|  |  |
| --- | --- |
| Minnesota Pollution Control Agency (MPCA), 520 Lafayette Road North, St. Paul, MN 55155-4194 | Anaerobic Sludge Digestion Review 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) 2014 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.

A “**N/A**” answer means not applicable because the equipment associated with the question is not included in the design.

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

**Type of sludge:**  Primary  Secondary  Waste Activated  Combination

Influent Characteristics

|  |  |  |  |
| --- | --- | --- | --- |
| Solids concentration: |  | % |  |
| Sludge flow per day: |  | gpd |  |

84. Anaerobic Sludge Digestion

*(Only use a “NA” answer if the equipment associated with the question is not included in the design)*

| ***84.1 General*** | **Yes** | **No** | **N/A** |
| --- | --- | --- | --- |
| Are the vector attraction reduction requirements of 40 CFR Part 503.33 of the Federal Regulations met? (U.S. EPA July 2003) |  |  |  |
| Will the sludge meet the PSRP requirement of treatment in the absence of air for a solids retention time and temperature between 15 days at 35 to 55 degrees Celsius (950F to 1410F) and 60 days at 20 degrees Celsius (680F)? (U.S. EPA July 2003) |  |  |  |

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **84.11 Multiple Units** | | | | | | | | | |
| Are multiple units or alternate methods of sludge processing provided? | | | | | | |  |  |  |
| Number of units: | | | | |  | | | | |
| Are facilities for sludge storage and supernatant separation in an additional unit provided, considering raw sludge concentration and disposal methods for sludge and supernatant? | | | | | | |  |  |  |
| **84.12 Depth** | | | | | | | | | |
| If the process design provides for supernatant withdrawal, does the proportion of depth to diameter allow for the formation of a reasonable depth of supernatant liquor? | | | | | | |  |  |  |
| Is the side water depth at least 20 feet? | | | | | | |  |  |  |
| Depth of side water per unit: | |  | | feet | | Recommended range is 25 to 50 feet for cylindrical tank (M&E 2014) | | | |
| Diameter: | |  | | feet | | Recommended range is 20 to 125 feet for cylindrical tank (M&E 2014) | | | |
| **84.13 Design Maintenance Provisions** *To facilitate emptying, cleaning and maintenance, the following features are desirable:* | | | | | | | | | |
| **84.131 Slope** | | | | | | | | | |
| Does the tank bottom slope to drain toward the withdrawal pipe? | | | | | | |  |  |  |
| Tank bottom slope: |  | | feet to feet | | | | | | |
| If the tanks are equipped with a suction mechanism for sludge withdrawal, is the bottom slope no less than 1 to 12? | | | | | | |  |  |  |
| If the sludge will be removed by gravity alone, is the bottom slope no less than 1 to 4? | | | | | | |  |  |  |
| **84.132 Access Manholes** | | | | | | | | | |
| Are at least two access manholes not less than 36 inches in diameter provided in the top of the tank, in addition to the gas dome? | | | | | | |  |  |  |
| Are stairways provided to reach the access manholes? | | | | | | |  |  |  |
| Is a separate side wall manhole provided that is large enough to permit the use of mechanical equipment to remove grit and sand? | | | | | | |  |  |  |
| Is the side wall access manhole, which may be buried in the earthen bank insulation, low enough to facilitate heavy equipment handling? | | | | | | |  |  |  |
| **84.133 Safety** | | | | | | | | | |
| Are non-sparking tools, rubber-soled shoes, safety harness, gas detectors for flammable and toxic gases, and at least two self-contained breathing units, as described in Paragraph 102.56, provided for emergency use? | | | | | | |  |  |  |
| **84.14 Toxic Materials** | | | | | | | | | |
| Is the basis of design for the anaerobic digestion process supported by wastewater analyses to determine the presence of undesirable materials, such as high concentrations of sulfates or inhibitory concentrations of heavy metals? | | | | | | |  |  |  |
| ***84.2 Sludge Inlets, Outlets, Recirculation, and High Level Overflow*** | | | | | | | | | |
| **84.21 Multiple Inlets and Draw-Offs** | | | | | | | | | |
| Are multiple sludge inlets and draw-offs, and where used, multiple recirculation suction and discharge points to facilitate flexible operation and effective mixing of the digestor contents provided unless adequate mixing facilities are provided within the digester? | | | | | | |  |  |  |
| Number of drawoffs: | | |  | | | | | | |
| **84.22 Inlet Configurations** | | | | | | | | | |
| Is one inlet discharge above the liquid level and located at approximately the center of the tank to assist in scum breakup? | | | | | | |  |  |  |
| Is the second inlet opposite to the suction line at approximately the 2/3 diameter point across the digester? | | | | | | |  |  |  |
| Number of inlets: | | |  | | | | | | |

