Permit to Install Guidance 5 **Final**	**Drip Distribution Systems**	
	Rule Reference: OAC 3745-42	Ohio EPA, Division of Surface Water Revision 0, December, 2008
This guidance document does not affect the requirements found in the referenced rules.		

Purpose

The purpose of this guidance document is to provide recommendations for minimum design standards and maintenance issues to be addressed for drip distribution systems.

Background

This guidance document should be referenced for reviewing designs of drip distribution systems that will treat domestic wastewater. Drip distribution systems may be appropriate where there are limiting conditions close to the surface or where trees/ other natural features need to be preserved.

Procedure

Contact the office listed below for more information.

Related Policy or guidance

Ohio EPA's Interim Onsite Sewage Treatment System Guidance Document, 2008

For more information contact:

Ohio EPA, Division of Surface Water
PTI, Compliance Assistance, & CAFO Unit
(614) 644-2001

State of Ohio
Environmental Protection Agency

Division of Surface Water

Guidance Document for Drip Distribution Systems

December 2008

Ted Strickland, Governor
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Acknowledge

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Abstract

This drip distribution system guidance document was developed to provide general information and basic design information as a supporting document to the Interim Onsite Sewage Treatment System Guidance Document. The guidance document is intended to provide technical specifications and design/installation guidelines for designers and Ohio EPA staff to consider when preparing or reviewing permit to install applications. Information and data was collected from various reference documents, other agencies, and recommendations set forth in the Interim Onsite Sewage Treatment System guidance document.

History

The history of drip distribution systems can be traced back to ancient times. In 6th Century B.C. Mesopotamia and Egypt civilizations were using a rudimentary means of watering their vegetation by "irrigating" water from rivers to crops. At that time, the sole purpose of irrigation was to provide water to their agriculture. Over time irrigation was not only used for agriculture, but to help transport drinking water. This is still evident today with the remains of the Great Roman Aqueducts.

Original designs of irrigation systems were far different from today's standards and practices. Development of modern irrigation technologies did not start until the 1860's in Germany where scientists were using clay piping to convey water to plants. In the early 1900's, researchers at Colorado State University were able to successfully apply water to the root zones of plants without changing the levels of the water table below. With the invention of modern plastics during World War II, further advancements were achieved in the field of irrigation. With the onset of these advancements, it opened the door for various applications of irrigation technology.

In the late 1950's and early 1960's major advances took place in Israel improving irrigation technology and pushing it closer to what we consider drip irrigation today. In the mid 1960's, drip irrigation technology finally made its way to the United States where initially was used for irrigation of agricultural plants. It wasn't until the 1980's where people in the Southeast part of the United States started experimenting with using drip irrigation as a wastewater treatment system. The technology slowly made its way across the United States, eventually finding its way to the Midwest and Ohio. Drip irrigation or "drip distribution" systems were first approved as a viable onsite sewage treatment system in the State of Ohio around 2000. Currently, Ohio EPA has approved over 85 drip distribution systems servicing commercial facilities throughout Ohio.

How Drip Distribution Works

The basic principles of drip distribution system are the same as for any other soil-based treatment systems: filtering and bacterial decomposition of wastewater in the soil. The difference is that a drip distribution system efficiently disperses the effluent in small quantities over large areas. A drip distribution system will pump pretreated wastewater to a soil absorption area where the pretreated effluent "drips" out of tubing at regular intervals, allowing small amounts of wastewater to permeate through the soils.

A drip distribution system typically is composed of four main parts: pretreatment components (septic tank and pretreatment unit), a dosing chamber, filter unit (disc, screen, or sand), and a soil absorption area (drip tubing “zones”). Depending on the soil conditions and the wastewater characteristics, some drip distribution systems may require additional treatment.

The dosing chamber can store the wastewater until the drip tubing zones are ready for a dose of effluent. Pump selection and installation should follow typical onsite sewage treatment system design practices.

