# Traditional and New Filtration Technologies for Turbidity Removal in Small Water Systems



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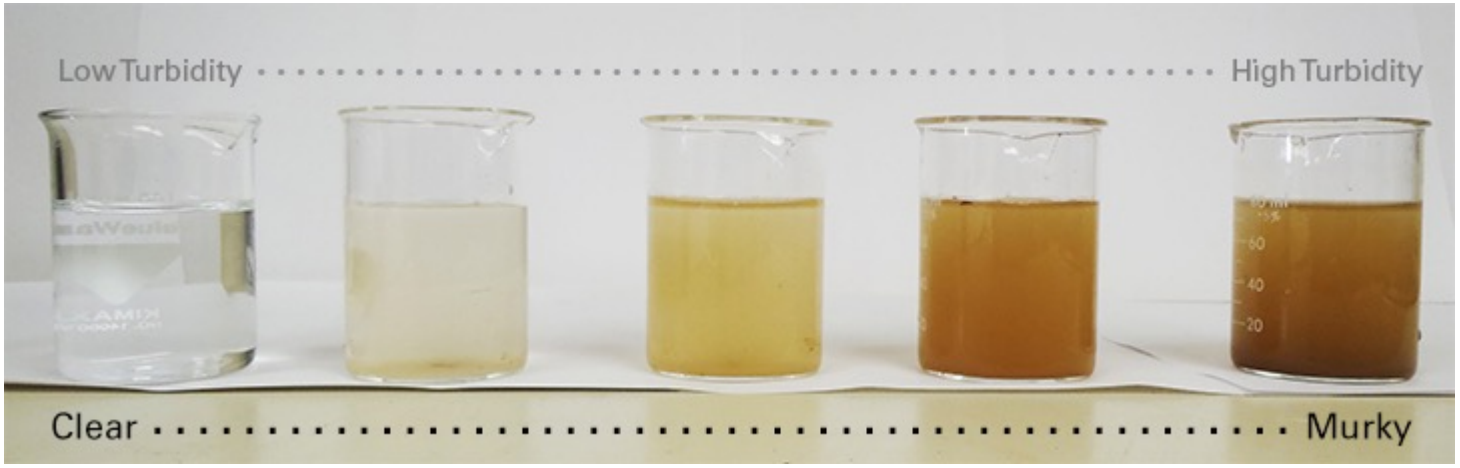
# Agenda

- What is turbidity and why are we concerned about it?
- How do we measure it and what are our treatment objectives?
- Traditional and modern treatment methods: limitations, advantages and disadvantages of each
- Best practices
- Monitoring
- Reducing operating costs

## What is turbidity?

- cloudiness caused by physical particles (sediment) of various sizes in the water



## Why are we concerned about turbidity?

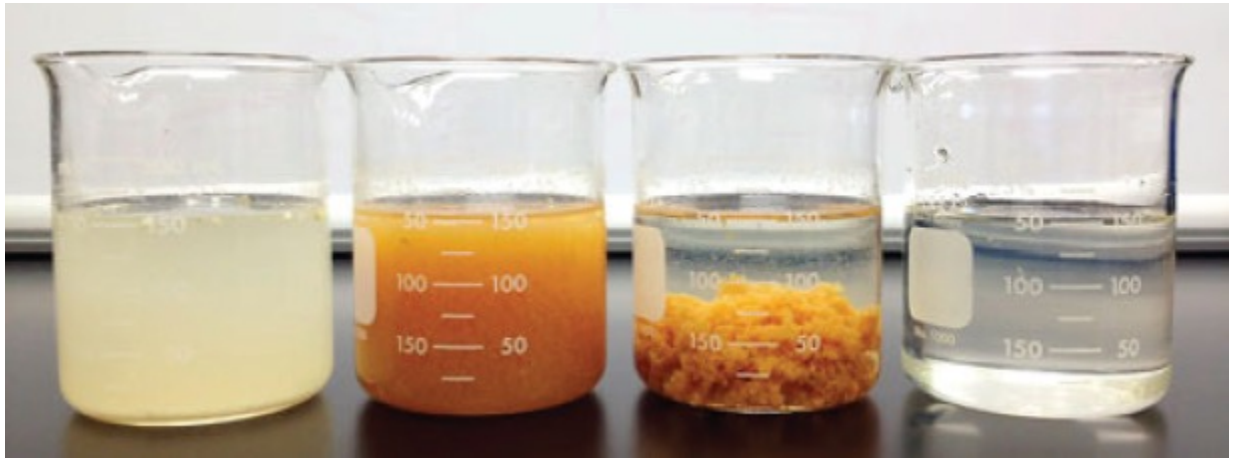
- Aesthetic problems
- Build-up of sediments in storage tanks and build up in distribution system requires maintenance
- Interferes with disinfection (UV and chlorination - especially crypto and giardia)

