

Membrane bioreactors

Need for disinfection with membrane bioreactors

As effluent limits for wastewater discharges become more stringent, it is anticipated that membrane bioreactors (MBRs) will become a more common treatment method. MBRs have shown to be effective in treating many pollutants to very low levels. This includes providing a physical barrier capable of removing fecal coliform bacteria and other pathogens. This has led to questions about the need for a separate disinfection process, such as chlorination or ultraviolet light (UV), if the permit limit for fecal coliform bacteria can be achieved with the MBR alone.

Disinfection equipment installation required

The Minnesota Pollution Control Agency (MPCA) has determined that a separate disinfection process is required to be installed and operable for all MBR facilities to maintain treatment reliability for compliance. Due to membrane imperfections, operational back-pulsing cycles, and routine cleaning, reliable continuous removal of fecal coliform cannot be guaranteed by membrane exclusion alone.

Operation of disinfection equipment

Discharges upstream of a drinking water intake

All wastewater treatment facilities that are 25 miles or less upstream of a drinking water intake must operate disinfection equipment continuously all year long as specified in the permit. Full redundancy of disinfection equipment is required.

Membranes with MAXIMUM pore size of 0.4 microns or larger

Full disinfection unit redundancy and continuous operation is required when a fecal coliform limit is effective.

Membranes with MAXIMUM pore size less than 0.4 microns and NOMINAL pore size less than 0.04 microns

Design requirements

1. Redundancy requirements may be met with a combination of the MBR and disinfection unit. Disinfection units capable of treating peak hourly flow are required. UV disinfection units shall provide at least two banks in series per 10 States Standards Chapter 104.3 of the *Recommended Standards for Wastewater Facilities (Ten States Standards)*. Continuous operation is required when a fecal coliform limit is effective.
2. Membranes with a nominal pore size of less than 0.04 microns may request to turn off disinfection equipment provided the following conditions are met:
 - a. Must have continuous turbidity monitoring after the MBR and before the disinfection unit.
 - b. Must have control systems in place to automatically turn on the disinfection system when turbidity monitoring reaches 0.1 nephelometric turbidity units (NTUs) or greater.
 - c. Must have process control monitoring for membrane flux, transmembrane pressure (TMP), and time when disinfection is not in operation. This monitoring is not reported on discharge monitoring reports, but records must be kept and retained in accordance with permit requirements.
 - d. Must have sufficient treatment units to allow for the return of all flow back through the MBR after a cleaning event until turbidity monitoring stabilizes below 0.1 NTUs.
 - e. Must have spare membrane modules/cassettes on hand to replace units suspected of having a breach.

Operation requirements

1. Disinfection equipment must be operated when there is a suspected membrane breach, or any time it is determined necessary by the Permittee to ensure compliance with permits terms and conditions. The Permittee is required to meet the fecal coliform effluent limit as required by permit regardless of whether the disinfection equipment is in operation or not.
2. Evidence of a membrane breach may include, but not be limited to:
 - a. A turbidity monitoring result of 0.1 NTUs or greater.
 - b. Changes in membrane flux or TMP that would indicate reduced MBR performance.
 - c. Increase in fecal coliform, total suspended solids, or other parameter that indicates reduced MBR performance.
 - d. Visual observations of the condition of the MBR that would indicate damaged membranes.
3. In the event of a membrane breach the following steps must be taken:
 - a. Immediately turn on disinfection equipment.
 - b. Take a fecal coliform sample at a point after the MBR and before the disinfection equipment.
 - c. Continue to sample effluent fecal coliform in accordance with the permit.
 - d. Disinfection equipment must stay in operation until turbidity readings have stabilized below 0.1 NTUs and fecal coliform monitoring results before the disinfection unit shows compliance with permit terms and conditions.

If you have any questions regarding a proposed MBR facility, you should contact the MPCA engineer assigned to your facility or region.