All systems can plug without a good filtering device, therefore incorporating a filter unit is vital to prevent clogging of the drip tubing. Filter units have the potential to remove particles down to 115 microns from the effluent prior to the drip tubing zones. Flushing capacity and the total dynamic head are important design features that assure effluent passes through the emitters in the tubing. Even with excellent filtration, growth in the tubing can cause plugging. Flushing the system removes the growth and prevents plugging.

The soil absorption system includes a supply manifold that carries wastewater from the pump to the drip tubing zones. The drip tubing is comprised of tiny emitters typically spaced 2 feet apart, which allows the wastewater to “drip” into the soil. The return manifold for the drip tubing zones connects back to the septic tank for any excess wastewater to be re-dosed.

Advantages

Drip distribution systems have numerous advantages over traditional conventional systems. Several advantages to consider when designing an onsite sewage wastewater treatment system(OSTS):

- Drip distribution systems can be installed in severe soil conditions where conventional systems would not be able to be installed or function properly. Because a large portion of Ohio soils are not well-suited for treating and dispersing wastewater, drip distribution’s versatility can play a vital role in the onsite treatment of sewage.

- Shallow installation of drip tubing, 4-10 inches below grade, allows the drip distribution system to maximize the evapo-transpiration processes in the upper portion of the soil column.

- The treatment of wastewater is dependent upon the amount of oxygen available to the application area. The shallow installation depth and slow drip of wastewater helps maintain an aerobic zone in the soils that is vital to adequately treat wastewater.

- Due to the nature of the design of the system, the wastewater will be better pretreated before dispersal in the soils. Combined with the low application rates, this reduces the potential of groundwater contamination. With large areas in Ohio with soils that are not conducive for conventional onsite sewage treatment systems, drip distribution systems can be installed with less risk of groundwater contamination.

- The installation of tubing by knifing or vibratory plows and utilizing topographic configurations allows for minimum site disturbance. This allows "green" space to be maintained on the property.

- Drip distribution systems can be sited and installed on sloped sites because of their ability to provide even distribution with no additional design requirements.

- Siting flexibility allows the drip tubing to be installed on most sites where a traditional onsite sewage treatment system may not have been able to be sited due to site restrictions (e.g. trees, rocks, etc).

Disadvantages

Even with a record of being able to go into severe soils while still treating wastewater to adequate levels, there are several disadvantages to drip distribution systems. They are:

- The drip distribution system has numerous mechanical/moving parts that need to be periodically maintained. A management plan should accompany the proposed drip distribution permit to install application. If proper operation and maintenance is not performed on the system, it will not function as designed and runs the risk of a failure/malfunction.

- Drip distribution systems are more expensive than conventional/traditional systems. With the additional mechanical/moving parts and management plans, the overall cost sometimes outweighs the advantages of the treatment system.

- The orifices on the drip tubing have the potential of clogging by dissolved/ suspended solids or roots. This will prohibit the drip tubing emitters from properly dispersing the wastewater into the soil resulting in uneven distribution of wastewater. If too many orifices become plugged, the system may malfunction and/or fail. Refer to the drip tubing zone section of this guidance document to see how this may be addressed.

Siting

When proposing any onsite sewage treatment system, the first step must be to determine whether or not an onsite sewage treatment system is feasible at the proposed site. To help determine the feasibility, a site & soil evaluation should be conducted.

Site Evaluation

A preliminary site evaluation will help determine the best suitable location and layout for the proposed OSTS. The site evaluation will also show what site specific conditions are present that may impact the placement of the system. The site evaluation should determine the following, but is not limited to:

- Property set-backs
- Any existing tankage or soil absorption systems on site.
- Low lying areas
- Trees, rocks, etc. that would block the placement of the system in the area
- Any disturbed area
- Contour and elevation of site
- Any existing or proposed buildings, sidewalks, driveways, paved areas or other hardscapes.
- Locations of streams, water supply wells, or other features that need to be avoided

Additional siting criteria that must be taken into account when designing a drip distribution system is the use of interceptor drains. These may be utilized up-gradient of drip zones to intercept ground water. Surface water diversion methods may also be used to redirect storm water run-off away from the soil absorption areas. At no time should an interceptor drain be placed down gradient of any drip tubing zones. The site/soil evaluation data should be completed using Form B2 and the soil evaluation form developed by the Ohio Department of Health. The applicant should refer to Ohio Administrative Code 3745-42-03 for a complete list of information that will need to be included in a permit to install application.