## What is our Objective?

- Measured in “NTU”, or **Nephelometric Turbidity Unit**
- Objective: <1 NTU minimum, <0.1 NTU goal
- If you come from the wastewater field, 1 mg/l (ppm) of total suspended solids = about 3 NTU
- Instruments measure turbidity by attempting to shine light though a column of water and then measuring the amount of light that is scattered at right angles due to the light reflecting off the particles in the water.

## Traditional Treatment - Municipal / Industrial Applications

- Injection of coagulant / flocculant > settling tank / sand filtration etc.
- Requires a lot of space and careful monitoring of chemical injection
- Not very practical for small systems



## Most Common Approaches for Small Water Systems

- Cartridge Filtration
- Bag Filters
- Spin Down Filters
- Multi-Media Filtration
- Rapid Sand Filtration - Specialty Media
- Concurrent Filtration (incidental removal while targeting another contaminant)
- Ultrafiltration Membranes

## Cartridge Filtration

- Construction: Pleated, Spun/Melt Blown, String Wound
- Micron ratings from about  0.3 microns to 100 microns
- Nominal vs. Absolute
- Multi-gradient (depth filtration)
- Washable/Reusable?
- Typical cartridge sizes ranging from 2.5 x 10 to roughly 8 x 30 inches




## Cartridge Filtration Continued - Housings

- Plastic to 4.5 x 20 (“Big Blue”) - Max about 20 GPM each
- Stainless steel (can hold single cartridges or up to 100s) - up to 2,400 GPM
- NEW: Fiberglass wrapped/reinforced plastic in “jumbo” sizes (Watts Big Bubba, Enpress ONE) - up to about 150 GPM – Very cost effective

## Cartridge Filtration Continued – Advantages / Disadvantages

- Very user friendly
- Large variety of options
- Generally cost effective but clogging can be costly where high turbidity levels are present especially for surface water with seasonal freshet

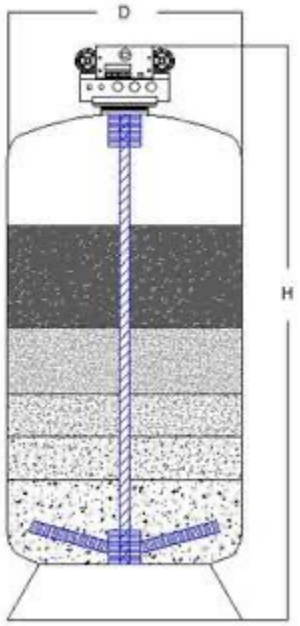
## Bag Filters

- Similar to cartridges except the filters look like a sock.
- Generally don’t last as long as a cartridge but are much cheaper
- Micron ratings from 1 to 200
- Various sizes, with housings options in plastic and stainless steel
- Limited options have necessary validations

## Spin Down Filters

- Especially useful for sand removal and coarse filtration
- Technology has improved allowing for finer filtration than previously possible.
- Up to about 100 GPM
- 15 to 700 microns
- Very cost effective
- Periodic manual flush by opening ball valve or automatic flush valves available

