|  |  |
| --- | --- |
| Minnesota Pollution Control Agency (MPCA), 520 Lafayette Road North, St. Paul, MN 55155-4194 | Attached Growth - Trickling Filter Biological Treatment Checklist  NPDES/SDS Permit Program  National Pollutant Discharge Elimination System (NPDES)/ State Disposal System (SDS)  Doc Type: Plan/Specification Review Summary |

**Purpose:** This checklist is intended for use by design engineers, to assist Minnesota Pollution Control Agency (MPCA) review engineers in the efficient review of planning and design documents. The information requested is the minimum technical data necessary for MPCA staff to review proposed designs and to determine whether there is reasonable assurance that the treatment system, when constructed, will comply with permit conditions, regulations, and criteria of the MPCA.

**Instructions:** The information in this checklist is based on the ***Recommended Standards for Wastewater Facilities published by the Great Lakes Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers (Ten State Standards) 2004 Edition,*** other accepted engineering references, and MPCA recommendations. Specific references, other than Ten State Standards, are listed where appropriate. The checklist is organized according to the numbering sequence found in Ten State Standards to allow for ease in locating the entire content and text of the recommendations.

The checklist is designed so that a “**yes**” answer indicates compliance with Ten State Standards et al.

A “**no**” answer indicates a deviation from Ten State Standards et al. Answering “no” to any question will require justification that can be provided at the end of the checklist and possibly supporting information, from wastewater treatment plant operational data, to demonstrate how the intent of the recommendation will be met. Additional information may be requested based on site specific conditions. Attachments and additional information is required for some questions and shall be included with the checklist for all questions when indicated, regardless of answering “yes” or “no”.

Wastewater Treatment Facility information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Date** (mm/dd/yyyy): | |  | **MPCA Project No:** |  |
| **Title of project:** |  | | | |

Permittee information

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Facility name: | |  | | | | |
| Contact name and title: | | |  | NPDES/SDS Permit No: | MN |  |
| Email: |  | | | Phone number: |  | |

Design Engineer information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Contact name: | |  | Contact phone number: |  |
| Email: |  | |  |  |

**Phase:**   Planning Phase  Design Phase

**Filter:**  New trickling  Rehabilitation

Trickling Filter Influent Characteristics

Hydraulic load and recirculation rate

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Hydraulic load (mgd)** (w/o recirculation) | **Recirculation rate (mgd)** | **Recirculation rate (percent)** |
| **ADW** |  |  |  |
| **AWW** |  |  |  |
| **DMD** |  |  |  |
| **PHWW** |  |  |  |
| **PIWW** |  |  |  |

|  |  |  |
| --- | --- | --- |
| **Organic Load** | **mg/L** | **#BOD/day** |
| **Design average BOD** |  |  |
| **Design maximum BOD** |  |  |
| **Design peak hourly BOD** |  |  |
| For strong industrial waste, consideration should be given to using peak loading. | | |
| **TKN Load** | **mg/L** | **#BOD/day** |
| **Design average TKN** |  |  |
| **Design maximum TKN** |  |  |
| **Design peak hourly TKN** |  |  |

For strong industrial waste, consideration should be given to using peak loading.

**Upgrading an Existing Trickling Filter**

|  |  |  |
| --- | --- | --- |
|  | **Yes** | **No** |
| Was the distribution system, underdrain system, and media inspected and evaluated (for an upgraded/expanded existing facility)? |  |  |
| Were rusted arms, missing and/or broken nozzles, splash plates, and plates and condition of bearings and bearing plate observed/evaluated? |  |  |

91. Trickling Filters

| ***91.1 General*** | | | **Yes** | **No** |
| --- | --- | --- | --- | --- |
| Are the trickling filters preceded by effective clarifiers equipped with scum and grease removal devices and other suitable preliminary facilities? | | |  |  |
| Identify the trickling filter(s) design influent dissolved oxygen concentration: |  | mg/L | | |
| Will influent to the trickling filter be pre-aerated to improve effectiveness of aerobic treatment in the upper sections of the reactor (e.g., pre-aeration basins, aerated grit removal, etc.)? | | |  |  |
| Will multi-stage filters, or other subsequent biological treatment processes, be included to meet effluent standards? | | |  |  |
| ***91.2 Hydraulics*** | | | | |
| **91.21 Distribution** | | | | |
| **91.211 Uniformity** | | | | |
| Are rotary distributors provided? (See note #1.) | | |  |  |
| Identify the distribution of influent across the filter at design flow: |  | gal/ft2 | | |
| Is uniform distribution provided within a 10 percent deviation (per square feet) at any point along the surface area of the trickling filter? (See note #2.) | | |  |  |
| Are reverse reaction nozzles, hydraulic brakes or motor-driven distributors provided for rotary distributors (to not exceed max speeds specified by the manufacturer)? | | |  |  |
| Are reverse reaction nozzles, hydraulic brakes or motor-driven distributors provided for rotary distributors to accommodate the media flushing rates below? (See note #2.) | | |  |  |

