POTABLE WATER TREATMENT AND CONDITIONING FACT SHEET

WPDES Permit No. WI-0046540-5
April 2007
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GENERAL PERMIT COVERAGE

General Permits (GP) are designed to cover discharges from a class of facilities or industries that are similar in nature. When a GP is issued, all facilities meeting its requirements are covered by the GP. GP's currently exist for groundwater remediations, nonmetallic mining operations, swimming pools and numerous other types of facilities. For facilities that are eligible for coverage under a GP, the Department sends a cover letter and a copy of the permit to the facility. The cover letter includes the Department's determination that a facility's discharge is covered under the GP and may specify alternate requirements outlined in the permit such as modified sampling frequencies for certain parameters or the inclusion of monitoring for parameters in addition to those requiring regular monitoring.

MORE THAN ONE GP CAN APPLY

A facility may need to be covered under more than one GP, depending on the different types of wastestreams that a facility discharges. A facility that manufactures concrete block could also mine gravel on site. The wastewater from the concrete block operation could be discharged in compliance with one GP and the wastewater from the gravel mining operation could be discharged in compliance with a different GP. However, a facility that requires an individual permit for any part of its discharge may have all of its discharges covered under an individual permit. An obvious exception would be for a facility that commences a discharge that is eligible for a GP, after an individual permit has already been issued or reissued for the facility. For example, a facility that currently has an individual permit may begin a process that results in the discharge of noncontact cooling water. The noncontact cooling water discharge can be covered under a GP, as long as it meets the requirements of the GP, until the individual permit can be reissued or modified to include the noncontact cooling water discharge.

GENERAL DESCRIPTION OF OPERATIONS COVERED UNDER THIS GP

Water treatment and conditioning operations eligible for this general permit include, iron/manganese filters, demineralizers, lime softening, alum coagulation units, granular media filters, and reverse osmosis units. Discharges from treatment systems not specifically mentioned that can meet the requirements of this permit are also covered under this permit. An example of a type of a treatment technology that could possibly be covered under this permit is microfiltration. However, more information is needed on

discharges from these types of systems to determine if they meet the requirements of this permit. In addition, not all wastewater discharges from these operations mentioned are eligible for this general permit. For example, in areas where radium or arsenic is present in the water supply, any of the treatment systems listed as applicable in this permit may concentrate radium or arsenic to a point where it becomes a human health or water quality concern and is not properly regulated by this GP. It should also be noted that sodium or potassium cycle ion exchange softening is not covered by this GP.

Iron/manganese Filters

Iron/manganese may be present in water as colloidal iron/manganese, soluble ferrous iron/manganese, or a chelated compound. Colloidal iron/manganese can be removed by coagulation, flocculation and precipitation or filtration. Removal of soluble ferrous iron/manganese and chelated compounds requires oxidation to form a precipitate. Oxidation can be accomplished by aeration, chlorine, hypochlorites, chlorine dioxide, or potassium permanganate ($KMnO_4$). Adjusting the pH optimizes the precipitation by balancing solubility and oxidation potential. Precipitation of ferric hydroxide is impeded when the pH of the water is less than 7.8. Lime, soda ash or other caustic may be added to raise the pH. The precipitated insoluble iron/manganese can be removed by settling or filtration.

Aeration is usually followed by filtration through a mixed media filter for removal of solids. Depending on the precipitate formed and the quality of water needed, polymer may be required for coagulation and flocculation. With large volumes of solids, the filter may be preceded by a clarifier or other type of settling tank.

Oxidation by $KMnO_4$ is performed in the presence of a manganese catalyst. The manganese dioxide is affixed to a "green sand" (either naturally occurring sodium-aluminum silicates or anthracite coated sands). There are two common methods of oxidizing the iron/manganese and regenerating the manganese dioxide. For home service units such as Culligan operations, the manganese dioxide is batch regenerated with a high concentration of $KMnO_4$. As the iron/manganese passes through the sand, the manganese dioxide oxidizes the iron/manganese and the precipitate is filtered out. For municipal water supplies, $KMnO_4$ is continuously fed to the water at a low concentration prior to the filter. The $KMnO_4$ directly oxidizes the iron/manganese and the precipitate is filtered out. If too little $KMnO_4$ is used, the manganese dioxide will oxidize the iron/manganese. If too much $KMnO_4$ is used, it will regenerate the manganese dioxide.

