TITLE 35: ENVIRONMENTAL PROTECTION

SUBTITLE C: WATER POLLUTION

CHAPTER II: ENVIRONMENTAL PROTECTION AGENCY

PART 373
THIRD STAGE TREATMENT LAGOON EXEMPTIONS

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AUTHORITY: Implementing and authorized by Section 39(a) of the Environmental Protection Act (Ill. Rev. Stat. 1989, ch. 111 1/2, par.

1039(a)).

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SUBPART A: INTRODUCTION

<BSection 373.101 Purpose>>

This Part describes information required in an application for lagoon exemption effluent limitations allowed by 35 Ill. Adm. Code 304.120(a) and (c). An approved lagoon exemption is required before the appropriate limitations can be specified in a National Pollution Discharge Elimination System (NPDES) permit.

<BSection 373.102 Definition of a Third Stage Treatment Lagoon Facility>>

A third-stage treatment lagoon is defined as a waste treatment facility employing an aerated or nonaerated waste stabilization lagoon alone or in conjunction with one or more additional treatment units in which the units are incapable of producing an effluent quality equal to or better than otherwise applicable effluent limitations of 35 Ill. Adm. Code 304.120 and water quality standards of 35 Ill. Adm. Code 302.

(Source Amended at 12 Ill. Reg. 3472, effective January 22, 1988)

<BSection 373.103 Eligibility>>

In accordance with the requirements of 35 Ill. Adm. Code 304.120(a) and (c), third stage treatment lagoon facilities must, in order to be eligible for consideration for a lagoon exemption, be properly constructed pursuant to 35 Ill. Adm. Code 370, and properly maintained and operated; cannot alone or in combination with other sources cause a violation of the applicable dissolved oxygen water quality standard of 35 Ill. Adm. Code 302.206; and must qualify under one of the following categories:

a) Any wastewater treatment works with an untreated waste load of less than 2,500 Population Equivalents (P.E.), which is sufficiently isolated so that combining with other sources to aggregate 2,500 P.E. or more is not practicable.

b) Any wastewater treatment works in existence and employing third stage treatment lagoons on January 1, 1986, whose untreated waste load is 5,000 P.E., or less and sufficiently isolated that combining to aggregate 5,000 P.E. or more is not practicable.

c) Any wastewater treatment works with an untreated waste load of 5,000 P.E., or less, which has reached the end of its useful life (see Section 373.205) by January 1, 1987, and is sufficiently isolated that combining to aggregate 5,000 P.E. or more is not practicable.

d) Any wastewater treatment works with an untreated wasteload of 5,000 P.E. or less which has not reached the end of its useful life and which has received an adjusted standard determination from the Board that it qualifies for a lagoon exemption. Such a Board determination will only be made in an adjusted standard proceeding, held in accordance with Section 28.1 of the Environmental Protection Act (Ill. Rev. Stat. 1989, ch. 111 1/2, par. 1028.1) and applicable by procedures set forth by 35 Ill. Adm. Code 106.

1) In an adjusted standard proceeding the Board may determine that the petitioning wastewater treatment source qualifies for a lagoon exemption if the wastewater treatment works proves that it is so situated that a land treatment system is not a suitable treatment alternative. Factors relevant to a suitability finding may include the following: cost; influent character; geographic characteristics; climate; soil conditions; hydrologic conditions; and the availability of irrigable land.

2) For the purpose of this subsection (d), a land treatment system is a wastewater treatment system which does not directly discharge treated effluent to water of the State but instead uses the treated effluent to irrigate terrestrial vegetation.

(Source: Amended at 14 Ill. Reg. 18289, effective October 30, 1990)

SUBPART B: FACILITY INFORMATION

<BSection 373.201 Application Requirement>>

In order to have the effluent limits stated in 35 Ill. Adm. Code 304.120(a) and (c) included in an NPDES permit, the discharger shall submit a written application to the Agency containing the information required by this Part. The application shall be on a form provided by the Agency.