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Guidelines for trickling filter dosing and flushing rates as a function of BOD loading (WEF 2000)**   |  |  |  | | --- | --- | --- | | **BOD loading (kg/c.m. x d)** | **Operating dose (mm/pass)\*** | **Flushing dose (mm/pass)\*** | | 0.25 | 10-30 | > 200 | | 0.5 | 15-45 | > 200 | | 1.0 | 30-90 | > 300 | | 2.0 | 40-120 | > 400 | | 3.0 | 60-180 | > 600 | | 4.0 | 80-240 | > 800 |   *\*mm/pass represents the amount of liquid applied for each pass of each distributor arm* |

| **91.212 Head Requirements** | | | | | **Yes** | **No** |
| --- | --- | --- | --- | --- | --- | --- |
| Is a minimum head of 24 inches between low water level in the siphon chamber (or similar allowance for added pumping head) and center of arms provided for reaction type distributors. (See note #2.) | | | | |  |  |
| **91.213 Clearance** | | | | | | |
| Is a minimum 12 inch clearance between media and distributor arms provided? | | | | |  |  |
| **91.22 Dosing** | | | | | | |
| Is the application of wastewater over the media continuous? | | | | |  |  |
| Is the piping system designed for recirculation? | | | | |  |  |
| ***91.3 Media*** | | | | | | |
| Identify type of media (rock, slag, plastic, etc.): |  | | | | | |
| **91.31 Quality** | | | | | | |
| Is the media durable, resistant to spalling or flaking and insoluble in wastewater? (Attach sodium soundness testing.) | | | | |  |  |
| Is slag media free from iron or other leachable materials? | | | | |  |  |
| Is manufactured media resistant to high influent temperature degradation, ultraviolet degradation, disintegration, erosion, aging, all acids and alkalies, organic compounds, fungus, and biological attack? | | | | |  |  |
| Identify the maximum temperature rating of the media: | |  | degrees Celsius | | | |
| Is the media able to support a person’s weight, or is an access walkway provided? | | | | |  |  |
| **91.32 Depth** | | | | | | |
| Does the trickling filter media have a minimum depth of 6 feet or greater above the underdrains? | | | | |  |  |
| Is the rock/slag filter media depth less than 10 feet? | | | | |  |  |
| Identify the media manufacturer’s maximum recommended depth for their media: | | |  | feet | | |
| **91.33 Size, grading, and handling of media** | | | | | | |
| **91.331 Rock, slag, and similar media** | | | | | | |
| Does rock, slag, and similar media contain less than five percent by weight of pieces whose longest dimension is three times the least dimension? | | | | |  |  |
| Is the media free from thin, elongated and flat pieces, dust, clay, sand or fine material? | | | | |  |  |
| Does the media conform to the gradation in Ten State Standards, when mechanically graded over a vibrating screen with square openings? (Attach screen/sieve analysis.) | | | | |  |  |
| **91.333 Handling and Placing of Media** | | | | | | |
| Will the material delivered to the filter site be stored on wood-planked or other approved clean, hard surfaced areas? | | | | |  |  |
| Will the material be re-handled at the filter site and not dumped directly into the filter? | | | | |  |  |
| Will crushed rock, slag and similar media be washed and re-screened at the filter site to remove fines? | | | | |  |  |
| Will the material be placed by hand to a depth of 12 inches above the tile underdrains? | | | | |  |  |
| Will the remainder of the material be place by means of belt conveyors? | | | | |  |  |
| Do the plans and specifications specify that cutting or shaping of manufactured media is not allowed in the filter to avoid clogging? | | | | |  |  |
| Will trucks, tractors, and other heavy equipment be precluded from driving over the filter during or after construction? | | | | |  |  |
| ***91.4 Underdrainage System*** | | | | | | |
| **91.41 Arrangement** | | | | | | |
| Are underdrains with semicircular inverts or equivalent provided? | | | | |  |  |
| Does the underdrainage system cover entire filter floor? | | | | |  |  |
| Do the inlet openings into the underdrains have an unsubmerged gross combined area of at least 15 percent of the filter surface area? (See note #2.) | | | | |  |  |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **91.42 Hydraulic Capacity** | | | | | **Yes** | **No** |
| Do the underdrains have a minimum slope of one percent? | | | | |  |  |
| Do the effluent channels have a minimum velocity of 2 feet per second at design average flow rates? (See note #2.) | | | | |  |  |
| **91.43 Ventilation** | | | | | | |
| Are the size of the drains, channels, and pipes such that not more than 50 percent or less of their cross-sectional area will be submerged under design peak instantaneous wet weather flow, including proposed or possible future recirculation flows? (See note #2.) | | | | |  |  |
| Are ventilating manholes with open-grating types of covers installed for both ends of the central collection channel? (M&E 2003)? | | | | |  |  |
| Are branch collecting channels with ventilating manholes or vent stacks installed at the filter periphery? (M&E 2003) | | | | |  |  |