|  | | | | | **Yes** | **No** | **N/A** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **84.23 Inlet Discharge Location** | | | | | | | |
| Are raw sludge inlet discharge points located as to minimize short circuiting to the digested sludge or supernatant draw-offs? | | | | |  |  |  |
| **84.24 Sludge Withdrawal** | | | | | | | |
| Is sludge withdrawal to disposal from the bottom of the tank? | | | | |  |  |  |
| Is the bottom withdrawal pipe interconnected with the necessary valving to the recirculation piping to increase operational flexibility when mixing the tank contents? | | | | |  |  |  |
| **84.25 Emergency Overflow** | | | | | | | |
| Is an unvalved vented overflow provided to prevent damage to the digestion tank and cover in case of accidental overfilling? | | | | |  |  |  |
| Is the emergency overflow piped to an appropriate point and at an appropriate rate in the treatment process or sidestream treatment facilities to minimize the impact on process units? | | | | |  |  |  |
| ***84.3 Tank Capacity*** | | | | | | | |
| **84.31 Rational Design** | | | | | | | |
| Is the total digestion tank capacity determined by rational calculations based upon factors such as: volume of sludge added, percent solids and character; the temperature to be maintained in the digestors; the degree or extent of mixing to be obtained; the degree of volatile solids reduction required; the solids retention time at peak loadings; method of sludge disposal; and the size of the installation with appropriate allowances for gas, scum, supernatant, and digested sludge storage? **Provide calculations to justify the basis of design.** | | | | |  |  |  |
| Are secondary digesters of two-stage series digestion systems used for digested sludge storage and concentration removed from volume calculations required for sludge digestion? | | | | |  |  |  |
| Type of digestion: | Single stage Two stage | | | | | | |
| Type of mixing: |  | | | | | | |
| Volumetric loading: |  | ft3/cap/d | | Recommended range is 1.3-4.0 ft3/cap/d (M&E 2014) | | | |
| Volatile Suspended Solids (VSS) loading: |  | lbs VSS/1000ft3/d | | Recommended range is 100-300 lbs VSS/1000ft3/d (M&E 2014) | | | |
| Number of digesters: |  | | | | | | |
| Volume of digesters: |  | | ft3 | | | | |
| Hydraulic residence time: |  | | days | | | | |
| Solids retention time: |  | | days | Recommended range is 15-20 days (M&E 2014) | | | |
| Volatile solids reduction: |  | | % | | | | |
| Digested sludge storage volume: |  | | ft3 | | | | |
| Method of sludge disposal: |  | | | | | | |
| **84.32 Standard Design** *These requirements assume that the raw sludge is derived from ordinary domestic wastewater, a digestion temperature is to be maintained in the range of 850F to 950F (290C to 350C), 40 to 50 percent volatile matter in the digested sludge, and that the digested sludge will be removed frequently from the process.* | | | | | | | |
| When calculations are not prepared to justify the design based on the factors above, is the minimum digestion tank capacity designed as outlined below? | | | | |  |  |  |
| Type of mixing: |  | | | | | | |
| **84.321 Completely Mixed Systems** | | | | | | | |
| For digestion systems providing for intimate and effective mixing of the digester contents, is the system loaded up to 80 pounds of volatile solids per 1000 cubic feet of volume per day in the active digestion units? | | | | |  |  |  |
| **84.322 Moderately Mixed Systems** | | | | | | | |
| For digestion systems where mixing is accomplished only by circulating sludge through an external heat exchanger, is the system loaded up to 40 pounds of volatile solids per 1000 cubic feet of volume per day in the active digestion units? | | | | |  |  |  |
| Is this loading modified upward or downward depending upon the degree of mixing provided? | | | | |  |  |  |
| **84.323 Multistage Systems** | | | | | | | |
| For digestion systems utilizing two stages (primary and secondary units), is the first stage (primary) either completely mixed or moderately mixed and loaded in accordance with Paragraphs 84.321 or 84.322? | | | | |  |  |  |
| Is the second stage (secondary) designed for sludge storage, concentration, and gas collection and not credited in the calculations for volumes required for sludge digestion? | | | | |  |  |  |
| **84.324 Digester Mixing** | | | | | | | |
| Are facilities for mixing the digester contents provided where required for proper digestion by reason of loading rates or other features of the system? | | | | |  |  |  |