Wastewaters generated from iron/manganese filtration include iron/manganese filter backwash, settling tank decant water preceding cleanout and $KMnO_4$ regeneration waste from batch regeneration. The solids released during filter backwash are easily removed by simple settling equipment. The water decanted from settling equipment can be controlled to prevent discharge of suspended solids.

The filter backwash from continuously regenerated iron/manganese filters is performed using water supply water dosed with the normal level of $KMnO_4$. These systems are

operated so that no pink color (representative of the detectable concentration of $KMnO_4$) is present in the backwash discharge.

The regeneration waste (and rinse water) from batch regeneration contains extremely high concentrations of $KMnO_4$. This waste can be captured and reused, or discharged to a sanitary sewer. There are two other acceptable alternatives:

> The waste can be discharged to septic system designed to handle domestic wastewater. There are several factors that will mitigate the oxidizing effect of the $KMnO_4$ on the wastewater treatment organisms. Typically, 2-4 ounces of saturated $KMnO_4$ solution is used to regenerate one cubic foot of green sand. The solution reacts with the substances that have attached to the sand granules during the service period. If the filter settings (dosing rate/period, regeneration interval, etc.) are properly adjusted, there will be minimal residual unreacted $KmnO_4$ going out to the septic system. Even if there was some unreacted $KmnO_4$ going out, 80% of the overall regenerant is backwash. This greatly dilutes the remaining unreacted solution. Even if the diluted solution got into the system unreacted, it would immediately react with the organic matter, thus eliminating its biocidal effect.
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> The waste can also be allowed to seep into the ground, provided there is no potential for runoff of the waste to a surface water. Additionally, the seepage area should not create a nuisance condition, such as burned or discolored vegetation.

Under no circumstances can a batch regenerated iron/manganese filter using $KmnO_4$ be allowed to discharge to a surface water, because of the toxicity of this strong oxidizing agent to aquatic and other biological life.

Demineralizers

Demineralizers are ion exchange units that use acids, bases, or salts to regenerate the exchange resins. Sodium or potassium cycle ion exchange units are not covered by this GP. The hydrogen-ion exchangers have cation-exchange resins that can be regenerated with sulfuric or hydrochloric acid. The hydroxide-ion exchangers have anion resins that can be regenerated with sodium hydroxide, sodium carbonate or ammonia. The regeneration waste from the two exchangers can be captured in a neutralization tank, provided final pH adjustment and discharged.

Lime Softening

Lime softening is the reduction of hardness by the application of hydrated lime ($Ca(OH)_2$) to water to precipitate $CaCO_3$ and $Mg(OH)_2$. Lime softening can be complete or partial, hot process or cold process. Cationic coagulants may be needed for partial lime softening while anionic coagulants (e.g., sodium aluminate) may be needed for complete lime softening when removal of positively charged magnesium hydroxide is desired. Complete lime softening also requires the addition of soda ash (Na_2CO_3). Hot process lime softening takes place in the range of 215-230°F, and cold process lime softening at 40-90°F. The most common process for removing calcium hardness is

partial lime softening at cold process temperatures. Other chemicals such as NaOH and KOH may be used, but in most cases these chemicals are more expensive. In most all cases the precipitating chemicals are added to the water in the presence of previously precipitated sludge due to the advantages gained in precipitate formation. The wastewater discharge from lime softening includes dewatering of sludge and clarifier blow-off, drainage, and washwater. These wastewaters may require additional clarification prior to discharge. Sludge from the lime softening process can have beneficial amendment properties for certain soils that are acidic and/or low in calcium. For this reason most lime softener sludges are being land applied to agricultural sites.