<BSection 373.202 Facility Description>>

The application shall describe the facility including, at a minimum:

a) location,
b) design and operating data,
c) untreated waste load and effluent quality,
d) construction permit and NPDES permit information, and
e) useful life of the facility being replaced, if applying per Section 373.103(c), and
f) any proposed expansion or upgrading program.

(Source: Amended at 12 Ill. Reg. 3472, effective January 22, 1988)

<BSection 373.203 Population Equivalent Requirements>>

a) If applying per Section 373.103(a), the applicant shall show that the facility is presently receiving an untreated organic waste load of less than 2,500 P.E.
b) If applying per Section 373.103(b) or (c), the applicant shall show that the facility is presently receiving an untreated organic waste load of 5000 P.E. or less.
c) If the facility is treating a waste load of less than the applicable P.E. limit as specified in Section 373.103 but is designed to treat a greater load, this regulation may be applied until the facility begins to treat the allowed maximum waste load. A specific deadline which estimates when this loading limit will be reached shall be included in the permit.

(Source: Amended at 12 Ill. Reg. 3472, effective January 22, 1988)

<BSection 373.204 Sufficient Isolation Requirements>>

The applicant shall show that the facility is sufficiently isolated so that combining with other sources to aggregate 2,500 P.E. or more if applying per Section 373.103(a), or more than 5,000 P.E. if applying per Section 373.103(b) or (c), is not practical.

a) If the facility is not located in a designated facilities planning area the facility will be considered isolated.
b) If the facility is located in a designated facilities planning area which has less than the allowable total wastewater load, it will be considered isolated. If load forecasts suggest that the P.E. limit will be met within the design life of the facility, the

lagoon exemption will be granted for only a fixed period of time. At each permit renewal, the condition shall be reevaluated based on actual load increases.

c) If the facility is located in a designated facilities planning area with more than the allowable total wastewater load, the exemption shall be denied unless one or more of the following conditions are met:

1) The facility is a permanent feature of an approved facilities plan for the area.

2) The facility is an interim feature of an approved facilities plan, in which case the exemption shall be granted with termination conditions as provided for in the plan.

3) The facility was not addressed in an approved facilities plan, and all units of government which might be considered capable of providing service have indicated in writing their inability to do so on equitable terms.

4) There is no completed and approved facilities plan for the area and the discharge is not located within the area of zoning control of any municipality or within any sewer district or any other unit of government capable of providing sewer service. In this case, the isolation criteria shall be satisfied on an interim basis pending completion and approval of the facilities plan for the area. In such instances, a lagoon exemption may be issued for a specified time period, subject to review and extension or termination after approval of the completed facility plan.

(Source: Amended at 12 Ill. Reg. 3472, effective January 22, 1988)

<BSection 373.205 Useful Life>>

Applicants wishing to qualify for an exemption under Section 373.103(c) must complete a Useful Life evaluation. This evaluation must demonstrate that the existing facility has exceeded its useful life. Useful life is considered to be the time span over which a wastewater treatment facility can be expected to be economically operated and maintained. Useful life is distinctly different from design life. Publicly owned treatment works constructed with the assistance of a federal or state construction grant must, at the minimum, be operated and maintained for the design life of the project (typically 20 years). The Useful Life requirement is intended to prevent the premature retirement of facilities capable of meeting the more stringent effluent limits of 10mg/1 BOD and 12 mg/1 total suspended solids. The evaluation is also intended to assess the Useful Life of individual components of the existing facility, so that any salvageable components are incorporated into the proposed facility for which an exemption is requested should it prove to be cost-prohibitive to continue to meet the more stringent limits. This ensures that the highest degree of treatment possible is provided, in the most cost-effective manner. Applicants will provide the following information:

a) Determine the structural integrity of the individual units in the existing facility.

b) Review the operations and maintenance record for past performance.

