SECTION IX BASIC PRETREATMENT

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A. GENERAL

The basic facilities for pretreatment of domestic wastewater consist of one or more septic tanks, preceded by one or more grease traps in cases where the wastewater contains fats, oils and greases (FOG) in amounts greater than that found in household wastewater.

B. SEPTIC TANKS

A septic tank is a passive device designed for:

- substantial separation of the solid and liquid components of wastewater;
- storage of the separated solids;
- limited digestion of stored organic matter by anaerobic and facultative bacteria;
- discharge of the liquid component of the wastewater to a subsurface wastewater absorption system (SWAS) for further renovation in the subsurface soils.

Separation of the solid and liquid components of the wastewater is brought about by settling of solids having a specific gravity greater than water to a bottom sludge layer, and floatation of FOG and other materials having a specific gravity less than water to a floating scum layer. Rising gas bubbles, resulting from the digestion of the organic matter in the lower reaches of the tank, also aid in carrying FOG with them to the top of the liquid. Factors that affect such separation include tank surface area, length-to-width ratio, depth, detention time, flow baffling provisions, number of tank compartments, the temperature of the wastewater discharged to the tank, and the ambient temperature of the soil surrounding the tank.

It is well established that surface loading rate is a major criterion for effective removal of settleable and floatable solids. Surface loading rate is a function of the effective horizontal area of the tank (inside clear length x clear width) and the rate of flow of wastewater through the tank, and is expressed as gallons per day per square foot of effective horizontal area. Time is also required for these solids to settle down to the lower portion of the tank volume where they will be stored and partially digested. This time factor is reflected in the detention time, which depends upon the liquid volume of the tank (inside clear length x clear width x liquid depth) and the rate of flow of wastewater through the tank. Baffling is required to promote the relatively quiescent conditions needed for effective solids separation and to hinder the escape of solids with the tank effluent. While not all investigators agree, it is generally accepted that separating the tank into two compartments assists in sedimentation of the settleable suspended solids. In fairly recent times, effluent filters have been used as an enhancement to the outlet baffles for more effective retention of solids in the tank.

The temperature of the wastewater in the tank and the ambient soil temperature have a significant effect on the settling rate/floatation rate of the solids and the microbial action in the tank that affects partial digestion of the solids. Lower temperatures aid in separation of the lighter solids by causing the soluble FOG in the wastewater to congeal and float to the higher portion of the tank, but hinder the settlement of the heavier solids, due to the increased liquid viscosity, and reduce the microbial action.

Higher temperatures aid in separation of the heavier solids (by decreasing the liquid viscosity) and increase the microbial action, but hinder the separation of FOG from the wastewater. Normal residential wastewater temperatures are usually not considered a significant factor. However, the higher temperatures of wastewaters discharged from facilities such as food processing and serving establishments can negatively effect the separation and retention of FOG. The ambient temperature of the soil can affect the temperature of the tank contents by heat transfer through the bottom, top and sidewalls of the tank.

The pollutant concentrations in the raw wastewater will be significantly reduced in a properly functioning septic tank. The septic tank will also serve to reduce instantaneous peak wastewater flow rates and pollutant loading rates. It should be noted that due to the large safety factor inherent in sizing of residential septic tanks, they normally provide detention times of several days. However, septic tanks for large-scale on-site systems typically have much shorter detention times and higher flow-through velocities. Therefore the pollutant removals reported for residential septic tanks are often not realized for the large-scale system tanks. This is important to remember when computing the organic and nitrogenous loading in the septic tank effluent.

Important design considerations for septic tanks include:

- Volume
- Surface Area
- Inlet and outlet provisions
- Internal baffling provisions
- Material durability
- Structural integrity
- Safe and controlled access for removal of accumulated scum and sludge and for inspection of inlet and outlet provisions.

C. GREASE TRAPS

The exterior, underground type of grease trap is a passive device designed to collect and retain the fats, oils and greases (FOG) normally found in wastewaters discharged from food processing and serving facilities. Grease traps, sometimes referred to as underground grease interceptors to differentiate them from the smaller automated grease recovery units (AGRU) installed within a building where the FOG originates, are similar in construction to septic tanks but differ in their inlet and outlet and baffling arrangements. The effluent from grease traps is discharged to a septic tank or other pretreatment facility before being discharged to a SWAS.