Alum Coagulation Units

Alum coagulation is basically the addition of aluminum sulfate ($Al_2 (SO_4)_3 \bullet 14 H_2O$) prior to a settling basin. Activated carbon may be added for taste and odor control. Also chlorine may be added as a disinfectant. Sludge is removed by periodically decanting (discharging) all water from the basin and pumping the sludge to a holding tank. Following settling in the holding tank, more water is decanted for discharge and the sludge is fieldspread.

Granular Media Filters

Granular media filters remove suspended solids by adsorption and straining. Single media beds or multi-media beds may be used. The flow pattern through the bed may be upflow or downflow. Backwash cleaning of the media bed is always upflow. The most common filtration media is silica sand. For dual media filters the most common combination is ground anthracite and silica sand. A three media filter may also include very fine grain size garnet.

During the backwash operation the filter media will classify according to size, the smallest particles at the top. The dual and triple media filters provide extended filtration capacity by using larger grain size material with lower specific gravity and very small grain size material with higher specific gravity. This causes the larger material to be deposited on the top and the very small material to be deposited on the bottom.

The solids released during backwash will require removal prior to discharge. Usually, given sufficient detention time, these solids can be removed by simple settling equipment.

Membrane Filtration

Membrane filtration uses semipermeable membranes to separate particulates, ions, salts or other substances from water. Water is forced across the membrane by a driving force (water pressure) leaving particulates behind on the membrane or in solution as a concentrate. The type of substances removed will be dependant on the membrane type, pore size, pressure, and quality of the raw water. The waste concentrate is regularly discharged and the membrane is flushed off with air and water. Periodically, the membrane is chemically washed with caustic soda and/or citric acid. Discharges of the concentrate and cleaning wastes that meet the requirements of this permit may be discharged after treatment. Examples of membrane filtration are r**everse osmosis (RO)**

units and **microfiltration**. The discharge from RO concentrate is often called RO reject water.

RATIONALE FOR PERMIT REQUIREMENTS

1 APPLICABILITY CRITERIA

1.1 Activities Covered

This permit is applicable to wastewater discharges from iron/manganese filters, demineralizers, lime softeners, alum coagulation units, granular media filters, membrane filtration units, and other similar systems engaged in potable water treatment and conditioning where backwash water, regeneration waste, concentrate, washwater and rinse water is discharged directly to surface waters or indirectly to groundwater.

Many facilities may discharge a portion of their wastewater to the sanitary sewer; these wastewaters, of course, are not regulated by the GP. Only the direct discharge of wastewater is regulated by this GP.

1.2 Discharges Not Covered

Some potable water treatment systems will generate some amount of sludges or solids. These wastes will be regulated on a case-by-case basis, and not by this general permit.

This permit does not authorize discharges from sodium or potassium cycle ion exchange units, as regenerant wastewaters from these systems contain very high chloride levels which exceed surface and groundwater standards. These treatment systems are more appropriately regulated under an individual WPDES permit.

Discharges from municipal water supply facilities that use water treatment for radium removal to meet drinking water standards are not addressed by this GP. The wastewater from these systems may contain radium levels that exceed the Safe Drinking Water Act (SDWA) standard of 5 pCi/L for radium 226 + radium 228. Indirect discharges to the groundwater will need to be evaluated for compliance with the SDWA standard on a case-by-case basis, and are therefore more appropriately regulated by an individual WPDES permit. Direct discharges to surface waters may also be a concern. The current Unity Equation contained in Ch. HFS 157, Wis. Adm. Code, limits radium 226 + radium 228 to 60 pCi/L. Direct discharges to surface waters will need to be evaluated for compliance with this limit on a case-by-case basis, and are therefore more appropriately regulated by an individual WPDES permit.

There are a number of different treatment processes that are used to remove various contaminants, **but coincidentally remove radium**. They include electrodialysis, cation exchange, greensand filtration, coprecipitation of radium

with barium sulfate, lime softening, hydrous manganous oxide, and reverse osmosis. All of these processes concentrate levels of radium in the byproduct wastewaters. Discharges from such water supply treatment processes need to be regulated under an individual permit for reasons discussed in the previous paragraph.