c) Relate Subsections (a) and (b) to the expected life cycle for the individual units. USEPA provides the following general guidelines for life cycle: conveyance structures (piping) -- 50 years; process equipment -- 15 to 20 years; buildings and concrete tanks -- 30 to 50 years; auxiliary equipment -- 10 to 15 years.

d) Determine the present worth cost to continue use of the existing facility over a 5, 10 and 20 year planning period using standard engineering economic analysis. Sunk costs are not included in this analysis. Relate this cost to user charges.

e) Describe alternatives to using the existing facility, ranging from addition of one or more lagoon cells in conjunction with upgrading of existing facilities to the construction of an entirely new lagoon system. Determine the present worth costs of these alternatives over the same planning horizons. Relate these costs to user charges.

(Source: Added at 12 Ill. Reg. 3472, effective January 22, 1988)

SUBPART C: STREAM INFORMATION

<BSection 373.301 Critical Length>>

The applicant shall provide information about the stream to which the facility discharges. This information shall describe the stream for its critical length as determined by the procedure outlined in Appendix A.

<BSection 373.302 Stream Description>>

The applicant shall provide the following information at a minimum:

a) The name of the receiving stream and the progression of higher order streams it flows into, up to and including the major river basin;

b) The location of the point of discharge by county and United States

Geological Society (USGS) coordinates;

c) A copy of the most recent 7.5 or 15 minute USGS topographic map, showing the entire critical stream length, the point of discharge for which the exemption is being requested and the discharge point of other dischargers if known;

d) A description of the stream's physical characteristics including substrate, channel obstructions, bank condition, and degree of meandering. This description shall also include a statement of the presence or absence of sludge or organic deposits of unnatural origin in amounts that are likely to elevate sediment oxygen demand above background levels for similar streams in the vicinity; and

e) The name, location, design average flow rate and NPDES permit limitations of other wastewater sources (if any) which may influence the critical length of the receiving stream.

<BSection 373.303 Smaller Facilities>>

a) Facilities which meet the following conditions need not perform the analysis required by Section 373.304:

  1) The facility must be designed for a waste load less than 750 P.E., and

  2) The critical length of stream below the discharge is not subject to significant sediment oxygen demand from bottom deposits as described in Section 373.302(d).

b) After review of the application for smaller facilities the Agency shall require further stream study if warranted by local conditions including:

  1) the impact of other dischargers on the stream,

  2) the stream use designation or stream segment classification, or

  3) other characteristics that would limit the assimilative capacity of the stream.

<BSection 373.304 Stream Assimilative Capacity>>

a) Unless conditions as described in Appendix D indicate otherwise, the applicant shall use the Modified Streeter-Phelps Equation contained in Appendix B to predict the influence of the treated wastewater discharge on the dissolved oxygen profile of the receiving stream.

b) The critical conditions for estimating the stream assimilative capacity shall include:

1) the 7-day 10-year low flow value,
2) ambient BOD concentration,
3) ambient total ammonia nitrogen concentration,
4) ambient dissolved oxygen concentration,
5) the lagoon system discharge at its design average flow rate and design effluent quality,
6) expected maximum stream temperature, and
7) other hydraulic parameters as described in Appendix C.

<BSection 373.305 Model Limitations>>

If the limiting factors described in Appendix D are present in the stream, the exemption shall be denied.

<BSection 373.APPENDIX A Maximum Critical Length>>

The maximum critical length of a receiving stream is the distance (downstream from the wastewater source) required at 7-day 10-year low flow to reestablish an instream BOD5 of 5 mg/l. The amount of time required to reestablish the 5 mg/l BOD 5 is termed the critical time of travel. The maximum critical length can be estimated by computing the maximum critical time of travel, which can be approximated using the following equation:

tc <Plesser than>> -1/Kc ln (5)/Ef

ln = natural logarithm function
Ef = BOD5 initially present in the stream
Kc = carbonaceous decay constant
tc = maximum critical time of travel

This relationship assumes that BOD5 decays according to ordinary first order reaction kinetics.