| If sludge recirculation pumps are used for mixing, are they provided in accordance with appropriate requirements of Paragraph 87.1? | | | | |  |  |  |
| ***84.4 Gas Collection, Piping, and Appurtenances*** | | | | | | | |
| **84.41 General** | | | | | | | |
| Are all portions of the gas system, including the space above the tank, liquor, storage facilities, and piping designed so that under all normal operating conditions, including sludge withdrawal, the gas will be maintained under pressure? | | | | |  |  |  |
| Are all enclosed areas where any gas leakage might occur adequately ventilated? | | | | |  |  |  |
| **84.42 Safety Equipment** | | | | | | | |
| Are all necessary safety facilities included where gas is produced? | | | | |  |  |  |
| Are pressure and vacuum relief valves and flame traps together with automatic safety shut off valves provided and protected from freezing? | | | | |  |  |  |
| Has water seal equipment not been installed? | | | | |  |  |  |
| Are safety equipment and gas compressors housed in a separate room with an exterior door? | | | | |  |  |  |
| **84.43 Gas Piping and Condensate** | | | | | | | |
| Does gas piping have a minimum diameter of four inches, with the exception of the pipe at the gas production meter which can be a smaller diameter? | | | | |  |  |  |
| Does gas piping slope to condensation traps at low points? | | | | |  |  |  |
| Are condensate traps controlled by something other than floats? | | | | |  |  |  |
| Are condensation traps protected from freezing? | | | | |  |  |  |
| Are tightly fitted self-closing doors provided at connecting passageways and tunnels that connect digestion facilities to other facilities to minimize the spread of gas? | | | | |  |  |  |
| Are piping galleries ventilated in accordance with Paragraph 84.47? | | | | |  |  |  |
| **84.44 Gas Utilization Equipment** | | | | | | | |
| Are gas boilers, engines, etc., located in well-ventilated rooms? | | | | |  |  |  |
| Are these rooms not classified as a hazardous location because they are isolated from the digestion gallery? | | | | |  |  |  |
| Are gas lines to these units provided with suitable flame traps? | | | | |  |  |  |
| **84.45 Electrical Equipment, Fixtures, and Controls** | | | | | | | |
| Does electrical equipment, fixtures and controls, in places enclosing and adjacent to anaerobic digestion appurtenances, where hazardous gases may accumulate comply with the National Electric Code for Class I, Division 1, Group D locations? | | | | |  |  |  |
| **84.46 Waste Gas** | | | | | | | |
| **84.461 Location** | | | | | | | |
| Are waste gas burners readily accessible and located at least 50 feet away from any plant structure? | | | | |  |  |  |
| Are waste gas burners of sufficient height and located to prevent injury to personnel due to wind or downdraft conditions? | | | | |  |  |  |
| **84.462 Pilot Light** | | | | | | | |
| Are all waste gas burners equipped with automatic ignition such as a pilot light or a device using a photoelectric cell sensor? | | | | |  |  |  |
| Has consideration been given to the use of natural or propane gas to ensure reliability of the pilot? | | | | |  |  |  |
| **84.463 Gas Piping Slope** | | | | | | | |
| Is gas piping sloped at a minimum of two percent up to the waste gas burner with a condensate trap provided in a location not subject to freezing? | | | | |  |  |  |
| **84.47 Ventilation** | | | | | | | |
| Are all underground enclosures connecting with digestion tanks or containing sludge or gas piping or equipment provided with forced ventilation for dry wells in accordance with Paragraphs 42.71 through 42.74 and 42.76? | | | | |  |  |  |
| Is the ventilation rate for Class I, Division 2, Group D locations including enclosed areas without a gas tight partition from the digestion tank or areas containing gas compressors, sediment traps, drip traps, gas scrubbers, or pressure regulating and control valves, if continuous, at least 12 complete air changes per hour? | | | | |  |  |  |
| Are switches for ventilation equipment marked? | | | | |  |  |  |
| **84.48 Meter** | | | | | | | |
| Is a gas meter with bypass provided to meter total gas production for each active digestion unit? | | | | |  |  |  |
| Is total gas production for two-stage digestion systems operated in series measured by a single gas meter with proper interconnected gas piping? | | | | |  |  |  |