Soil Evaluation

A certified professional soil scientist should conduct the soil evaluation to determine the site specific characteristics of the soils. This information will be used to establish the size of the system and determine the proper location for the OSTS. A non-certified professional soil scientist may perform the evaluation as long as they can demonstrate training and knowledge of soils as they are related to wastewater treatment and transport. The soils professional or qualified individual should be able to identify the following soil characteristics, including but not limited to:

- Depth to limiting condition
- Nature of limiting condition
- Soil classification per USDA nomenclature
- Estimated permeability of soil horizons that will be used for soil absorption
- Estimate the soil's linear loading rate

A limiting condition is defined as any condition present in the subsurface soil that limits the treatment and/or dispersal of wastewater. Limiting conditions include:

- Seasonal high ground water
- Ground water
- Sand/gravel lenses
- Bedrock
- Fractured bedrock
- Compacted soils (impervious layer)

A suitable area should be chosen and marked with visible markers so that the soil absorption area is not disturbed during construction, however, if the area is disturbed or compacted, then the soils should be deemed unsuitable unless the soil scientist evaluates the soil again and demonstrates it is still suitable.

Design Recommendations

Due to the lack of rules governing the design of a drip distribution system, one may also use the design manuals of nationally accredited organizations to complete specific calculations on sizing, loading, dosing and distribution. A list of several of these documents is located in the Reference section of this guidance document. Calculations must be submitted with the permit to install application and should provide justification for the design. The design should also comply with any applicable guidance set forth in the Ohio EPA's Interim Onsite Sewage Treatment System guidance document.

Design Flow

When determining the design flow, the designer of the system shall use the flows set forth in OAC 3745-42-05. Water use records may be used as a substitute to the flows set forth in the design flow rule. Water use records shall be evaluated on a case-by-case basis with the Ohio EPA.

It is imperative that all sources of wastewater are taken into account, including toilets and sinks. Additional sources of wastewater may include, but are not limited to:

- Floor Drains
- Kitchens
- Showers
- Dishwashers
- Clothes washers

Note: Only domestic sewage or wastewater that has the same characteristics as domestic sewage should be discharged into the soils.

Equally important as hydraulic loading is the organic loading rate. If it is determined that the system will have higher BOD_5 levels than typical domestic wastewater, additional pretreatment should be required to reduce the waste strength. Refer to the design flow rule, OAC 3745-42-05 for proper BOD_5 loadings.

Sizing

Once the design engineer has obtained the design flows, organic loading, and the site specific soil data for the proposed system, the design engineer may begin sizing the system. The designer should use the linear loading rate table developed by Jerry Tyler to help size the drip tubing zone area required. Using the linear loading rate table is critical to properly configure the drip distribution system. It is imperative that the system design allows the soils to effectively treat, and disperse the wastewater. When designing the drip distribution systems, a good rule of thumb is:

Dispersal Field Area = Design Flow / Hydraulic Loading Rate

Tankage

All drip distribution systems should utilize primary settling in the form of septic tanks. The design must incorporate a septic tank with a storage capacity with at least 2.5 times the average daily design flow. For larger systems or systems with sporadic weekly flows, equalization may be incorporated into design of the system to reduce the overall footprint of the drip tubing zone. However adequate settling capacities should still be applied to the pre-equalized flow.

Note: It is beneficial to install a water metering system prior to the tankage allowing the operator/owner to record the volume of wastewater entering the system. This will also allow the operator/owner to adjust the dosing volumes and frequencies more accurately by knowing actual flows of wastewater entering the system.

Pretreatment

Pretreatment to reduce the wastewater down to secondary effluent standards is recommended for all drip distribution systems before wastewater is sent to the drip zones. Typical waste strengths for domestic wastewater can be determined using the design flow rule, OAC 3745-42-05. Additional pretreatment may also be required when soils are extremely poor or nitrogen reduction may be needed to minimize the risk of contaminating groundwater.