<BSection 373.APPENDIX B Modified Streeter-Phelps Equation>>

The Modified Streeter-Phelps Equation mathematically defines the relationship between carbonaceous oxygen demand, nitrogenous oxygen demand, natural stream reaeration and the dissolved oxygen deficit as a function of time:

D = KcLac/K2-Kc (e -Kct -e -k2t)

+ KnLan/K2-Kn (e -Kn(t-tO) -e -K2 (t-tO))

$$+D_a e^{-K_2 t}$$

Definition and discussion of terms:

a) D = Dissolved oxygen deficit; units = mg/l; defined as the difference between the dissolved oxygen concentration at saturation and the actual instantaneous dissolved oxygen concentration at time t, i.e.,

D = D.O.(sat) - D.O.(actual). From this relation, the stream dissolved oxygen concentration can be computed for various times-of-travel (t's) downstream and plotted on a graph of t vs. D.O.(actual).

b) Kc = carbonaceous decay constant; units = 1/day; this constant describes the rate at which carbonaceous BOD is utilized in a stream. Its value may be determined experimentally for a specific effluent and a specific stream. The actual value of Kc depends essentially upon the origin and strength of the wastewater, the type of treatment that wastewater has undergone, as well as various stream characteristics.

The following guidelines may be used for selection of a Kc value for various applications:

1) Effluents containing up to and including 10 mg/l BOD5: 0.10

2) Effluents containing between 10 and 30 mg/l BOD5: 0.30

3) Virtually all effluents may be tested using an appropriate experimental procedure for a more precise determination of Kc.

c) Lac = ultimate carbonaceous demand; units = mg/l; this term may be calculated once the BOD5 and Kc are known by use of the following equation:

$$Lac = <P \; \frac{Ef}{1 - e^{-5Kc}} \; >>$$

In this equation, Ef is the treatment works effluent BOD5.

d) $K2$ = stream reaeration constant; units = 1/day; this constant describes the rate at which atmospheric oxygen diffuses into the water of a flowing stream. Its value depends upon the hydraulic and geometric properties of the stream in question. Many investigators have developed equations to predict $K2$. The equation given below has been shown to yield results which best fit the field observations of many researchers over a wide variety of stream types:

$$K2 = \frac{(110.5H = 0.5832V2)<P(SV)0.375>>}{H2}$$

In this equation, "H" is average depth of flow in feet, "V" is stream average velocity in feet per second, and "S" is the dimensionless parameter, stream slope, ft./ft. Velocity and average depth of flow may not be estimated but must be field measured at the 7-day 10-year low flow stream condition or computed from field measurements of stream geometry (cross sections and slopes using ordinary principles of open-channel hydraulics). Significant changes in stream geometry will change average velocity and average depth of flow. $K2$ must be computed for each stream segment as defined in Appendix C.

e) e = the Naperian logarithm base, dimensionless; $e = 2.71828...$

f) t = time; units = days.

g) Kn = nitrogenous decay constant; units = 1/day; this constant describes the rate at which nitrogenous BOD is utilized in a stream. Its value may be determined experimentally for a specific effluent and a specific stream. Previous experimental work has established a range of typical values for Kn of 0.25 to 0.37 per day with an average of 0.29 per day. It should be noted that the higher values of Kn yield generally more conservative results when applied to the Streeter-Phelps Equation.

h) Lan = ultimate nitrogenous demand; units = mg/l; this term may be calculated, once the initial ammonia nitrogen concentration is established, by use of the following formula:

$$Lan = 4.57 \text{ (Amm-N concentration in mg/l).}$$

i) tO = nitrogenous lag time; units = days; when a waste contains both carbonaceous and nitrogenous oxygen demand, there is usually a time lag before the onset of nitrogenous oxygen demand. The time lag may typically vary from 0-10 days with its actual value dependent upon the complex chemical characteristics of the waste as well as various stream characteristics. The value of tO may be experimentally determined where effluent or stream field measurements are practicable. In the case of well nitrified effluents, the value of t0 may generally be considered to be less than 1 day. Note that for t less than t0 the nitrogenous term,