| Is a gas meter provided for each primary digestion unit where multiple primary digestion units are utilized with a single secondary digestion unit? | | | | |  |  |  |
| Is the secondary digestion unit interconnected with the gas measurement unit of one of the primary units? | | | | |  |  |  |
| Is interconnected gas piping properly valved with gas tight gate valves to allow measurement of gas production from either digestion unit and maintenance of either digestion unit? | | | | |  |  |  |
| Are gas meters of the orifice plate, turbine, or vortex type? | | | | |  |  |  |
| Is the use of positive displacement meters avoided? | | | | |  |  |  |
| Is the meter specifically designed for contact with corrosive and dirty gases? | | | | |  |  |  |
| ***84.5 Digestion Tank Heating*** | | | | | | | |
| **84.51 Insulation** | | | | | | | |
| Are the digestion tanks constructed above groundwater level and suitably insulated to minimize heat loss? | | | | |  |  |  |
| Is there maximum utilization of earthen bank insulation? | | | | |  |  |  |
| **84.52 Heating Facilities** | | | | | | | |
| Is the sludge heated by circulating the sludge through external heaters or by units located inside the digestion tank? | | | | |  |  |  |
| **84.521 External Heating** | | | | | | | |
| Is piping designed to provide for the preheating of feed sludge before introduction into the digesters? | | | | |  |  |  |
| Are provisions made in the layout of the piping and valving to facilitate heat exchanger tube removal and cleaning of the lines? | | | | |  |  |  |
| Is heat exchanger sludge piping sized for peak heat transfer requirements? | | | | |  |  |  |
| Do heat exchangers have a heating capacity of 130 percent of the calculated peak heating requirement to account for the occurrence of sludge tube fouling? | | | | |  |  |  |
| **84.522 Other Heating Methods** | | | | | | | |
| Is the use of hot water heating coils affixed to the walls of the digester or other types of internal heating equipment that require emptying the digester contents for repair avoided? | | | | |  |  |  |
| If there is a new system or device developed to provide both mixing and heating, has it been reviewed on their own merits? **Provide operating data detailing their reliability, operation, and maintenance characteristics**. Refer to Paragraph 53.2. | | | | |  |  |  |
| **84.53 Heating Capacity** | | | | | | | |
| **84.531 Capacity** | | | | | | | |
| Is sufficient heating capacity provided to consistently maintain the design sludge temperature, considering insulation provisions and ambient cold weather conditions? | | | | |  |  |  |
| If digestion tank gas is used for other purposes, is an auxiliary fuel provided? | | | | |  |  |  |
| Is the design operating temperature in the range of 850F to 1000F (290C to 380C) where optimum mesophilic digestion is required? | | | | |  |  |  |
| **84.532 Standby Requirements** | | | | | | | |
| Has the provision of standby heating capacity or the use of multiple units sized to provide the heating requirements been considered? | | | | |  |  |  |
| Are acceptable alternative means of handling raw sludge provided for the extended period that a digestion process outage is experienced due to heat loss? | | | | |  |  |  |
| **84.54 Hot Water Internal Heating Controls** | | | | | | | |
| **84.541 Mixing Valves** | | | | | | | |
| Is a suitable automatic mixing valve provided to temper the boiler water with return water so that the inlet water to the removable heat jacket or coil in the digester can be held below a temperature at which caking will be accentuated? | | | | |  |  |  |
| Is manual control provided by suitable bypass valves? | | | | |  |  |  |
| **84.542 Boiler Controls** | | | | | | | |
| Is the boiler provided with suitable automatic controls to maintain the boiler temperature at approximately 1800F (820C) to minimize corrosion and to shut off the main gas supply in the event of pilot burner or electrical failure, low boiler water level, low gas pressure, or excessive boiler water temperature or pressure? | | | | |  |  |  |
| **84.543 Boiler Water Pumps** | | | | | | | |
| Are boiler water pumps sealed and sized to meet the operating conditions of temperature, operating head, and flow rate? | | | | |  |  |  |
| Are duplicate units provided? | | | | |  |  |  |
| **84.544 Thermometers** | | | | | | | |