| Is 1 square foot of ventilation area for each 10 to 15 feet of trickling filter tower periphery provided? (MOP 8 1977) | | | | |  |  |
| Is 10 square feet of gross area of open grating in ventilating manholes and vent stacks provided for each 250 square feet of filter area? (M&E 2003) (See note #2.) | | | | |  |  |
| Is a minimum airflow of 1 c.f./min.- s.f. of filter area in either direction provided? (M&E 2003) (See note #2.) | | | | |  |  |
| Will forced ventilation be provided? | | | | |  |  |
| Are windows or simple louvered mechanisms arranged to ensure air distribution throughout the enclosure? | | | | |  |  |
| Does the design of ventilation facilities provide for operator control of air flow? | | | | |  |  |
| Are the design computations showing adequacy of air flow to satisfy process oxygen requirements provided with this checklist? (See note #2.) | | | | |  |  |
| Does the design include provisions to restrict air flow through the filter to keep it from freezing during periods of extremely low air temperature? | | | | |  |  |
| **91.44 Flushing** | | | | | | |
| Are provision in the plans and specifications included for flushing the underdrains? | | | | |  |  |
| Are inspection facilities provided? | | | | |  |  |
| ***91.5 Special Features*** | | | | | | |
| **91.51 Flooding** | | | | | | |
| Are appropriate valves, sluice gates, or other structures provided to enable flooding of filters? | | | | |  |  |
| **91.52 Freeboard** | | | | | | |
| Is a freeboard of four feet or more provided between the media surface to the top of the tank wall? | | | | |  |  |
| Is a headroom of at least six feet provided between the distributor and the tank cover for maintenance of the distributor? | | | | |  |  |
| **91.53 Maintenance** | | | | | | |
| Are distribution devices, underdrains, channels, and pipes designed so that they may be properly maintained, flushed and/or drained? | | | | |  |  |
| **91.54 Winter protection** | | | | | | |
| Are covers provided for all trickling filters? | | | | |  |  |
| **91.55 Recirculation** | | | | | | |
| Is the recirculation rate variable and subject to plant operator control at the range of 0.5:1 up to 4:1 pursuant to section 91.211? | | | | |  |  |
| Are a minimum of two recirculation pumps provided? | | | | |  |  |
| Identify the design flow for each pump: |  | mgd | | | | |
| Identify the TDH for each pump: |  | feet | | | | |
| Identify the design flow for the pumping system: |  | mgd | | | | |
| Identify the TDH for the pumping system: |  | feet | | | | |
| Is the media flushing rate variable and subject to plant operator control at the range of 0.5:1 up to 4:1 pursuant to section 91.211? | | | | |  |  |
| **91.56 Recirculation measurement** | | | | | **Yes** | **No** |
| Is a device provided to measure the recirculation rate? | | | | |  |  |
| Identify the maximum recirculation rate: |  | mgd | | | | |
| Identify the minimum recirculation rate: |  | mgd | | | | |
| **91.57 Ventilation ports** | | | | | | |
| Are the underdrainage ventilation ports designed to ensure that the interior flow will be retained inside the trickling filter? | | | | |  |  |
| ***91.6 Rotary Distributor Seals*** | | | | | | |
| Are existing seals mercury free (for existing facilities)? | | | | |  |  |
| Are mercury seals being replaced (for existing facilities)? | | | | |  |  |
| Do the plans and specifications provide for ease of seal replacement to ensure continuity of operation? | | | | |  |  |
| ***91.7 Unit Sizing*** | | | | | | |
| Were the MPCA Reliability Guidelines used to determine required number of units? | | | | |  |  |
| Is the required volume(s) of filter media based on pilot testing with the particular wastewater? (See note #2.) | | | | |  |  |
| Is the required volume(s) of filter media based on use of empirical design equations that have been verified through full scale experience with the particular wastewater? (See note #2.) | | | | |  |  |
| Is the trickling filter design based on the peak organic load conditions including the oxygen demands due to recycle flows? (See note #2.) | | | | |  |  |
| Is the volume of media determined based upon design maximum day BOD organic loading rate? (See note #2.) | | | | |  |  |
| Identify the design formulations being utilized (NRC, Velz, Howland, Schulze, Germain, Eckenfelder, Barnhart, Galler & Gotaas, Bruce & Mertens, etc.): | | |  | | | |
| Identify the media constants/packing coefficients: | | |  | | | |
| Identify the design minimum temperature: | | |  | degrees Celsius | | |
| Identify the treatability factors/treatability constants/rate constants/hydraulic constants: | | |  | | | |
| Identify the tricking filters design removal rate(s) (e.g., settled filter effluent BOD/filter influent BOD) (See note #2.): | | |  | (mg/L)/(mg/L) | | |
| Identify the design equations contact time (t): | | |  | minutes | | |
| Are the design loadings calculations attached in the design summary? The design loading calculations listed below are considered the minimum. | | | | |  |  |