<PKnLan>> (e-Kn(t-t0) -e-K2 (t-t0))
K2-Kn

does not enter into the calculation of D.

j) Da - initial dissolved oxygen deficit; units = mg/l. Determined by subtracting assumed effluent dissolved oxygen concentration of 6.0 mg/l from dissolved oxygen saturation value at the expected maximum stream temperature.

Temperature Adjustments

KC,K2,Kn and Lac are temperature dependent quantities. The values calculated in accordance with the above are 20 degree Celsius values. Since the saturation D.O. decreases with increasing temperature, it will be necessary to adjust the parameters KC,K2,Kn and Lac to reflect the expected maximum stream temperature condition. In the equations listed below, T is the expected maximum stream temperature in degrees Celsius.

a) Kc(T) = Kc x 1.047(T-20)

b) K2(T) = K2 x 1.024(T-20)

c) Kn(T) = Kn x 1.047(T-20)

d) Lac(T) = Lac (0.02T + 0.6)

Since the time of the year at which the 7-day 10-year low flow occurs typically varies from stream to stream, it is not possible to prescribe a uniform maximum temperature adjustment throughout the state. The maximum temperature should be ascertained from field measurements in the stream at the time of year at which 7-day 10-year low flow is expected to occur. IEPA ambient water quality monitoring network data are available for making such determination. This data may be obtained by contacting the Division of Water Pollution Control.

(Source: Amended at 8 Ill. Reg. 3286, effective March 7, 1984)

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<BSection 373.APPENDIX C Hydraulic Parameters>>

In order to utilize the modified Streeter-Phelps dissolved oxygen model specified in Section 373.304, it is necessary to determine specific hydraulic parameters including mean stream depth, mean stream velocity and time of travel. These factors can be estimated for the critical 7-day 10-year low flow condition through basic open-channel hydraulic calculations (Manning Equation) for each stream segment.

The critical stream length must be divided into one or more segments of uniform hydraulic, geometric and water quality characteristics. The characteristics of importance in this analysis include volumetric flow rate, average stream velocity, depth and width of flow, stream slope, channel geometry, and BOD and total ammonia nitrogen concentrations. As a rule of thumb, therefore, a new segment should begin where:

a) there is a wastewater discharge to the stream,
b) the stream channel undergoes a change in slope or cross sectional geometry, or
c) stream flow increases through addition of another point source discharge, or confluence with another stream with non-zero 7-day 10-year low flow.

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<BSection 373.APPENDIX D Model Limitations>>

The Modified Streeter-Phelps Equation used in this Part should not be construed as a precise predictive model but rather as a means of demonstrating adequate receiving stream assimilative capacity under estimated worst-case conditions. Even for a general application of this type, there are inherent limitations to the model that will preclude its utilization in some instances.

The modified Streeter-Phelps Equation constitutes a steady state, one dimensional model and as such is limited in its application to free flowing stream systems that can be reasonably well represented as steady state, one dimensional systems. Once mixing of the wastewater discharge and natural stream flow is accomplished, there should be minimal vertical or lateral variation (throughout a given stream cross section) of key factors such as waste concentration, temperature, and carbonaceous and nitrogenous bacteria population density. In most free flowing streams in Illinois (even with predominantly pool/riffle morphology) this should not be a limitation.

However, lakes, ponds, stream segments impounded by man-made structures or natural impediments, streams with unstable channel characteristics, swamps and marshes are all examples of systems that may not be successfully modeled with the Modified Streeter-Phelps Equation. Likewise, systems with wide variations in temperature, flowrate or organic loading may not reach a steady state condition conducive to model application. The applicant should be aware of these limitations when applying the model to a particular situation.
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