Secondary effluent limits are typically accepted to be less than 30 mg/L TSS, 30 mg/L BOD_5, and 15 mg/L FOG. Several pretreatment units that may be utilized to achieve this standard include but are not limited to:

- Micro FAST
- SCAT Biofilters
- Quanics Aero Cell
- Quanics Biocoir
- Delta ECOPOD
- Recirculating Sand Filters / Single Pass Sand Filters

Disinfection may be required for sites when the proposed drip distribution system has the potential to discharge into a usable aquifer or is located within a sensitive watershed. Disinfection may be considered on a case by case basis only and should not include chlorination because of the impact on the "good bugs" in the soil. Disinfection can be achieved by:

- UV
- Peat Biofilters

Filtration

Effluent that is sent to the drip tubing zones must first be filtered due to the potential of clogging the emitters. Typical filtration designed into a drip distribution system comprises of a disk filter, screen filter, or sand filter. The removal capabilities of these filters are:

- Disk removes down to 115 microns
- Screen removes down to 100 microns
- Sand removes down to 100 microns

Other filtration units may be used and must be evaluated on a case by case basis by the Ohio EPA. Schematics of these filtration units can be found in the Appendix of this guidance document.

Hydraulic/Control Unit

The hydraulic/control (H/C) unit is essential for any drip distribution system. The H/C unit is used for time dosing and time flushing of the filter and drip tubing zones. The H/C unit should be placed near the filtration unit to ease the maintenance and upkeep of the system. The H/C should be installed below grade in weather proof boxes to prevent freezing.

Dosing

As stated previously, one of the main reasons drip distribution is so effective and reliable for treating wastewater is the pressurized system that allows for even distribution and timed dosing of the wastewater. Drip distribution systems micro dose the drip tubing zones to help ensure the soil absorption area remains at an unsaturated condition.

The dosing chamber should be able to hold about 60% of the average daily design flow. Each zone should be dosed 4 times per day and at peak 5-6 times per day per zone. Typical pump run time is anywhere from 2 to 18 minutes. Each facility should have a spare pump or have ready access to a spare pump in case of malfunction.

Supply & Return Manifold

The supply and return manifolds, made of rigid PVC pipe, should be installed at a depth of 32 to 36 inches below grade to protect against frost heave. The supply and return lines must be designed so that in between doses, the drip zones drain back into the manifolds. This will prevent water from collecting in the tubes when not being dosed and greatly decrease the likelihood of the tubes freezing in the winter. The supply manifold should be designed to maintain a velocity between 2 and 5 feet per second, while the design of the return manifold should maintain a minimum velocity of 1 gal/min from each drip tube run to provide cleaning of the tubing.

Valves

Air/Vacuum (A/V) relief valves are needed to release air at the start of a dose so the system has the ability to charge quickly and uniformly with wastewater. The A/V relief valve also allows air to quickly enter the system at the end of a dose to minimize aspiration of fine soil particles into the drip emitters due to the vacuum that would otherwise be created as the drip lines drain following a dose.

A/V relief valves need to be located at the highest elevation in each zone (above the highest drip emitter) to prevent soil from being sucked into the emitters due to backpressure. A/V relief valves should also be installed at the high end of the supply manifold and one installed on the high point of the return manifold. Additional A/V relief valves may be required depending on the site.

Solenoid flush valves should be used in the design of the drip distribution system to allow the flushing operation to be automated. These flush valves should be installed near the flush return tank to provide for easy maintenance.

Drip Tubing Zones

The preferred design should be long and narrow zones compared to zones that are short and wide. This design allows for easier installation and reduces the likelihood that installation equipment will compact the soil. Drip tubing zones should not be designed for more than 2,400 gpd per lateral and runs should not be longer than 300 lineal feet. Flex tubing should be used when connecting the runs of drip tubing to the supply and return manifolds. The installer needs to make sure that the flexible tubing is elevated to allow any wastewater to drain from these lines and collect back in the manifold. A minimum of 25 feet spacing between zones on flat ground and 50 feet for slope ground should be maintained.

