THIS POLICY DOES NOT HAVE THE FORCE OF LAW

GUIDELINES FOR TREATMENT PROCESS RATINGS AT PRECIPITATIVE (e.g.,LIME) SOFTENING GROUND WATER TREATMENT PLANTS

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I. PURPOSE:

The purpose of this policy is to clarify the requirements of certain provisions of Ohio Revised Code Section (ORC) 6109.07 and Ohio Administrative Code (OAC) Rules 3745-82-02 and 3745-91-08. More specifically, the purpose is to establish the standard design criteria for clarifier, filter and other precipitative softening treatment process loading rates and the requirements necessary to justify higher treatment process rates than the standard design criteria provided in this policy. These guidelines shall not affect existing process loading rates approved by the director of the Ohio EPA.

It is intended that the successful application of these guidelines will result in the design of a treatment system that will provide stable water onto the filters and a drinking water of consistent softened water quality at reasonable cost. It must be recognized that additional treatment may be required to address other water quality problems such as microbial treatment, taste and odor, color, disinfection byproduct formation, organics removal, or other contaminants which might be present.

II. BACKGROUND:

There are no Ohio Primary or Secondary Drinking Water Rules that specifically address hardness. Secondary Drinking Water Rule 3745-82-02 of the Ohio Administrative Code (OAC) has been established that recommends the finished water be non-corrosive. Therefore, the public water system is expected to develop its own softened water quality goals that may be periodically changed. It is good engineering practice that the water treatment plant be designed and operated to meet those goals in the best interest of the customer.

Before beginning construction or installation of a public water system, or making a substantial change in a public water system, the owner of the system must obtain approval of plans for such construction or changes from the director of the Ohio EPA in accordance with ORC Section 6109.07. OAC Rule 3745-91-08 provides procedures for approval of such plans and OAC 3745-91-08(A) requires that guidance for designers prepared by the Ohio

EPA to be used as a guide in the review of plans for public water systems. The objective of the guidelines provided in this policy is to achieve consistency throughout the State of Ohio in administering these provisions of the Revised Code and Administrative Code to achieve treatment system designs for precipitative softening ground water treatment plants that cost-effectively provide stable water onto the treatment system's filters and a drinking water of consistent softened water quality. This will be accomplished by establishing standard design criteria as guidance for designers of treatment processes and procedures for demonstrating the efficacy of designs that vary from the standard design criteria. These standard design criteria and demonstration study criteria will be used by the Ohio EPA as a guide in the technical review of plans submitted for approval.

As identified in OAC 3745-91-08(A), other applicable guidance includes The Great Lakes Upper Mississippi River Board of State and Provincial Public Health and Environmental Managers**,** Recommended Standards for Water Works 1997 (TSS).

III. POLICY:

Rates for treatment processes at precipitative softening ground water treatment plants shall be determined in accordance with the following procedures.

IV. PROCEDURE:

1.0 GENERAL CRITERIA

1.1 The accepted design parameters (e.g., surface overflow rate, launder loading (weir overflow) rate, flow-through velocity, detention time, etc.) with all treatment units in service are those listed in TSS and standard engineering references as follows:

Rapid Mix (If a coagulant is used)

Detention time.....≤ 30 sec

G value.....Adequate to keep lime particles dispersed, or ≥ 900 sec -1 at minimum water temperature *

Mechanical Flocculation

Detention time.....≥ 30 minutes

G value.....20 to 70 sec -1

Settling Basins

Surface loading rate.....≤ 0.75 gpm/sf *
Flow-through velocity.....≤ 0.5 fpm *
Length:width ratio.....≥ 3:1 *

Launder loading (weir overflow) rate.....≤ 20,000 gpd/lf
Detention time.....≥ 2 hrs

Solids Contact Clarifiers

Upflow rate.....≤ 1.75 gpm/sf
Launder loading (outlet weir overflow) rate.....≤ 20 gpm/lf
Detention time
Flocculation zone.....≥ 30 min *
Clarification zone.....≥ 2 hrs *

Catalytic Fluidized Bed Reactors (for Calcium Removal Only)	
Reaction Zone Upflow Rate (at bottom of reactor)	50 to 200 GPM/SF*
Total Detention Time	6 to 12 Min*

Stabilization Units

1. Recarbonation Basins

Detention time	
Total	≥ 20 min
Mixing compartment	≥ 3 min
Diffuser submergence	≥ 7.5 ft

2. Other, as justified by an engineering submission

It is recommended that water treatment plants which provide high pH softening (>10.4) be designed for two stage softening.

Clearwell

Detention time	> 30 min *

* Or as justified by an engineering submission.

1.2 The total approved filtration capacity is based on a filtration rate for a single media sand or anthracite filter of 2 gallons per minute per square foot (gpm/sf) of filter area with all filters in service. For approved dual media or multimedia filter beds the provisional rate is 4 gpm/sf of filter area with one filter out of service; after 12 months of compliance with the approval criteria in Section 3.1.1 of this guideline this rate will become permanent in accordance with Section 3.4.