Discharges from municipal water supply facilities that use water treatment for arsenic removal to meet drinking water standards are not addressed by this GP. The wastewater from these systems may contain arsenic levels that exceed the Safe Drinking Water Act (SDWA) standard of 10 ug/L. Indirect discharges to the groundwater will need to be evaluated for compliance with the SDWA standard on a case-by-case basis, and are therefore more appropriately regulated by an individual WPDES permit. Direct discharges to surface waters may also be a concern. Ch. NR 105, Wis. Adm. Code, has aquatic life and human cancer criteria for arsenic. Direct discharges to surface waters will need to be evaluated for compliance with this code on a case-by-case basis, and are therefore more appropriately regulated by an individual WPDES permit.

There are a number of different treatment processes that are used to remove various contaminants, **but coincidentally remove arsenic**. They include anion exchange, greensand filtration, activated alumina, media adsorption, chlorination followed by sand or anthracite/sand pressure filtration, and membrane filtration (reverse osmosis and nanofiltration only). All of these processes concentrate levels of arsenic in the byproduct wastewaters. Discharges from such water supply treatment processes need to be regulated under an individual permit for reasons discussed in the previous paragraph.

Discharges from the treatment of water from non-potable sources, such as whey or other process waters, is not allowed under this GP since they may contain contaminants not properly regulated by this GP.

Batch regeneration wastes (and rinse water) from filters using $KMnO_4$ will contain toxic concentrations of $KMnO_4$. The discharge of these wastewaters to surface waters is not authorized under this GP and is more appropriately regulated by an individual WPDES permit. As previously discussed in the description of iron/manganese/manganese filters, these wastewaters may be discharged to the sanitary sewer (following approval by the governing municipality), a domestic septic system, or allowed to seep into the ground. Backwash wastewater from iron/manganese filters that are continuously regenerated with very low concentrations of $KMnO_4$ while on line, are authorized to discharge under this GP.

Discharges covered under this permit shall meet the wetland protection requirements of ch. NR 103, Wis. Adm. Code, and shall not significantly adversely impact wetlands. For discharges that impact wetlands, a facility will

need to submit information that allows the Department to determine if a discharge meets code requirements.

Discharges to outstanding and exceptional resource waters are not authorized by this permit. Regulation of discharges to outstanding and exceptional resource waters requires an individual permit which provides the oversight and discharge limitations necessary to protect these types of receiving waters.

The discharges from facilities eligible for this permit are not expected to exceed any surface water or groundwater standards. Facilities with discharges that may violate surface water quality standards or groundwater quality standards require the oversight available under an individual permit.

2 REQUIREMENTS FOR ALL DISCHARGES

2.1 Reporting Monitoring Results

Reporting of monitoring results is required annually unless specified as quarterly or monthly in a letter from the Department or other appropriate notification. Monitoring results obtained during the specified reporting period (monthly, quarterly but not less than annually) shall be summarized and reported on a Department Wastewater Discharge Monitoring Report or other reporting form or system approved by the Department (including the electronic Discharge Monitoring Report (eDMR) system when available for General WPDES permits). This report is to be returned to the Department no later than the date indicated on the form (typically the 15th day of the month following the end of the specified reporting period of monthly, quarterly or annually). When submitting a Department paper Discharge Monitoring Report form, the original (and one copy if required on the DMR form) shall be submitted to the return address printed on the form. A copy of the Wastewater Discharge Monitoring Report Form submitted or an electronic file of the report shall be retained.

The permittee shall report exceedances of any limits for each parameter regardless of monitoring frequency. For example, monthly, weekly, and/or daily limits shall be met even when only monitoring once per month. The permittee may monitor more frequently than required for any parameter.

2.2 Dikes and Berms

Dikes and berms constructed as part of a treatment facility shall be designed to have no above ground leakage through or over the outer surface of such dikes or berms.

3 REQUIREMENTS FOR SURFACE WATER DISCHARGES

Surface water discharges include ditches, storm sewers and pipes that convey wastewater to creeks, streams, rivers and lakes in Wisconsin.