Note: Design of the drip zones should provide for a minimum flushing velocity of 2 ft/s throughout each zone.

Mounded drip tubing zones may be installed but shall be evaluated on a case by case basis. These should only be designed/ installed when the limiting condition is within 12 inches from grade. Studies have shown that the level of treatment does not change significantly beyond 12 inches of sand, therefore to reduce costs and problems with construction it's recommended that only up to 12 inches of sand be used to mound the drip distribution tubing.

Emitters

Emitters are to be offset between runs, and each run should be 2 feet apart (i.e. 1 emitter per 4 sq feet of infiltration area). Spacing of the emitters may be closer, but will be evaluated on a case by case basis. Closer spacing, however, should not reduce the size of the drip zone required. Emitters typically operate at pressures between 5 and 70 psi, but it is recommended to design them to operate at 10 to 45 psi to prolong their life. Emitters will have flow rates that vary from 0.4 gal/ hr to 1.0 gal/ hr. Multiple types of emitters are available including:

- Turbulent
- Laminar
- Vortex
- Pressuring Compensating

It is recommended that pressure compensating emitters be used as they provide a more equal distribution of wastewater throughout the drip zones. This also helps prevent the chance of emitters clogging because pressure compensating emitters automatically increase the flow velocity if it starts to plug.

Freezing

Freezing of drip distribution systems is a concern for systems being installed in the northern part of the United States and Ohio. There are several measures that should be taken to prevent freezing. If the necessary precautions are incorporated into the system, freezing should not be an issue to the drip distribution system. Tips to prevent freezing of the drip distribution system are:

- The end flexible tubing should be elevated to allow any wastewater to drain from these lines and collect back in the manifold.
- The vertical pipe connector from the force main to the manifold should be insulated.
- H/C Unit should be insulated.
- Vegetated cover should be provided over the zones and manifolds and;
- Bury the return manifold and force main line below the Ohio frost line of 32 to 36 inches.

Additional precautions may be necessary to prevent freezing in other areas of the system not mentioned above. These items should be discussed with the design engineer and the appropriate Ohio EPA district office staff before the application for the drip distribution system is submitted.

Helpful Hints

When designing a drip distribution system, there are a few helpful hints that should be looked at that will help the system maintain optimal performance and prolonged the life of the system:

- When animal hair may get into the system, the design must incorporate effluent filters to collect as much hair as possible to reduce the risk of the hair clogging the drip emitters,

- Higher concentrations of iron in the wastewater have been known to plug drip emitters. If high iron is a possibility in the wastewater stream, preventative measures may be needed to reduce the amount of iron being discharged into the drip tubing zones,

- Make sure the area over the manifolds and drip tubing zones has vegetation as this will provide additional thermal protection against the lines freezing during the winter; and

- Drip distribution systems servicing laundry facilities may not be recommended as the detergents and lint may cause the system to fail.

Installation

It is very important to have a qualified installer install the drip distribution system as even small errors can cause the drip distribution system to not function properly. The applicant/owner should make sure that the company installing the system is experienced and should be a qualified installer through the Ohio Department of Health's Residential Sewage Program. Detail plans for construction should include general notes to address the following if they are not spelled out in the detailed drawings:

- It is recommended that drip tubing be buried 4-10 inches below grade to utilize the root zone, but may be to installed 18-24" below to protect against frost heave/freezing (case by case basis only),

- Each run of drip tubing should not deviate +/- 2 inches off of contour during installation,

- Drip tubing should be installed by either knifing or using a vibratory plow,

- Supply/Return manifolds must be buried 32-36 inches to prevent freezing of line(s),

- Systems shall not be installed during wet weather events or when there is a possibility of soil smearing,

- Make sure that the soil absorption area is marked off prior to construction to help reduce the possibility that heavy equipment will be driven over the absorption area,

