

### 5.3.2.1 Effluent Limits/Technology-Based Effluent Limits/ Domestic Discharges/Secondary Treatment

#### **Applicability:**

This section outlines the standard procedure for setting Missouri State Operating Permit limitations for secondary treatment technology based limits.

#### **Content:**

Secondary treatment consists of biological treatment followed by clarification. Biological treatment uses microscopic organisms to reduce the organic component of the wastewater through metabolic activity. Clarification is the removal of the solid component of wastewater through settling.

The simplest secondary treatment process includes an aerobic biological treatment basin followed by a clarifier from which clarified liquid is discharged or further treated and then discharged. Most of the solids (sludge) settled in the clarifier is returned to the aerobic basin with a portion of the sludge periodically wasted for further treatment and disposal.

More complex secondary treatment processes include an anaerobic biological treatment basin followed by an anoxic biological treatment basin followed by an aerobic biological treatment basin. Liquid from the aerobic stage flows to a clarifier from which clarified liquid is discharged or further treated and then discharged. Most of the sludge settled in the clarifier is returned to the anaerobic basin with a portion of the sludge periodically wasted for further treatment and disposal. Aerated mixed liquor (i.e., wastewater containing a significant concentration of treatment microorganisms) from the aerobic basin is returned (recycled back) to the anoxic basin with the effect that this portion of the waste flow receives treatment for a second time. The aerobic basin contains significant amounts of free oxygen. The anoxic basin contains no free oxygen but does contain nitrogen in the oxidized forms (nitrates, nitrites). The anaerobic basin contains no free oxygen and the nitrogen is in the reduced form (ammonia). The use of anoxic and anaerobic components improves nitrogen and phosphorous removal with this additional biological treatment.

The Environmental Protection Agency (EPA) defines secondary treatment as the technology-based requirements for direct discharges from municipal sewage treatment facilities. These are performance-based requirements that were based on available wastewater treatment technology during the early 1970's. The Missouri Clean Water Commission Regulations incorporate the secondary treatment requirements into the effluent regulations (10 CSR 20-7.015); however, the minimum secondary treatment technology based limits do not apply in all circumstances. These limits are not allowed for discharges to geologically losing streams, discharges to groundwater, discharges within one-half (1/2) stream mile of classified lakes, or when a water quality review sheet or total maximum daily load has been prepared which shows more restrictive permit limits are required.

The standard secondary treatment technology based parameters are five-day biochemical oxygen demand (BOD<sub>5</sub>), five-day carbonaceous biochemical oxygen demand (CBOD<sub>5</sub>) as a substitute for BOD<sub>5</sub>, total suspended solids (TSS) also called nonfilterable residue (NFR), and pH. In addition to the standard permit limits, oil and grease, fecal coliform, Escherichia Coli (E. Coli), and total chlorine residual may also be required depending on the beneficial uses of the receiving stream. These additional limits are derived from information in the Water Quality Standards, in particular Table A.

Secondary treatment technology based limits listed below are standardized in Missouri Clean Water Commission (MCWC) regulations and in the U.S. EPA NPDES Permit Writers' Manual, EPA-833-B-96-003. Monthly and weekly limits for BOD5, TSS, and pH shown below are taken directly from the regulations. Daily limits are back calculated using standard U.S. EPA lognormal procedures. Carbonaceous biochemical oxygen demand limits are taken from EPA-833-B-96-003 and may be substituted for BOD5 when nitrogen removal processes are used. BOD5 and TSS minimum removal percentage are taken from EPA-833-B-96-003.

Parameter	Units	Effluent Limitation		
		Daily	Weekly	Monthly
		Maximum	Average	Average
Five-Day Biochemical Oxygen Demand (BOD5)(Note1)	mg/L	60	45	30
Five-Day Carbonaceous Biochemical Oxygen Demand (CBOD5)	mg/L	50	40	25
Total Suspended Solids (TSS) (Note 1)	mg/L	60	45	30
pH Range 6.0 to 9.0	SU	--	--	--

Note 1: A 30-day average percent removal of at least 85% is required for these parameters.

$$\% \text{ Removal} = \frac{(\text{influent flow})(\text{influent concentration}) - (\text{effluent flow})(\text{effluent concentration})}{(\text{influent flow})(\text{influent concentration})} \times 100$$

$$\frac{(\text{influent flow})(\text{influent concentration}) - (\text{effluent flow})(\text{effluent concentration})}{(\text{influent flow})(\text{influent concentration})} \times 100$$

If both influent flow and effluent flow are not available, removal can be approximated by:

$$\% \text{ Removal} = \frac{(\text{influent concentration}) - (\text{effluent concentration})}{(\text{influent concentration})} \times 100$$

Secondary treatment technology limits (except for pH ) can be expressed as mass limits instead of or in addition to concentration limits listed above. Mass limits must be based on design average day flow and the concentration limits listed above. An example is shown below for BOD5 limits for a 50,000 gallon per day (gpd) design average day flow.

$$\left( \frac{50,000 \text{ gal}}{\text{day}} \right) \left( \frac{3,735 \text{ L}}{\text{gal}} \right) \left( \frac{30 \text{ mg BOD}_5}{\text{L}} \right) \left( \frac{\text{LB BOD}_5}{153,590 \text{ mg BOD}_5} \right) =$$

= 12.52 LB BOD<sub>5</sub> / day monthly average

$$\left( \frac{50,000 \text{ gal}}{\text{day}} \right) \left( \frac{3,735 \text{ L}}{\text{gal}} \right) \left( \frac{45 \text{ mg BOD}_5}{\text{L}} \right) \left( \frac{\text{LB BOD}_5}{153,590 \text{ mg BOD}_5} \right) =$$

= 18.73 LB BOD<sub>5</sub> / day weekly average

$$\left( \frac{50,000 \text{ gal}}{\text{day}} \right) \left( \frac{3,735 \text{ L}}{\text{gal}} \right) \left( \frac{60 \text{ mg BOD}_5}{\text{L}} \right) \left( \frac{\text{LB BOD}_5}{153,590 \text{ mg BOD}_5} \right) =$$

= 25.03 LB BOD<sub>5</sub> / day daily maximum

## Legal References:

*Code of State Regulations:*

[10 CSR 20-7.015](#) Effluent Regulations

[10 CSR 20-7.031](#) Water Quality Standards

*Code of Federal Regulations*

[40 CFR 133](#) Secondary Treatment Regulation

## Other Links:

[2.3.1.1 Secondary Treatment](#)

[6.1.5.3 Analytical Detection Levels – Total Residual Chlorine](#)

[U.S. EPA NPDES Permit Writers' Manual](#)

## Key words:

Permit, operating permit, secondary treatment, technology based limits

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