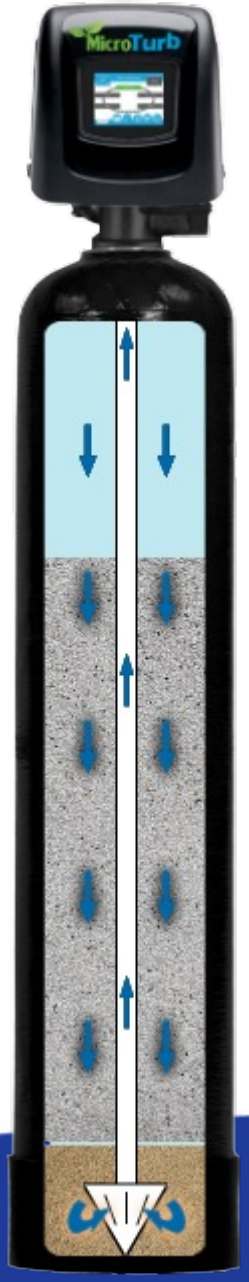
## Multi-Media Backwashing Filters




- Involves the layering of various water filter media in a tank (usually coarse gavel, garnet, fine gravel, sand, and anthracite) and passing the water through the tank where sediments get trapped in the various layers and are backwashed away periodically.
- Generally considered old technology and not recommend anymore for new systems, but some systems will still operates these units as they can last a very long time and have low operating costs.
- 10-25 microns

## Rapid Sand Filtration - Specialty Media

- Similar to multi-media filter except the layers other than a gravel underbed are replaced by a specialty media with angular forms that make them ideal for the removal of particulates.
- Generally alumino silicates, recycled activated glass, or ceramics.
- Common brands: NextSand, Filter Ag Plus, Turbidex
- 3 to 5 micron level filtration possible
- Very low operating cost and very long life



## Rapid Sand Filtration - Specialty Media Continued

- Higher flow rates, lower backwash rates, and finer filtration than multi-media filters
- Very popular on surface water sources or systems of seasonally-high turbidity that cause pre-mature cartridge filter clogging, or where turbidity exceeds 3 NTU.

## Concurrent Filtration

- Many media designed to remove iron and manganese in particular also make very effective turbidity reduction media so in systems where removal of these contaminants is also required, the proper selection of the iron/manganese removal media can also be used to remove turbidity.
- 3-5 micron level filtration is possible
- Very low operating cost and very long life

## Ultrafiltration

- Capable of removing ultra-fine and even colloidal sediments
- Filtration to 0.02 microns absolute
- Expensive but typically long life and low maintenance
- Requires very frequent backwashing with treated water, but each backwash uses only a small amount of water and takes a few minutes
- Requires pre-filtration

## Best Practices

- Stepped/staged filtration, often combining technologies
- Pressure gauges or sensors installed before and after each filtration step to monitor pressure loss
- Replace cartridges based on pressure loss (measured during flow), not based on appearance (generally >10 psi)
- For housings with drain ports, plumb them in and use them often
- Considering adding water meters to backwashable systems to add flexibility to monitor flow rates and gallons treated and to be able to backwash based on throughput, not just time. Some systems can also allow you to backwash based on pressure differential signals from sensors.

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## Best Practices Continued

- Keep a log book with pressure info for all sensors and meter data (water consumption)
- Equipment validation (NSF 42/58/61/372) etc.

## Monitoring

- Pressure gauges / sensors
- Automated pressure differential monitoring and alerts - WIFI (H2OnAlert), SCADA etc.

  ($1,000 to $3,000)
- Handheld turbidity meters (about $1,000)
- Inline turbidity meters (expensive)

## Other Considerations

- Avoidance:

  Can you change the location of the intake esp. lake water?
  Can you close the intake during extreme weather events etc.?
  Can you use another water source?

**Some tips to reduce operating cost**

- Consider switching cartridge brands / models (permit may be required)
- Consider modern plastic “jumbo” housings vs. stainless steel
- Multi-gradient and pleated cartridge filters last longer
- Don’t replace cartridges based on visible appearance - pressure differential is the key!
- Consider a spin down or backwashable media filter as first step in system especially where raw water turbidity exceeds 3 NTU
- Go to great length to protect your 1 micron absolute filters (which are $$$) with 1 micron nominal rated filters ahead of them

**Questions?**

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