

Description

Stormwater media filters typically include a pretreatment settling basin and a filter bed or cartridge in a subsurface vault or manhole structure (Figure 1). Cartridge filters or beds may filter water through a media bed comprised of sand, perlite or an absorptive filtering media, or may filter water through a thin fabric membrane with a large surface area. Coarser solids settle out in the pre-settling area and then finer particles and other pollutants are removed as stormwater flows through the filter membrane or media.

Media filters do not contain vegetation and can accept flow from a curb inlet, grate inlet or inlet pipe. They are exceptionally versatile and can be integrated into most sites while allowing the overlying land to be used for most non-building purposes including vehicular or pedestrian traffic or landscaping.

California Experience

There are currently over 2,000 manufactured filter systems in operation in California.

Advantages

- Requires a smaller area than standard flatbed sand filters, wet ponds, and constructed wetlands.
- Media capable of removing dissolved pollutants can be selected.
- Simplified design and procurement with most systems provided to the site pre-assembled with all components and media included.
- Rigorous independent performance assessments are available for many media filter systems.
- Well suited for installation downstream of detention systems.
- Captures and holds solids, oil and trash out of public view and out of contact with wildlife, native soils and groundwater.

Design Considerations

- Design Storm
- Media Type
- Maintenance Requirement

Targeted Constituents Removal

Sediment	High
Nutrients	Low
Trash	High
Metals	Med
Bacteria	Low
Oil and Grease	Med
Organics	Low



Figure 1. Stormwater media filter vault, mid-construction.

Source: Contech Engineered Solutions

Limitations

- As with all filtration systems, use in catchments that have significant areas of non-stabilized soils can lead to premature clogging.

Design and Sizing Guidelines

Design of media filters is typically flow-based with the size and/or quantity of units increasing as the design water quality flow rate increases. Most filters have a characteristic hydraulic loading rate expressed as flow rate per filter surface area that is associated with a specific targeted pollutant concentration reduction or effluent concentration. In some filters this is converted to a design flow rate per cartridge or filter module for standard sizes. Sizing most commonly simply entails dividing the design water quality flow rate by the design flow rate per cartridge to get a total number of filter cartridges required.

Alternatively, where a specific maintenance interval is targeted, the filters can be sized based on a mass loading assessment where the number of cartridges required is equal to the pollutant load expected to be retained during the service period, divided by the load capacity of each cartridge. This approach is most common when the media filter is installed downstream of detention since the number of cartridges required to treat the discharged flow rate may be very low. Where a mass load-based sizing approach is pursued, a check of flow-based sizing must also be conducted with the number of cartridges specified being the greater of two approaches.

As with all filters, maintenance interval, hydraulic loading rate, and pollutant removal performance are inextricably linked with an increase in any one factor necessarily requiring a reducing in at least one other factor.

Construction/Inspection Considerations

Some media filter systems are shipped without the cartridges installed or with a construction bypass in place to prevent the filters from being fouled by construction stormwater runoff. Once the construction phase is complete the cartridges must be installed and/or the construction bypass components must be removed to activate the system. Most stormwater filtration systems are installed below grade with access provided by manhole openings or hatches. Entry into the systems during construction, activation, inspection, or maintenance may require OSHA confined space entry protocols to be followed.

Performance

The mechanisms of pollutant removal are essentially the same as with sand filters (TC -40) if of a similar design. Whether removal of dissolved pollutants occurs depends on the media. Perlite and fabric do not remove dissolved pollutants, whereas for example, zeolites, compost, activated carbon, and peat have this capability.

There are numerous media filter design variations and media types commercially available. Performance depends primarily on the hydraulic loading rate of the media bed and the media composition. Additionally, the presence or absence of pretreatment components can affect performance and longevity.

Protocols for testing and verifying the performance of innovative stormwater treatment systems have been developed by the Washington State Department of Ecology and the New Jersey Department of Environmental Protection. Both programs provide certification or approval of treatment systems following independent verification that those systems meet certain performance targets. Both programs have been endorsed by numerous states and public agencies including EPA and the Water Environment Federation (WEF) and have been supported by the Stormwater Equipment Manufacturers Association (SWEMA).

The Technology Assessment Protocol – Ecology (TAPE) from the Washington State Department of Ecology program requires full-scale field testing and has performance standards for sediment removal (Basic Treatment), phosphorus (Phosphorus Treatment), dissolved metals (Enhanced Treatment) and hydrocarbons (Oil Treatment). All are applicable to media filter performance evaluation although the Oil Treatment standard is intended for influent concentrations higher than 10 mg/L which are more common at industrial sites than sites regulated by municipal stormwater permits. A list of technologies, including several media filters that have met these treatment standards can be found on the Ecology web page for emerging technologies at: <http://www.ecy.wa.gov/programs/wq/stormwater/newtech/technologies.html>

The New Jersey DEP laboratory protocol for filter requires 80% removal of a TSS gradation with a mean particle diameter of 75 microns and an 80th percentile particle diameter of 8 microns. A list of technologies, including several media filters that have met this standard can be found on the NJ DEP web page for Stormwater Manufactured Treatment Devices at: <http://www.njstormwater.org/treatment.html>

To ensure acceptable media filter performance and operational feasibility, selection of media filters that have been verified by the Ecology and/or NJ DEP programs is recommended. Furthermore, design and sizing should be consistent with approvals issued by those programs.

Siting Criteria

Media filters can receive runoff from the surface through a curb inlet, grate inlet, or through one or more inlet pipes. They can be installed under vehicular or pedestrian traffic areas or under landscaping. Maintenance typically requires a vacuum truck so media filters should be located where they can be accessed without unduly disrupting traffic flow or site operations.

Additional Design Guidelines

Follow guidelines provided by the manufacturer.

Maintenance

- Maintenance activities and frequencies are specific to each product. Annual maintenance is typical.
- Manufactured filters, like standard filters (TC-40), require more frequent maintenance than most standard treatment systems like wet ponds and constructed wetlands, typically annually for most sites.

- Pretreatment systems that may precede the filter unit should be maintained at a frequency specified for the particular process.

Cost

Manufacturers provide costs for the units including delivery. Installation costs are generally on the order of 25 to 50% of the manufacturer's costs.

Cost Considerations

- The modularity of the manufactured systems allows the design engineer to closely match the capacity of the facility to the design storm, more so than with most other manufactured products.
- Treatment with one larger systems is typically more cost effective than using multiple smaller systems.
- Installation of media filters downstream of detention systems can significantly reduce the flow rate treated and the size and cost of the required system.

References and Sources of Additional Information

Minton, G.R., 2002, Stormwater Treatment: Biological, Chemical, and Engineering Principles, RPA Press, 416 pages.