- When at-grade drip lines are being plowed in, it is a good idea to apply a few inches of sand so that when plowed, a smoother transition from the soil to the sand is provided,

- If the electrical control panel is installed outside, it should be raised at least 2 feet above ground level,
- Make sure to cover all open ends to ensure no foreign material gets into the drip distribution system that would cause the system not to function properly,
- If a system is being sited in a wooded area make sure the under brush is properly removed to allow easier access when installing the drip tubing. (Plants to be cut to ground level-removal of roots will disturb soils)
- The trench to the manifold and force main should remain open until after start up testing has been conducted and it's been determined that there are no leaks in the system.
- Equipment and material should be present during the start up phase in case any minor maintenance is required before the system is ready to be used.

Management Plan

Currently an onsite sewage treatment system is not required to submit a management plan with the PTI. However, for drip distribution systems it is recommended that a management plan be developed for the applicant and/or owner to help ensure proper operation and maintenance of the system. Several key items that the management plan should contain are:

- The drip distribution system needs to operate in accordance with the approved Ohio EPA Permit to Install. Any deviation from this permit may require another PTI application be submitted to the Ohio EPA for approval
- Periodic inspection of the mechanical equipment and drip zones to make sure everything is running properly
- Emergency contacts in case of malfunctioning and/or failure
- Contact information for a hauler to pump out the septic tank(s); and
- How operation and maintenance records will be maintained
    - Records include: flow data, pumping schedule, any maintenance performed, sampling data (if applicable)