Grease traps accomplish separation of FOG by taking advantage of the difference in specific gravity between FOG and liquid in the trap and the cooling effect of heat transfer between the trap contents and the surrounding soil. Under quiescent conditions, a significant percentage of the FOG and suspended solids in the wastewater will be removed in the trap. FOG will tend to float to the top of the liquid in the trap, where it is retained in baffled areas, and suspended solids in the wastewater will settle out to the bottom of the trap.

Conditions affecting the efficiency of a grease trap, other than tank geometry and baffling, include wastewater temperature and strength, and types of solvents, detergents and chemical cleaners contained in the wastewater discharged to the trap, and the ambient soil temperature.

These traps are effective in accomplishing a considerable reduction of FOG derived from animal fats if they are properly designed and maintained. However, they can be much less effective in removal of vegetable oils, which are more easily emulsified than animal FOG. The temperature of the wastewater also plays an important part in the ability of FOG to become emulsified, with high temperatures aiding in the emulsification process. Emulsified FOG will escape from the grease trap, may pass through the septic tank and reach the SWAS where, as it cools and congeals, it can cause severe clogging of the infiltrative surfaces.

Important design considerations for exterior grease traps are similar to those previously given for septic tanks.

The volume and surface areas of the trap(s) are important design considerations. The volume must be sufficient to provide adequate detention time of the FOG laden wastewater in the trap to effect the desired separation. A minimum of 24 hours of liquid detention time at the peak rate of discharge into the trap should be provided, and more is desirable. Additional volume should be provided for storage of the FOG that floats on the wastewater and any solids that may collect at the bottom of the trap(s). The storage volume will depend on the frequency of removal of the solidified FOG and the heavier solids that have settled to the bottom of the trap. A minimum storage volume equal to at least 33% of the design liquid detention time should be provided. Thus, the gross working capacity of the grease trap(s), based on inside horizontal dimensions of the trap(s) and the distance from bottom of the trap(s) to the outlet invert(s) should be equal to, or greater than, 133% of the volume necessary to provide the 24-hour liquid detention time.

The surface area in contact with the soil is an important factor in reducing the temperature of the liquid in the trap by heat exchange with the cooler surrounding soil. An important goal in design of a grease trap should be to reduce the temperature of the wastewater in the grease trap to 24°C (75°·F) or less. Mean soil temperatures in Connecticut, at the depths in which underground grease traps are normally installed, range from 9° C to 11°C (48°F to 52°F), while the temperature of FOG laden wastewater may range from 49°C (120°F) to 60 °C (140°F) or more. Thus, there is a significant temperature gradient available to conduct the heat in the wastewater out of the trap. The greater the contact area between the trap and the soil, the more heat transfer will occur.

<u>At least</u> two grease traps, arranged in series flow, should be provided. This will promote better grease separation than a single tank of equivalent liquid capacity because the heat transfer capability, and thus the cooling capacity, will be greater than that of a single trap. Vent piping should be installed between the two tanks to permit venting of the trap to the atmosphere via the building plumbing stack.

For example, a 2000-gal.exterior underground grease trap available in Connecticut might consist of a tank having a length of 12 ft, a width of 5.5 ft and a height of 5.7 ft. A similar 1000-gal. trap might have a length of 8.5 ft, a width of 4.6 ft, and a height of 5.3 ft. The soil contact area of the single 2000-gallon trap would be about 265-sq. ft., exclusive of the top area. If two, 1000-gallon traps were used, in lieu of the single 2000 gal. trap, the total contact area would be about 356-sq. ft. exclusive of the top area. Thus, the contact area of two, 1000-gal. grease traps would be about 34% greater than the single 2000 gal. trap. (If the top areas are included, the contact area of the single 2000 gal. trap would be 331 sq. ft. while the combined contact areas of the two 1000-gal. traps would be 434 sq. ft. and thus the two 1000-gal. tanks would have about 31% greater contact area.) Also note that the sum of the horizontal cross-sectional areas of the two tanks is 18% greater than in the single trap. Larger horizontal surface areas contribute to more efficient floatation of the FOG and settlement of the heavier suspended solids.

