Filter Surveillance: An Ounce of Prevention

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Optimization
Goals of Optimization

Use existing facilities to maximum extent

Non-capital focus – tweak what you have

BUT some capital may be required → CIP

Enhance staff / management capabilities

Maintain for the long-term

Prioritize for future improvements

Process

Results are not the end-point

Each plant is unique

No preconceived notions
What Happens Before Filtration
Critical to Filter Optimization

It starts with the water source…

Recycle?

Pretreatment
  Oxidation
  Coagulation

Clarification
  Flocculation
  Flow

Features

Solids EQ Basins

Sand Drying Beds
Why Optimize Filters?

Major barrier against pathogen passage
Maximize production efficiency
Minimize spent filter backwash water
  Duration
  Frequency
Increasing reliance on other WQ goals
  T&O control
  Fe and Mn control
  Bacteriological stability
More Than Meets the Eye

When operational, filters are covered with water
Traditionally, only indicators
  Water quality data
  Visual observations
Must literally dig into them to improve understanding
Filter Surveillance
Filter Surveillance - Three Main Tests

Bed Expansion
Spent Backwash
Turbidity
Floc Retention Analyses
Before Surveillance Begins, do your homework..

Do you have any filters with shorter filter runs?
Any higher turbidities?
Noticeable media loss?
Look at backwash protocol
How long with testing take?
What can your SCADA tell you?
Key to Good Filter Backwash Techniques

During backwash

Choose a temperature dependent high flow wash rate
Avoid washes that are too short or long
Hose down the side walls and pipes/gutters

OBSERVE THE BACKWASH

Observations at each backwash

Surface or air wash effectiveness
View surface for boils or “hot spots”
Look for uneven wash areas or uneven troughs
Filter Profile

Graphical summary of performance for entire run
Turbidity routine - particles counts can be used
What’s wrong with this picture?
Routine Parameters

Filter applied turbidity
Filter run time
Headloss
Filter effluent turbidity profile
Backwash use / temperature
Backwash Program

Drain

  Make sure level is low enough to maximize energy and minimize media loss

Surface wash or air wash

  3 to 4 minutes is usually sufficient

Low rate – initiates expansion

High rate – expands media, temp dependent

Low rate - reastratification
Assemble the Right Team of People
Tools and Techniques for Surveillance

HEALTH & SAFETY REQUIREMENTS
Review AWWA Standard B100

Measurement Tools
- Shovel, level, 3/8 inch steel rod, tape measure

Coring Tool
- 1.5 inch electrical conduit, 5 foot length, baggies

Expansion Tool
- One-inch interval tubes or cups

Laboratory Instruments and Tests
- Turbidimeter, glassware, balance, sample bottles, baggies
Filter Surveillance Tools
Lab Setup for Core Samples

Turbidimeter
Pan balance
Baggies –
Glassware
Lab water
Weigh boats
Filter Surveillance Techniques

Visual observations of surface and components
Probing media
Spent filter backwash assessment
Solids (Floc) retention analyses
Sieve analyses / media assessments
Drain and Observe

Surface level with no hills or holes
Note accumulations at surface

Small solids at surface
Can grow bigger and sink → Mudballs ←
Measure Media Depth / Check Troughs

Know original depth
Slender rods best
Measure around filter area
Note areas where depth varies
Gravel – you’ll feel it
If losses – investigate
Check trough levelness and features
Observe the Backwash Cycle
Bed Expansion Measurement

Check high flow wash rate the expansion
Desire 20-30% expansion
Wash bed under the normal conditions
Example – Bed Expansion

Bed Expansion Measurement with Expansion Tool (Example for 30 inch bed)
Bed depth measured at 30 inches
Bed expansion tool captured 9 inches
Bed Expansion Measurement calculations
9 inches / 30 inches = 30% approx
Are you Backwashing too much are too little?

Backwash turbidity sampling is the next step

Set up sampling in 30 second increments – then 1 minute
Bottles Ready for Spent Backwash Turbidity Sampling
Spent Backwash Turbidity Analyses

Too little / too much washing is common
Washwater turbidity should be measured for duration of wash
Sample at 30 second intervals
Graph results as NTU vs. time
Record all data
  Volume of backwash, rates,
  Ramping intervals, operator habits
A Tale of One City.... Plant 1

Turbidity goal = 5 min
But at Plant 2
Next Step: Floc Retention Analyses

Measures backwash effectiveness
Can show issues with your backwash
Note changes in historical solids retention results
Graphs results
Core Sampling for Solids Retention

Use core sampling tool to obtain depth samples

Take samples 0-2” and every 6” after

Sample before and after backwash

Wash 50 gms of each sample with 5 successive 100 mL washes of lab water
Floc Retention Analysis Plot

Run Time = 82 hours
Headloss = 1'
Loading rate = 1.2 gpm/sf

Turbidity per 100 mg of media vs Media Depth, inches
Solids Retention- where are the solids?

Wash 50 gms of each sample with 5 successive 100 mL washes of lab water

Measure turbidity of each sample

Plot on graph as NTU/100 grams media
Biofiltration is still filtration…..

Must also consider
Turbidity/particle removal
Filter operations - headloss, filter run length
Iron/manganese control
BAF Concerns

- Substantial accumulation of biological solids
- Significant amount of biological growth

North

Substantial accumulation of biological solids
Recommended Filter Surveillance Frequency

Once per quarter (per season)

- Adjust high flow rate for temperature
- Check media expansion – make adjustments
- Review unit filter run volume data
- Check media depth
- Review all filter profiles
Temperature Matters

![Graph showing the relationship between filter backwash rate (gpm/sf) and bed expansion (%) for 50 and 86 degree F water. The graph illustrates that as the filter backwash rate increases, the bed expansion also increases.]
# Backwash Rate Temp Correction

## Bed Expansion Measurement Rate Requirement

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Recommendations

Optimize pretreatment & filtration
Observe every backwash
Acquire filter surveillance training
Make operational changes before you spend money
New media?
Every year …

Core the filter – solids retention
Send media to lab for sieve analysis
Assign a team
Document and evaluate the results
Add media if necessary
BUT – know why it’s being lost
As long as you are already in the filter, have a look around……

Check out the concrete
Spalling repair
Cracks?
Did you make any operational changes?

Coagulant changes?

pH changes?
Thank You!!!
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