| Are thermometers provided to show inlet and outlet temperatures of the sludge, hot water feed, hot water return, and boiler water? | | | | |  |  |  |
| **84.545 Water Supply** | | | | | | | |
| Has the chemical quality of the water supply been checked for suitability? | | | | |  |  |  |
| Is there a break tank for indirect water supply connections? Refer to Paragraph 56.23. | | | | |  |  |  |
| **84.55 External Heater Operating Controls** | | | | | | | |
| Are controls necessary to ensure effective and safe operation provided? | | | | |  |  |  |
| Are there provisions for duplicate units in critical elements? | | | | |  |  |  |
| ***84.6 Supernatant Withdrawal*** | | | | | | | |
| Does the design provide for ease of operation and positive control of supernatant quality where supernatant separation is used to concentrate sludge in the digester units and increase digester solids retention time? | | | | |  |  |  |
| **84.61 Piping Size** | | | | | | | |
| Is the supernatant piping no less than 6 inches in diameter? | | | | |  |  |  |
| **84.62 Withdrawal Arrangements** | | | | | | | |
| **84.621 Withdrawal Levels** | | | | | | | |
| Is the supernatant piping arranged so that withdrawal can be made from three or more levels in the tank? | | | | |  |  |  |
| Is an unvalved vented overflow provided? | | | | |  |  |  |
| Is the emergency overflow piped to an appropriate point and at an appropriate rate in the treatment process or side stream treatment units to minimize the impact on process units? | | | | |  |  |  |
| **84.622 Withdrawal Selection** | | | | | | | |
| On fixed cover tanks, is the supernatant withdrawal level selected by means of interchangeable extensions at the discharge end of the piping? | | | | |  |  |  |
| **84.623 Supernatant Selector** | | | | | | | |
| Is a fixed screen supernatant selector or similar type device limited for use in an unmixed secondary digestion unit? | | | | |  |  |  |
| If a supernatant selector is provided, are provisions made for at least one other draw-off level located in the supernatant zone of the tank, in addition to the unvalved emergency supernatant draw-off pipe? | | | | |  |  |  |
| Are high pressure back-wash facilities provided? | | | | |  |  |  |
| **84.63 Sampling** | | | | | | | |
| Are provisions made for sampling at each supernatant draw-off level? | | | | |  |  |  |
| Are sampling pipes at least 1.5 inches in diameter and do the pipes terminate at a suitably sized sampling sink or basin? | | | | |  |  |  |
| **84.64 Supernatant Disposal** | | | | | | | |
| Are supernatant return and disposal facilities designed to alleviate adverse hydraulic and organic effects on plant operations? | | | | |  |  |  |
| Is a separate supernatant side stream treatment system provided if nutrient removal (e.g., phosphorus, ammonia nitrogen) must be accomplished at the plant? | | | | |  |  |  |
| ***84.7 Anaerobic Digestion Sludge Production*** | | | | | | | |
| For calculating design sludge handling and disposal needs, are the sludge production values from a two-stage anaerobic digestion process based on a maximum solids concentration of 5 percent without additional thickening? | | | | |  |  |  |
| Are the solids production values on a dry weight basis based on the following listed processes?  Primary plus waste activated sludge: at least 0.12 lb/P.E./day  Primary plus fixed film sludge: at least 0.09 lb/P.E./day | | | | |  |  |  |

|  |
| --- |
| Justification for all questions answered with a “no |
|  |
| Additional comments: |
|  |

**References**

GLUMRB (2014 Edition) *Recommended Standards for Wastewater Facilities* (Ten State Standards), Health Research, Inc., Health Education Services Division, Albany NY.

Metcalf & Eddy, Inc. (2014) *Wastewater Engineering, Treatment and Resource Recovery*, 5th ed., McGraw-Hill, New York. (M&E 2014)

U.S. EPA (Revised July 2003) *Environmental Regulations and Technology, Control of Pathogens and Vector Attraction in Sewage Sludge,* U.S. EPA Office of Research and Development, National Risk Management Research Laboratory, Center for Environmental Research Information, Cincinnati OH. (U.S. EPA July 2003)

**Acronym definitions**

C Celsius

F Fahrenheit

ft3 feet cubed

ft3/cap/d cubic feet per capita per day

ft3/P.E./day feet cubed per population equivalent per day

lb/P.E./day pounds per population equivalent per day

lbs VSS/cf/day pounds of Volatile Suspended Solids per cubic foot per day

PSRP Processes to Significantly Reduce Pathogens

VSS Volatile Suspended Solids