Discharges to surface waters shall meet the requirements outlined in this section, including the effluent limitations and monitoring requirements specified in Table 3.1. Samples taken in compliance with the monitoring requirements specified in Table 3.1 shall be taken at each outfall following treatment (if applicable) and prior to discharge to surface waters. The samples taken shall be representative of the discharge.

Table 3.1 – Potable Water Treatment System Wastewater to Surface Water

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		gpd	Quarterly	Estimate	See 3.1.1
Suspended Solids, Total	Daily Max	40 mg/L	Quarterly	Composite	See 3.1.2
pH	Daily Min	6.0 mg/L	Quarterly	Grab	See 3.1.3 and 3.1.4
pH	Daily Max	9.0 mg/L	Quarterly	Grab	See 3.1.4
Potassium Permanganate ($KMnO_4$)	Daily Max	16 µg/L	Quarterly	Grab	See 3.1.5
Metals and Hardness	Daily Max		Annual	Composite	See 3.1.6

Flow Rate
An estimate of the average daily flow performed on a quarterly basis is required by the permit. An estimate means a reasonable approximation of flow based on any of the following: (a) water balance, (b) an uncalibrated weir, (c) calculations from the velocity and cross section of the discharge, (d) intake water meter readings where the intake, or a specific portion of it, is discharged, (e) discharge water meter readings, and (f) any of the more complex methods listed in section NR 218.05(1), Wis. Adm. Code. The Department may approve additional methods for estimating flow.

Total Suspended Solids (TSS)
Discharges of backwash water from iron/manganese filters, lime softeners, and granular filters and discharge water from alum coagulation units contain suspended solids. The TSS daily maximum effluent limit is 40 mg/l (milligrams per liter). For some operations, the backwash suspended solids concentrations may be consistently below the 40 mg/L effluent limit, in which case no treatment will be necessary. For other operations, backwash suspended solids concentrations may be considerably higher than 40 mg/L, in which case some type of gravitational settling will be required prior to discharging. Decanting wastewater from the lime softeners and alum coagulation settling basins can be operated to maintain a discharge concentration of less than 40 mg/l. If decanting alone is insufficient for removing water from the sludge to the desired level, then additional solids removal equipment may be required prior to discharge. TSS monitoring is required on a quarterly basis using a composite sample.

pH
For all permittees, except lime softening operations, the pH is limited to within the range of 6.0 to 9.0. This is consistent with the water quality based pH range for waters classified for fish and aquatic life. For lime softening wastewater discharges, the pH is

limited to within the range of 6.0 to 11.0. The expanded pH range is intended to accommodate the higher operating pH of lime softening. Prior to issuing the permit to lime softening operations, the discharge and receiving water will be examined by the Department to assure that the pH limit of 11.0 will not interfere with maintenance of water quality. Sampling for pH is required on a quarterly basis using a grab sample.

Potassium Permanganate ($KMnO_4$)
$KMnO_4$ is a strong oxidizing agent that is toxic to aquatic organisms. The document titled, "Aquatic Life Toxicity Criteria for Chemicals Used in Fish Hatcheries Operated by the Wisconsin Department of Natural Resources," dated January 1994, calculates the LC_{50} for $KMnO_4$ at 15.5 µg/l. Therefore, in accordance with the procedures outlined in ch. NR 106.10(1)(a), the daily maximum limit is 16 µg/l (rounded from 15.5 µg/l). Due to the short and intermittent nature of the discharge, a chronic limit is not necessary. Monitoring of $KMnO_4$ is only required for discharges from iron/manganese filters using $KMnO_4$. Monitoring is required on a quarterly basis using a grab sample.

Metals and Hardness
Metals and hardness monitoring is being required to gather information on their levels in discharges from membrane filtration units (for example, reverse osmosis and microfiltration units). Facilities with membrane filtration units shall monitor for copper, lead, and zinc. Note, however, the waiver of further metals monitoring for permittees who have already submitted that information.

