Guidance for Biological Treatment Processes for Surface Water (Taste and Odor Removal)

The Minnesota Department of Health (MDH) requires that pilot studies be performed for all alternative treatment technologies, including biological treatment processes. This guidance document for biological treatment processes to reduce constituents that cause taste and odor (T & O) problems in drinking water outlines the process for getting a biological treatment proposal for T & O reduction approved by MDH.

Biological filters/contactors can be used for the removal of T & O constituents if a pilot study on the raw water source is conducted and can show removal/reduction of unwanted taste and odor constituents below thresholds widely recognized by the industry, and/or those established by randomly chosen personnel panels that evaluate water from the said system. The design parameters that are determined during the pilot study will be required to be implemented in the full-scale design for all new or modified, existing treatment plants. In addition, all surface water treatment plants must meet the requirements of the Safe Drinking Water Act Rules.

The first step in the approval process is to submit a pilot study for the proposed treatment technology. Proposals for pilot studies must first be reviewed and approved by MDH. A final pilot study report must be submitted to and approved by MDH before proceeding to final full scale design. The design of biological filters/contactors shall comply with the Great Lakes Upper Mississippi River Board Standards Recommended Standards for Waterworks (Ten States Standards) and this policy.

The pilot study must:

1. Accurately represent the final proposed treatment process, which may include but is not limited to:
    a. Type of filtration
    b. Depth of filter media/contactor media
    c. Type of filter media
    d. Size and gradation of filter media
    e. Filtration rates, backwash system design (air and water is required)
    f. Backwash rate
    g. Type of backwash water (raw, treated and unchlorinated, or de-chlorinated, etc.)
    h. Empty bed contact time
    i. Dissolved oxygen concentration
    j. Number and types of filters piloted
    k. Method of oxygen addition
    l. Chemical addition
    m. Maximum allowable filter/contactor headloss before backwash
2. Establish filter effluent water quality goals for taste and odor components.
3. Operate through the anticipated temperature range of the raw water once stabilized bacteriological growth is established.

4. Discharge all treated/filtered water to waste, unless otherwise allowed by the administrative authority.
5. Monitor and record filter influent measurements of:
    a. Organic carbon(s) (OC) [1]
    b. Dissolved oxygen content [3]
    c. pH [2]
    d. temperature [2]
    e. taste and odor contaminants [4]
6. Monitor and record filter effluent measurements of:
    a. Organic carbon(s) (OC) [1]
    b. Dissolved oxygen content [3]
    c. pH [2]
    d. turbidity
    e. taste and odor contaminants [5]

    - OC monitoring can be reduced to once a week.
    - At least twice a week.
    - It is recommended that dissolved oxygen be monitored continuously.
    - At least once during the pilot study.
    - Multiple times during the pilot study characterize treatment effectiveness.
7. Monitor and record filter headloss, water flow rates, and filter run times.
8. Microbial inactivation requirements for surface water must be addressed in the full scale application.
9. Disinfection By-Product (DBP) formation potential must be addressed in the full scale application.
10. Determine appropriate water and air backwash rates and time for the proper removal of loose clusters of bacteria that may break through the filter. The use of air and water backwash is required. Consideration should be given to backwashing with chemical addition.
11. Determine maximum shutdown time for the biological filter/contactor while maintaining water quality goals upon start-up.
12. Establish a protocol for start-up after a period of shutdown and after backwashing events. Consideration should be given to backwashing the filter/contactor after a period of shut down. (This backwash requirement must be taken into account for the maximum shut down time in Step No. 11.) It should also be determined if a minimum volume of water is required to be filtered to waste upon filter startup after a backwash and/or shutdown in the full-scale operation.
13. Indicate if backwash reclaim is to be used in the final water treatment plant design.
14. Only use chemicals that are ANSI/NSF Standard 60 listed.

Once the pilot study is completed, a copy of the final study and results shall be submitted to the MDH for approval. After the final report has been approved, a complete set of plans and specifications for the full-scale treatment plant design shall be submitted to MDH for review and approval. The final design shall include the following items:

1. Smooth-nosed sample taps shall be provided on the raw water influent, on the effluent line from each biological filter, and on the finished water effluent downstream of the final chemical feed point.
2. Secondary disinfection must be provided. A minimum residual of 0.2 mg/L of free chlorine or 1.0 mg/L of total chlorine must be maintained at all points of the distribution system. The total chlorine level shall not exceed 4.0 mg/L.
3. All chemical, air injection, and pH adjustment points shall be clearly labeled on the plans.
4. The type, size, gradation, and depth of the filter media shall match the parameters established in the pilot study.
5. A means for measuring headloss must be provided. The project specifications shall indicate the maximum headloss allowed before backwashing of the filters/contactors is required.
6. Continuous monitoring on individual filter effluent turbidity must be provided.
7. Backwashing the filters/contactors with air and water shall be provided. The backwashing rates for both air and water shall be provided.
8. The filtration rate and empty bed contact time for each filter shall be provided in the project specifications.
9. Filter to waste piping must be provided for all new treatment plant designs and plant rehabilitations.
10. The project design specifications should include the run time of the filter to waste step after backwashing the filter/contactor. This shall be determined in Step No. 12 of the pilot study requirements (above).
11. The provisions for backwashing the filter/contactor shall be described in detail.
12. Consideration should be given to the building size to allow for additional chemical feed equipment for the biological treatment process if future chemical addition is needed to enhance performance.
13. A means for cleaning and maintaining the clearwell, while still maintaining plant operation, shall be provided. It is recommended that the clearwell/wet well be separated into at least two separate basins to allow for cleaning and maintenance of the clearwell while still allowing operation of the treatment plant.
14. The water operator must be certified at the proper level. A recalculation of the certification level will be conducted. Additional training may be required by the administrative authority.
15. The full-scale design must include the continuous monitoring of dissolved oxygen in the filter/contactor effluent.

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06/05/2018
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