1.3 Approval of design parameters varying from those referenced in paragraph 1.1, or filtration rates higher than those rates in paragraph 1.2, for either new treatment plants or upgrading existing treatment plants, shall require an approved demonstration study.

1.4 A demonstration study shall be performed, using an existing, full-scale treatment plant or, if this is impractical, a pilot-scale unit.

1.5 Demonstration studies are classified into three categories:

1.5.1 The use of a complete, pilot-scale treatment plant for those cases in which there is no existing, full-scale water treatment plant. (Note: In this case the pilot plant shall be equipped with a minimum of one stabilization unit and two filters.)

1.5.2 The use of a pilot-scale clarifier, stabilization unit and/or filter unit operated at higher rates for comparison with the full-scale clarifier(s) and/or filters of an existing water treatment plant.

1.5.3 The isolation of full-scale clarifier(s) and/or filter(s) at an existing water treatment plant operated at higher rates for comparison with all or some of the remaining full-scale clarifiers and/or filters. It may be necessary to install a pilot-scale, stabilization unit and filter to the high-rate clarifier where the clarifier to be high rated does not discharge to particular stabilization units and filters.

1.6 Prior to performance of a demonstration study for an existing full-scale water treatment plant**,** the following criteria must have been met for the previous 12 months of operation of the water treatment plant:

1.6.1 Filtered water shall have met the performance goals of Section 3.0 of this guideline at the existing loading rate.

1.6.2 Gross water production or production efficiency or settled water turbidities shall comply with the limits contained in the "Guidance for Surface Clarification and Filtration" document.

1.7 Additional requirements that must be met prior to performing a demonstration study for an existing treatment plant are:

1.7.1 The water treatment plant shall be under the responsible charge of a properly certified operator.

1.7.2 All equipment shall be maintained in good condition.

1.7.3 The filter media bed depths, effective sizes and uniformity coefficients in the proposed full-scale control and high-rate demonstration filters shall comply with the current TSS or latest EPA approval.

2.0 DEMONSTRATION STUDY CRITERIA

2.1 Prior to the performance of a demonstration study, a plan shall be submitted and approved. The plan shall include:

2.1.1 Results from analysis of raw water quality data for the previous 12-month period, if any are available.

2.1.2 Statement of objectives and conclusions from an evaluation of the raw water quality identifying critical conditions to be evaluated during the demonstration study.

Ohio EPA/Industry Suggested Goals**:** A single target value should be established for each of the following finished water parameters. The variation from each target value should be limited to the ranges shown in 3.1.2.

Finished Water Goals	
Total Hardness	80 to 150 mg/l as $CaCO_3$
Magnesium	<40 mg/l as $CaCO_3$ where Mg removal is provided
Total Alkalinity	<80 mg/l as $CaCO_3$
Phenol Alkalinity	<40 mg/l as $CaCO_3$
pH (Secondary MCL)	7.0 to 10.5

Turbidity	<0.5 NTU

Operational Goals	
Average Total or carbonate Alkalinity Drop Across Filters	<5 ÷ [filter loading rates in gpm per square foot] in mg/l as $CaCO_3$
Filter Influent Marble Test	-2 to +2 mg/l as $CaCO_3$
Gross Water Production	>5000 gal/sf of filter area

2.1.3 Schematic drawings and detailed descriptions of the facilities to be used.

2.1.4 Mode(s) of operation to be tested.

2.1.5 Time schedules for each mode of operation, in relation to the critical conditions to be evaluated (Item 2.1.2).

2.1.6 Sampling locations to be monitored.

2.1.7 Parameters to be monitored at each sampling location.

2.1.8 Frequency of monitoring for each parameter.

2.1.9 Description of on-line and bench analytical equipment to be used for monitoring each parameter.

2.1.10 Quality assurance/quality control procedures to be used.*****

2.1.11 Description of analyses to be used for evaluating the data collected.*****

2.1.12 Discussion of how the system will be able to provide adequate quantities of water meeting applicable water quality standards when one clarifier is taken out of service for normal maintenance or for emergency repair.

*****May refer to "Laboratory Manual for Chemical Analyses of Public Drinking Water"

2.2 A demonstration study shall provide for at least eight consecutive days (or 200 intermittent hours) and 100 treated water data sets of operating data at the current approved rate and the proposed high rate, and some lesser period at some higher rate. The purpose for operation at a rate higher than the proposed high rate is to provide an indication of a safety factor during operation at the proposed high rate. The selection of the time frame(s) is to be based on raw water quality data as indicated in Item 2.1.5 and the intended mode of operation of the proposed full scale treatment plant.

If satisfactory results in accordance with 3.1.1.2 are not obtained over the above study period, the study of the stabilization units and filters may be extended to up to 12 months. The clarifiers will be required to be operated only at achievable rates during the extended period.

The above study periods shall be exclusive of any mobilization, initial or shake-down periods. An initial or shake-down study period, preceded by jar testing, is recommended to determine chemical dosages and other treatment conditions that result in effective treatment.