Floating Solids and Foam
This is a Best Professional Judgment (BPJ) condition dating back to the Refuse Act Permit Program and the Corp of Engineer's River and Harbor Act of 1899. This condition is achievable by application of best practicable control technology.

Solids Removal
Over time, settling equipment fills up with settled solids, resulting in decreased volume and residence time for wastewater and ultimately, ineffective solids treatment. Solids must be removed upon occasion to insure effective settling occurs and that permit limits are met.

Compliance With Potassium Permanganate ($KMnO_4$) Limitation
The standard mode of operation for continuously regenerated iron/manganese filters should result in compliance with this effluent limit. Potassium permanganate is fed into the water supply at a relatively constant concentration. Operators dose $KMnO_4$ at a concentration so that there is no discernable pink color in the treated water supply. If, upon visual inspection, the discharge has no discernable pink or purple color, the discharge is considered in compliance with the permit limit. The appearance of a pink color is equivalent to 100 ug/l of $KMnO_4$. Therefore, a pink or purple color in the discharge indicates that discharge is not in compliance with the permit limit.

4 REQUIREMENTS FOR GROUNDWATER DISCHARGES

A discharge to groundwaters in Wisconsin includes wastewater infiltration from irrigation, drain fields, ditches, and ponds that may impact water beneath the ground surface.

The permittee shall comply with the monitoring requirements specified in Table 4.1.

Table 4.1 – Potable Water Treatment System Wastewater to Groundwater

Monitoring Requirements and Effluent Limitations					
Parameter	**Limit Type**	**Limit and Units**	**Sample Frequency**	**Sample Type**	**Notes**
Flow Rate		gpd	Annually	Estimate	See 4.1.1

Solids Removal
Occasional removal of solids from seepage areas is necessary to insure that these areas can continue to absorb wastewater. Solids in wastewater can clog spaces between soil particles, resulting in decreased seepage capacity.

Flow
The description of "flow" in the "Surface Water Discharge" section of this fact sheet also applies here.

CHANGES FROM THE PREVIOUS GENERAL PERMIT REISSUANCE

The Department has been standardizing the formatting of general permits. This new permit conforms to that formatting. There are numerous editorial changes to improve readability, which will not be discussed here. There are six substantive changes in the new permit as compared to the existing:

- Revised the applicability criteria in Subsection 1.1. "Reverse osmosis units" was replaced by "membrane filtration units". Nanofiltration and other membrane technologies are currently used for treating potable water supplies.

- Filters using potassium permanganate for regeneration are also being used for manganese removal from potable water supplies, in addition to iron removal. Accordingly, the word "iron" has been deleted from first and second bullets in Subsection 1.1.

- Revised the applicability criteria in Subsection 1.2. The item relating to the 21 bioaccumulators was eliminated. This is now addressed in the last bullet that states water quality standards for surface water and groundwater may not be exceeded. The previous language that said adding any detectable quantities of

bioaccumulators wasn't realistic because improvements in the analytical level of detections can detect very minute concentrations of contaminants.

- Also eliminated from Subsection 1.2 is the discharge containing quantities of radiation that exceed the standards of HFS 157, Wis. Adm. Code. This item is redundant with the exclusion of discharges from treatment systems operated to meet drinking water standards for radium or arsenic (4^{th} bullet).

- The prohibition on chlorination during backwash operations (existing permit Subsection C.(2)) was eliminated. This prohibition was interpreted by some water utilities to mean that supply water used to backwash could not be chlorinated. This would create an unsafe water supply. The intent of the provision was that additional chlorination, over and above that which is normally used to disinfect the water supply, is prohibited. The Department is not aware of any water supply treatment operations that add additional chlorine to backwash. Therefore, this provision is eliminated from the new permit.

- The new permit now requires pH monitoring for all discharges to surface water. The previous permit required monitoring only for lime softening and neutralization tank wastewater discharges. However, chemicals that can cause pH excursions are frequently used for cleaning water treatment membranes.

Respectfully submitted,

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cc: U.S. EPA, Region V, Permits Branch
South Central Region
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