Appendix

Figure A.1: General Layout of Drip Distribution System

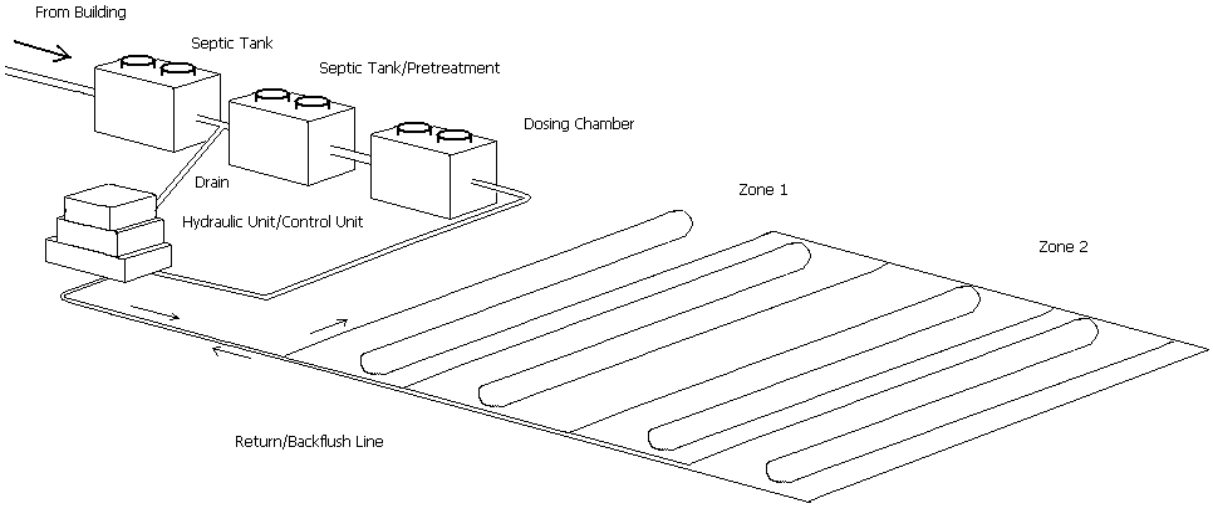


Figure A.2: Drip Tubing Cross Section

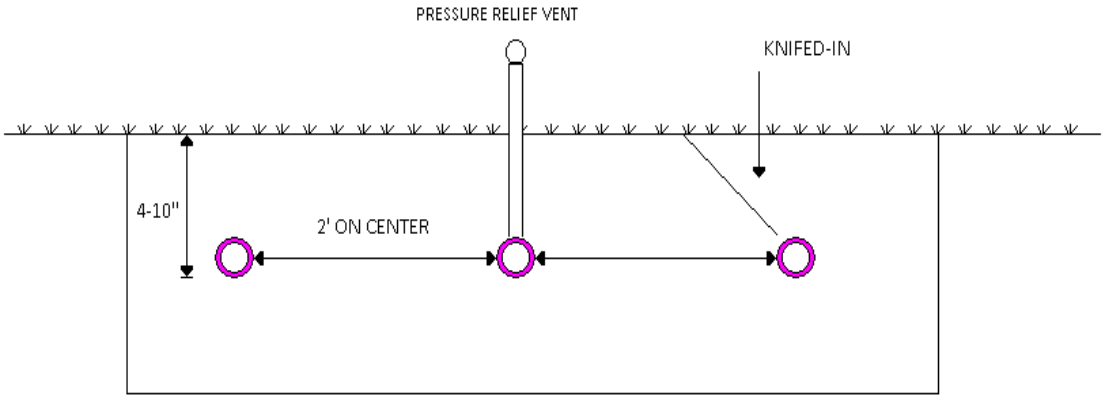


Figure A.3: Disc Filtration

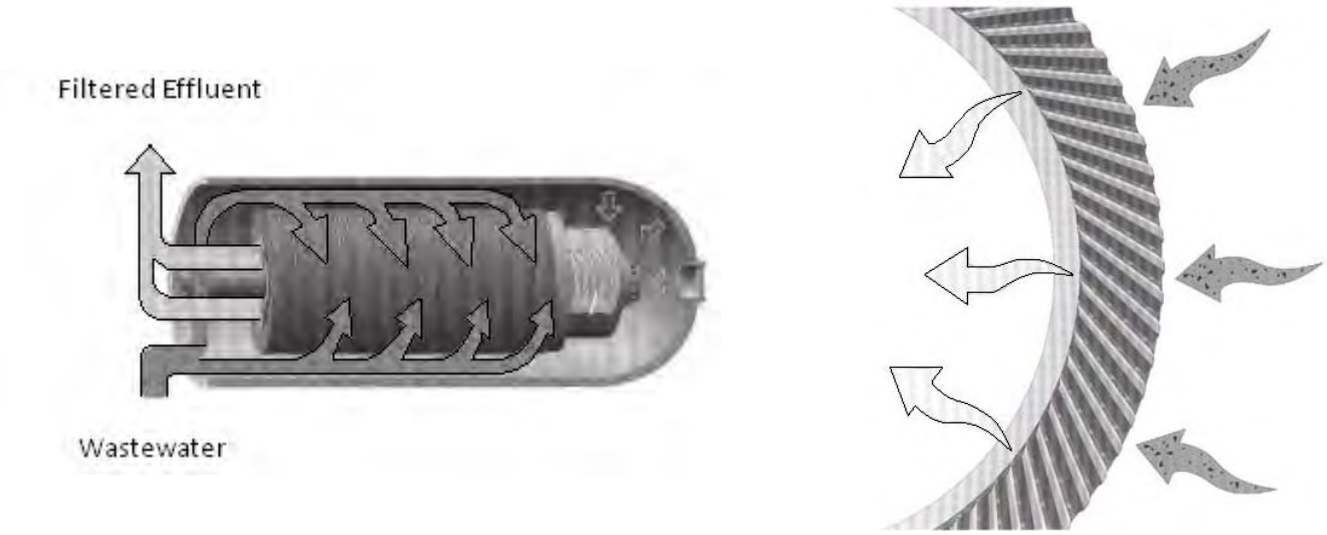
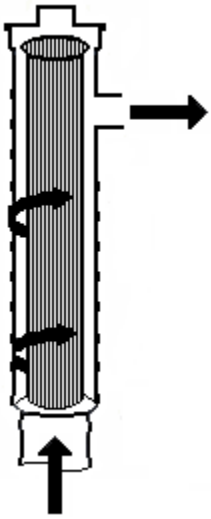


Figure A.4: Screen Filtration



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