2.3 In case of existing, full-scale water treatment plants, at least one control clarifier and/or filter should be operated at the currently approved rate. Alternating periods of operating a clarifier at the control**,** high-rate and some higher rate may be considered.

2.4 The data collected during the demonstration study shall be agreed to prior to initiation of the study:

2.4.1 OHIO EPA RECOMMENDS THE FOLLOWING PARAMETERS, AND MONITORING FREQUENCIES:

	RAW	**CLARIFIER EFFLUENT***	**FILTER INFLUENT***	**FILTER EFFLUENT***
CALCIUM	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS
MAGNESIUM	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS
TOTAL HARDNESS	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS
TOTAL ALKALINITY	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS
PHENOL ALKALINITY	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS
pH	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS
TURBIDITY	DAILY	EVERY 2 HOURS	EVERY 2 HOURS	EVERY 2 HOURS

TEMPERATURE	WEEKLY	---	---	---
LOSS OF HEAD	---	---	EVERY 2 HOURS	EVERY 2 HOURS
MARBLE TEST	WEEKLY		DAILY	DAILY

* May be reduced after 3 consecutive days of maintaining results within the ranges listed in 3.1.2 to first and last hour of the operating day and every 4 hours between for plants operating less than 24 hours per day, or every 4 hours for plants operating 24 hours per day. It is recommended that this data be collected hourly during the shake-down period of the study in order to establish stable treatment.

2.4.2. Acid solubility test of multiple samples (AWWA Std. B100-89, 3.3.1), control and test filter media before and after study. Collect at least ten 1.5 inch diameter filter media cores evenly spaced throughout the filter. Mix the samples and divide out at least a two liter sample. Return remainder to the filter.

2.4.3. Gross water production of each filter run.

2.5 Data analysis shall consist of at least:

2.5.1 Data analysis to be provided shall be agreed to prior to initiation of the demonstration study. Ohio EPA recommends that graphs of each parameter vs. time for raw, softened and finished water should be submitted for each of the flow rates being tested. A statistical analysis of each day, week and month should be provided for each parameter and sampling location providing at least the average, maximum and minimum values for each period.

3.0 APPROVAL CRITERIA FOR HIGH-RATE CLARIFICATION AND/OR FILTRATION

3.1 The applicant shall submit a proposal which presents the performance goals to be achieved, the data to be collected and the analyses to be done. Prior to the initiation of the study the applicant and Ohio EPA shall agree upon these items.

3.1.1 OHIO EPA RECOMMENDS THAT THE WATER TREATMENT PLANT MEET ANY ONE OF THE FOLLOWING FOUR CRITERIA:

3.1.1.1 Filter media growth shall be less than five percent (5%) per year on an annual basis, based on acid solubility testing as detailed in Section 2.4; or

3.1.1.2 The average total or carbonate alkalinity drop (in mg/l as $CaCO_3$) through the filters shall be no more than 5 divided by the filter loading rate in gpm. This limits the deposition per square foot through the filter, and the media growth rate to five percent per year. The mass of deposition per square foot of filter area can be calculated as

alkalinity drop X filter loading rate
X length of operation.

For a 54 inch depth of media (30 inches of filter media plus 24 inches of support), this mass can be converted to the amount and percent of media growth over the length of operation.

3.1.1.3 The applicant shall agree to document through annual probing and sieve analysis that the filter media in each filter is within the approved effective size range and uniformity coefficient range specifications; or

3.1.1.4 The applicant shall agree to document replacement of the filter media every three years.

Alternative criteria may be considered based on documentation provided by the applicant

3.1.2 Two standard deviations or 95% of the data points for the following filtered water quality parameters shall have a maximum variation from the high rate performance goals as indicated below:

pH value	$\pm$0.3 s.u.
Total Hardness	±10%
Total Alkalinity	±25%
Total Magnesium	±30% (where Mg removal treatment is provided)

3.2 A report shall be submitted in which the data collected, results of the data analysis, and the conclusions and recommendations are presented and clearly summarized. Data shall also be submitted in ASCII electronic format. The report shall also include all other data collected during startup prior to the demonstration study, or other operation periods.

For each operation mode performed during the demonstration study, the pertinent parameters (raw water source, lime dose, pH, etc.) should be clearly defined and presented in the report.

3.3 Gross water production or production efficiency or settled water turbidities shall comply with the limits contained in "Guidance for Surface Clarification and Filtration" document.

3.4 Provisional ratings (See 1.2) shall become final after operating at least one treatment train at the provisional rate for at least one year achieving agreed upon goals. Upon satisfactory submission of acceptable data, a confirmation letter shall be issued by the Engineering Group of the Ohio EPA Division of Drinking and Ground Waters making the provisional rate permanent.

4.0 Conflict Resolution

Will be resolved following the procedures as specified in the "Ohio EPA Plan Review Procedures for Drinking Water Facilities" document.

V. HISTORY

This policy was finalized on December 8, 1999.