The inlet, outlet, and internal baffling of a grease trap are also important design considerations. The inlet should consist of a baffle tee or similar flow control device that extends no closer than 4 inches to the inside top of the trap and to within 12 inches of the bottom of the trap. The outlet of the grease trap should be fitted with a filtering unit designed specifically for use in grease traps and shall extend to within 12 inches of the inside bottom of the trap. A difference in elevation between the inlet and outlet inverts of 3 inches to 6 inches should be provided to ensure flow through the grease trap without backing up of waste in the inlet sewer. (As grease begins to accumulate, the top of the grease layer will begin rising above the normal water level at a distance of approximately one inch for each 9 inches of grease thickness.)

Material durability is important because of the harsh conditions that exist within the trap, including high temperatures and corrosive conditions. Precast, reinforced concrete tanks have been found most suitable for use as exterior underground grease traps.

Grease Traps should only be connected to fixtures that discharge FOG. These may include:

- Pot sinks;
- Pre-rinse sinks;
- Any sink into which fats, oils or grease are likely to be introduced;
- Soup kettles or similar devices;
- WOK stations;
- Sinks into which kettles may be drained;
- Automatic hood wash units
- Any other fixtures or drains that are likely to allow fats, oils and grease to be discharged, and
- Dishwashers without pre-rinse sinks.

The design engineer should carefully evaluate the use of cleaners and sanitizers within the establishment served because of their potential adverse effects on the biological processes used for wastewater treatment.

Easy access to the interior of the trap for removal of accumulated FOG is important, as it will contribute to proper maintenance procedures. Risers should be provided, extending from the top of the tank to the ground surface and should conform to the requirements of the Connecticut Public Health Code. To prevent escape of odors between cleaning, the frames and covers for grease traps should be of the gas-and-watertight-type. The trap should be vented as required by the applicable plumbing codes.

D. FLOOR DRAINS

Emulsifiers, cleaning products that keep fats, oils and grease in suspension, may allow the fats, oils and grease to short-circuit the grease trap and their use should be strongly discouraged. It is also very important that room floor area drainage systems do not discharge to the grease trap. Chemical solutions used for cleaning floors and sanitizing other food processing and serving areas often have an adverse (toxic) effect on the biological activities in grease traps, septic tanks and enhanced pretreatment facilities. Therefore, room floor area drains should not be connected to wastewater plumbing systems that discharge to underground grease traps, septic tanks or other pretreatment facilities. Chemicals used for sanitizing other surfaces (e.g.: countertops, etc.) should be used with caution and kept from the wastewater plumbing systems whenever possible. Where special floor drains are required for receiving discharge of fats, oils and grease from soup kettles or similar devices, the areas in which the special drains are located shall be raised or curbed to prevent chemical solutions used for cleaning the room floor areas from discharging to the special floor drains.

Room floor area drains shall be connected to a separate floor drainage piping system that discharges to a separate holding tank or separate treatment facilities. Where floor drainage holding tanks are utilized, they should be equipped with high water level alarms. The contents of floor drainage holding tanks shall be removed as required to prevent overflow of the tank, and disposed of in conformance with the rules and regulations of the Department and the Connecticut Department of Public Health. Where on-site treatment is provided to eliminate the toxic effects of the contents of the holding tank, provisions can be made for bleeding the treated contents from floor drain holding tanks in a controlled fashion into the wastewater pretreatment facilities. This cannot be done without prior approval of the Department.

E. GREASE TRAP AND SEPTIC TANK MONITORING SYSTEMS.

Equipment is now available that permit continuous monitoring (both locally and remote) of the liquid, scum and sludge levels in grease traps and septic tanks and provide warnings when it is time for pumping of trap or tank contents or replacement of effluent filters. At least one type provides for remote monitoring via the Internet to determine the reason for the alarms received or for periodic monitoring. Such systems provide advanced notice of impending problems and incorporation of such equipment into the grease trap and septic tank facilities serving food processing and serving establishments and are strongly recommended for all new and retrofitted on-site systems serving such establishments.

F. FLOW EQUALIZATION

Where peak daily flows occur sporadically, such as on weekends, flow equalization facilities should be strongly considered. This will reduce the loading on downstream treatment facilities and on the SWAS, resulting in a cost saving normally significantly greater than the cost of the equalization tank and associated facilities. Consideration should be given to equalization of the daily flow during peak days as well as on the basis of average daily vs. peak daily flows. Additional guidance on flow equalization facilities is given in other sections of this document.