

HIGH RATE FILTRATION GUIDELINES

SUBJECT: Surface Water Treatment Plant High Rate Approval Process

LAST REVISION DATE: April 2003

PURPOSE: The purpose of this document is to establish the *minimum* requirements for high rate study proposals and full-scale demonstration studies in order to obtain approval for filtration rates greater than 4 gpm/ft² or clarification rates higher than typical design values. This document also establishes *guidelines* for the approval of such proposals and full-scale demonstrations. These guidelines are general in nature and each high rate project will be plant specific.

1.0 BACKGROUND

The *State Primary Drinking Water Regulations* allow 4.0 gpm/ft² for typical dual media gravity filters. This is considered to be the standard filtration rate in South Carolina for dual media gravity filters. However, filtration rates of up to 6 gpm/ft² can be approved by the Department if a full scale demonstration study shows that settled water and filtered water quality are not significantly impacted. A full-scale study is also required to high rate clarification processes. This document will focus on the high rating of a surface water treatment plant based on filtration rates above 4 gpm/ft². Other high rate studies (sedimentation basins, etc) can follow the same general approach. The Department reserves the right to reject a high rate request if it is determined that water quality and/or public health is compromised.

2.0 APPLICABILITY

While any water system can request to perform a high rate study, all requests may not be approved. All water plants are not good candidates for high rate filtration. The following items are *preferred* for plants that seek high rate filtration:

- Consistent raw water quality (turbidity, pH, TOC, alkalinity, etc.)
- Efficient pre-filtration treatment
- Good compliance history
- 24-hour operation
- Existing performance at or near AWOP turbidity goals
(settled water turbidity 2 ntu or less 95% of the time if the annual raw water turbidity averages > 10 ntu; settled water turbidity 1 ntu or less if the annual raw water turbidity averages < 10 ntu; filtered water turbidity 0.1 ntu or less 95% of the time based on maximum daily combined filter effluent)
- Plant has excess capacity (80% capacity has not been reached for any monthly avg.)

3.0 INITIAL HIGH RATE STUDY PROPOSAL REQUIREMENTS

Prior to conducting a full-scale demonstration study, approval of the proposed study must be obtained from the Department. The study proposal establishes the framework for the remainder of the project. The following items must be completed and submitted as the high rate study proposal:

1. The proposal should state the objectives for the high rate study. Included should be the desired **maximum instantaneous** flow rate (including while one filter is being backwashed). The need for high rating should also be explained.
2. The proposal must demonstrate the current water demand as compared to plant capacity, including maximum daily demand and peak monthly demand. Projected future demands may be included as well.
3. Any Inter-Basin Transfer issues must be addressed.
4. An engineering evaluation of the existing facilities and unit process components must be conducted. At a minimum, the engineering evaluation must describe the existing major unit processes, chemical feed equipment, pumping capabilities, and piping to determine if each can support the higher rate. Include weir loading rates, theoretical detention times, G values, hydraulic profile, waste handling, etc.
5. If the engineering evaluation reveals that the plant's existing facilities may have difficulty performing at the high rate, some improvements may be required before the full-scale demonstration begins in order to improve the chances of successful operation. The proposal should outline any needed improvements.
6. The pilot and control filters and their characteristics must be identified. If no improvements are planned for the filters, a filter assessment may be performed on the pilot and control filters in order to demonstrate the relative age, media type, media depth, media size, and overall condition of the filters. The proposal must indicate if the pilot filter(s) will be improved or re-configured prior to the full-scale demonstration.
7. The proposal must indicate if any additional treatment techniques will be applied to the pilot trains (i.e., polymer addition, change in coagulant or coagulant dose, addition of any other treatment chemicals/processes) during the study.
8. The flow distribution through the water plant must be described and the engineer should explain how the additional flow will be routed onto the pilot filter(s). The engineer should also indicate the flow rates through the pilot and control clarification units. Drawings or plant schematics should be included.

