and water scour	Outlet to backwash Inlet to waste	Optional very short step for more aggressive cleaning; care must be taken to avoid water level and media reaching tank outlet/backwash trough
4	Air scour	Outlet closed Inlet to waste	Because Macrolite utilized more bed depth for particle removal, air scour is required; surface wash is generally not adequate
5	Pause	Outlet closed Inlet to waste	Short delay to allow much of the entrained air to escape
6	Backwash	Outlet to backwash Inlet to waste	Usually 10-15 minutes; turbidity set points are often used to determine adequate backwash duration (within minimum and maximum limits)
7	Settle	Outlet to backwash Inlet off	Ranges from 1-5 minutes
8	Filter to waste	Inlet to service Outlet to waste	Rinse up to quality; usually based on turbidity set point or maximum alarm time limit
9	Service	Inlet to service Outlet to service	

Pressure Loss Data

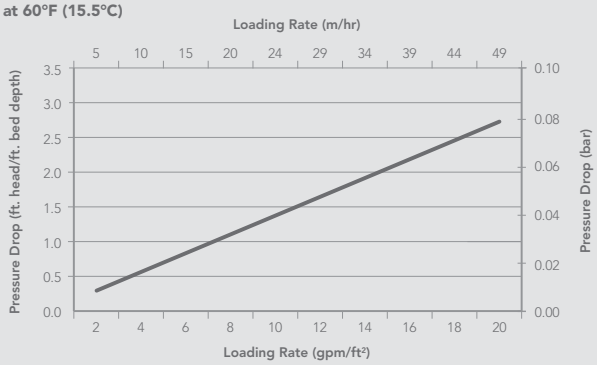
Macrolite M1 Clean Bed Pressure Drop
at 60°F (15.5°C)



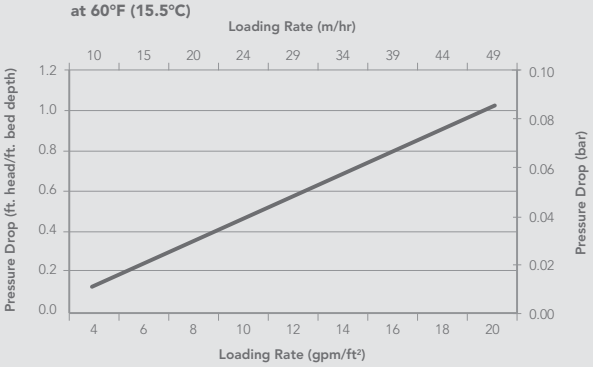
Macrolite M2 Clean Bed Pressure Drop
at 60°F (15.5°C)



Macrolite M4 Clean Bed Pressure Drop
at 60°F (15.5°C)

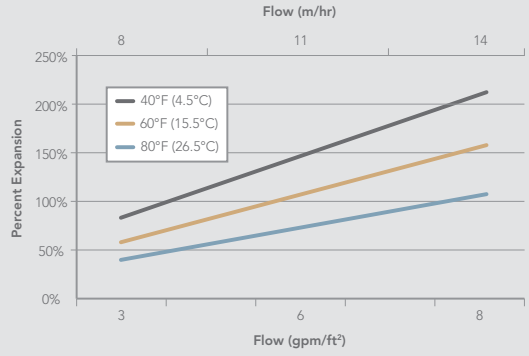


Macrolite M6 Clean Bed Pressure Drop
at 60°F (15.5°C)

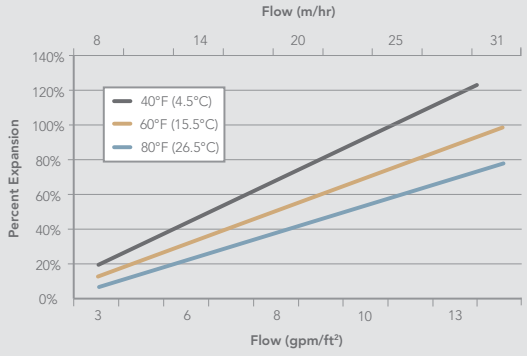


Backwash Expansion Data

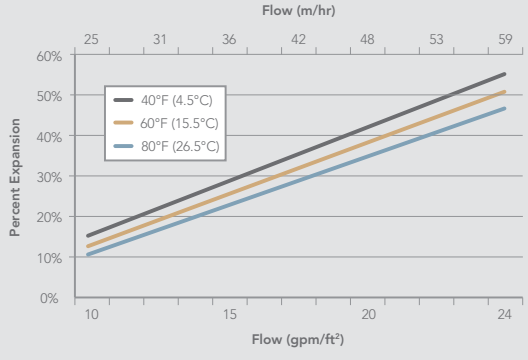
Macrolite M1 Backwash Expansion



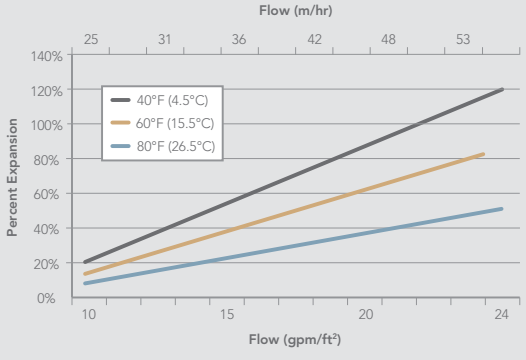
Macrolite M2 Backwash Expansion



Macrolite M4 Backwash Expansion



Macrolite M6 Backwash Expansion



Macrolite® Engineered Ceramic Media Evaluations and Certifications

- **American Water Works Association Research Foundation** (AWWARF)
  - #2661-Macrolite Coagulation Filtration
- **National Sanitation Foundation**
  - NSF Standard 61 Certification
  - NSF / EPA Environmental Technology Verification (NSF ETV)
    - Macrolite Coagulation Filtration
    - Macrolite Arsenic Removal
- **Ontario Ministry of the Environment**
  - New Environmental Technology Evaluation Program
  - Macrolite Filtration Process: Approvable chemically assisted filtration process

Fairmount Water Solutions is your source for filtration media and technology solutions, from the highest quality sand and gravel to high-performance, engineered ceramic media.

Fairmount Water Solutions is a subsidiary of Fairmount Minerals Ltd. headquartered in Chardon, Ohio. Fairmount Minerals is North America's largest producer of industrial quartz sand and coated quartz products. Our mission is to deliver superior products and services, while working to ensure the preservation of the environment and the responsible use of our natural resources.

Fairmount Minerals places great emphasis on its social responsibilities, and strives to always exceed our Sustainable Development practices and expectations. We work to ensure that our actions positively meet our social responsibility, environmental stewardship, and economic prosperity goals for stakeholders and for the world community.

Fairmount Minerals Ltd. supports and adheres to the UN Global Compact principles—making us accountable to ourselves, and more importantly, to the rest of the planet. For more information call 1-800-237-4986, or visit us at **www.fairmountminerals.com.**

Do Good. do well.

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