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Value** | **Unit** |
| Number of filters |  |  |
| Diameter |  | feet |
| Depth |  | feet |
| Total packing volume |  | c.f. |
| Media surface area |  | s.f./c.f. |
| Hydraulic load |  | gpd/s.f.\* |
| Organic load |  | #BOD/1000 c.f. – day |
| TKN load |  | #TKN/1000 c.f. – day |
| Maximum temperature |  | degrees Celsius |
| Minimum temperature |  | degrees Celsius |
| Total pumping rate |  | gpd, gpm, and cfs |
| Recirculation ratio |  | unitless |
| Number of distributor arms |  |  |
| Normal distributor speed |  | minutes/revolution |
| Flushing distributor speed |  | minutes/revolution |
| Number of clarifiers |  |  |
| Clarifier depth |  | feet |
| Clarifier diameter |  | feet |

*\*Without recirculation*

|  |
| --- |
| **Notes**  1. If no, attach alternative design summary.  2. Attach design summary, reports, analysis, pilot testing, calculations, etc.  Justification for all questions answered with a “no”: |
|  |
| Additional comments: |
|  |

**References**

GLUMRB (2004) *Recommended Standards for Wastewater Facilities* (Ten States Standards), Great Lakes-Upper Mississippi River Board of State Sanitary Engineering Health Education Services Inc., Albany NY.

Metcalf & Eddy, Inc. (2003) *Wastewater Engineering, Treatment and Reuse,* 4th ed., McGraw-Hill, New York. (M&E 2003)

WEF (1998) *Design of Municipal Wastewater Treatment Plants, Manual of Practice No. 8,* Water Environment Federation, Alexandria, VA. (MOP 8 1998)

WEF (2000) *Aerobic Fixed-Growth Reactors; A Special Publication,* Water Environment Federation, Alexandria, VA. (WEF 2000)

WPCF (1977) *Wastewater Treatment Plant Design, Manual of Practice No. 8,* Water Pollution Control Federation, Alexandria, VA. (MOP 8 1977)

**Acronym definitions**

ADW Average Dry Weather flow

AWW Average Wet Weather flow

BOD Biochemical Oxygen Demand

c.f. cubic feet

cfs cubic feet per second

c.m. cubic meter

d day

DMD Design Max Day

gal/ft2 gallon/feet squared

gpd gallons per day

gpm gallons per minute

kg kilogram

mg/L milligram per liter

mgd million gallons per day

mm millimeter

PHWW Peak Hourly Wet Weather flow

PIWW Peak Instantaneous Wet Weather flow

s.f. square feet

TKN Total Kjeldahl Nitrogen

TDH Total Dynamic Head