9. The disinfection credit (CT) must be estimated at the high rate. The proposal must also indicate if a new tracer study will be required at the higher rate.
10. The proposal must describe what parameters will be tested throughout the duration of the full-scale demonstration study. The proposal should also describe who will perform the testing for each parameter and what laboratory methods will be used. At a minimum, the following parameters are required:
 - a. Pilot & control clarified water turbidity (every 2 hours)
 - b. Pilot & control filtered water turbidity (continuous)
 - c. Particle count data from the pilot & control filters (3-18 micron range at least every 2 hours, continuous)
 - d. Monthly TOC samples must be taken during normal operating conditions each month. The TOC samples must be analyzed for the raw water source, pilot & control clarified water, as well as pilot & control filtered water.
11. The proposal must also describe what operational data will be recorded throughout the duration of the study. At a minimum, this should include:
 - a. Filter run times (pilot & control)
 - b. Loss of head (pilot & control)
 - c. Backwash and rewash times (pilot & control)
 - d. Daily flow rates through pilot and control processes
12. The proposal should indicate how filter run time will be determined. In other words, what will initiate a filter backwash? Normal backwash triggers may include turbidity, head loss, particle counts, and time. The values of each trigger should be clearly defined and it should be followed throughout the full-scale demonstration so that filter run times can be evenly compared.
13. The proposal must indicate the duration of the proposed study (duration must be for at least 12 months unless supporting data demonstrates that source water quality variability can be evaluated in less than 12 months).
14. The proposal should indicate the desired performance (i.e., describe performance goals for the full-scale study and indicate what results would most likely constitute success and failure).

4.0 FULL-SCALE DEMONSTRATION

Once the high rate proposal has been approved by the Department, the full-scale demonstration may be conducted in accordance with the approved proposal. Any deviations from the proposal must be approved by the Department.

5.0 FINAL ENGINEERING REPORT REQUIREMENTS

Upon completion of the high rate study, an engineering report incorporating the tabulated results, laboratory analysis, and other pertinent findings must be submitted to the Department for review and comment. The objective of the report is to compare the

performance at the higher rate versus the control rate (for clarified and filtered water) as well as the absolute performance at both rates. At a minimum, the final report must include:

1. The engineer must determine if the goals for success, which were outlined in the proposal, were achieved. The engineer must also make a professional recommendation that the plant be high rated *if* he or she feels that the full-scale data supports such a recommendation. This should be included in the cover letter.
2. Clarified & filtered water turbidity data for the pilot and control trains should be summarized (average, max, min, 95% etc.)
3. Charts must be provided for settled water turbidity, filtered water turbidity, particle counts, and head loss. These parameters should be plotted versus time for each day (24 hr charts). Each daily chart should include the pilot and control trains for comparison. Reports that are divided into sections (e.g. a section for particle counts versus time, a section for head loss versus time, etc.) are easier to interpret. For filtered water data, backwash events should be clearly identified by listing the backwash times or, preferably, by data gaps.
4. A chart should also be produced for the duration of the study showing filter run time versus filter run number. A total of two (2) such charts should be provided (pilot and control trains).
5. A chart showing TOC values and percent removal vs months showing both pilot & control trains.
6. An analysis of how the increased rate will impact the water plant's ability to meet any applicable future regulations.

6.0 SPECIAL CONDITIONS & MAINTAINING HIGH RATE APPROVAL

In addition to the guidelines outlined in Section 7, the following conditions must be met in order to obtain high rate approval and continue operating at the high rate:

1. An operator holding at least a "B" treatment plant operator certification must be present at all times while the plant is in operation.
2. The water system must remain in compliance with all current regulations, as adopted by the state of South Carolina. If the plant is in violation of any regulations during the full-scale demonstration, the study must be suspended and a new proposal must be submitted before continuing with the high rate process.
3. The Department reserves the right to rescind the high rate approval if the plant is observed to be consistently out of compliance with drinking water regulations and MCLs. The Department also reserves the right to rescind the high rate approval if water quality is significantly compromised because of the higher rate, even if the plant is meeting the *minimum* regulatory requirements.
4. The Department reserves the right to require additional improvements or testing before or during the full-scale demonstration study.

5. Plants with approved filtration rates $> 4 \text{ gpm/ft}^2$ are strongly encouraged to operate 24 hours per day before filtering at rates above 4 gpm/ft^2 .

REFERENCES

1. USEPA. Handbook: Optimizing Water Treatment Plant Performance Using the Composite Correction Program. EPA/625/6-91/027. 1998 Edition.
2. Kinard, Doug. "High Rate Filtration Guidelines." SCAWWA Workshop: Optimizing Treatment Plant Capacity. February 2000.
3. State Primary Drinking Water Regulations. South Carolina Department of Health & Environmental Control. February 2003.