TENNESSEE
OIL AND GREASE CONTROL
GUIDANCE DOCUMENT

PROVIDED BY THE TENNESSEE DEPARTMENT OF
ENVIRONMENT AND CONSERVATION
DIVISION OF WATER POLLUTION CONTROL

June 2002

ACKNOWLEDGMENTS

The Tennessee Division of Water Pollution Control acknowledges the considerable effort and cooperation of the many people whose contributions helped to successfully complete this guidance document. The editors were as follows:

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The committee would like to thank Environmental Biotech, Inc., and the Plumbing and Drainage Institute for permission to use copyrighted material in this manual. The committee would also like to thank the University of Tennessee Municipal Technical Advisory Service for use of their model ordinance; Charlotte County, Florida, for use of the grease section of their SUO; the Town of Cary, North Carolina, for use of their Fats, Oils, and Greases Control Ordinance; Knoxville Utilities Board (Tennessee) for use of their Grease Control Program document; and Louisville and Jefferson County Metropolitan Sewer District (Kentucky) for use of their example restaurant permit.

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INTRODUCTION

Oil and grease in sewer systems are quickly becoming a problem in many cities and towns across Tennessee. The increase in restaurants, the aging sewage collection systems, and the decrease in oil and grease disposal options have all contributed to the problem. Federal pretreatment regulations (40 CFR 403.5(b)(6)) specifically prohibit petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through. However, the federal regulations are silent on other types of oils and greases and very few cities have regulations that specify limits and enforcement of oil and grease (lipids) discharges from restaurants.

Historically, problems related to discharges of oil and grease (lipids) from restaurants have been downplayed. The main focus has been on control of industrial waste discharges and sewer line repair. With the state pretreatment program at maturity, time and resources can now be directed toward addressing this type of waste. By minimizing the contribution of oil and grease to the collection system, the risk of sewer line blockages and sewage backing up into service laterals can be reduced up to 50% by some estimates.

The purpose of this manual is to give municipalities tools for creating regulations and enforcement plans dealing with oil and grease on a local level. In addition, the information in the manual should be useful to restaurants. This guidance document focuses primarily on control of edible oil and grease from restaurants, since most industrial users that discharge oil and grease of a mineral origin and large industrial food processors should be covered by a pretreatment program and 40 CFR 403. Therefore, unless otherwise stated, further references to oil and grease will pertain specifically to animal/vegetable oil and grease from sources that would not already be covered by a pretreatment program. In addition, this manual focuses on oil and grease (lipids) from restaurants, but other entities that process food (i.e., prisons, churches, schools, etc.) may cause the same types of problems. References to restaurants may also be applicable to these other entities.

This manual is not intended to be an exhaustive treatise covering all facets of grease and its control and/or disposal. Rather, this manual is intended to provide the reader with a basic understanding of grease, its significance in affecting the operation of sewer systems, the various devices that are used to remove grease from waste streams, some of the recycling options, and examples of oil and grease management. The reader is strongly encouraged to research this topic in much greater detail especially if funds are to be expended to control grease.

Characteristics of Oil and Grease

In order to control oil and grease, one must have a basic understanding of its characteristics. Oil and grease are found in wastewater either as an emulsion or as free-floating agglomerates. Chemicals, such as detergents and solvents, and mechanical agitation can cause oil and grease to become emulsified. Triglycerides are glycerol esters

of fatty acids. Fats are mixtures of various triglycerides, with a small percentage of monoglycerides and diglycerides. Triglycerides that are liquid at room temperature are often referred to as oils. According to the Water Environment Federation's *Pretreatment of Industrial Wastes, Manual of Practice FD-3*, "Grease is a general classification for grouping such materials as fats, oils, waxes, and soaps according to their effect on wastewater collection and treatment systems or their physical (semisolid) forms." For the purpose of this document, the acronym "FOG" will be used as a general term for fats, oil, and grease.

By its very nature, grease will adhere to many types of surfaces, with sewers especially vulnerable to grease build-up. The cool internal surfaces of sewers provide ideal locations on which thin layers of grease can build up. While a large clump of grease will not attach itself to a sewer, it will leave a tiny portion of itself if it does come into contact with the sewer. Over a period of time, subsequent "touches" by clumps of grease will build up to the point that the sewer is completely choked by a "grease log." Grease also accumulates due to cooling and dilution of surfactants, that allows the grease to separate and collect on all sewer system surfaces, including wetwells at pump stations, where controls can become fouled and prevent pumps from operating properly.

When sewage can no longer get past a grease build-up, it must go somewhere. Sewage will seek the nearest outlet, which may be a manhole or a service lateral, sometimes backing up into a house or business. Regardless where the sewage goes, the sewer agency is responsible for any damage that occurs. If that damage results in a violation of a permit that is issued by this department, enforcement action against the sewer agency is a distinct possibility.

SECTION I: FATS, OIL, AND GREASE LIMITS

When setting FOG limits, municipalities must take into consideration many things: protection of the collection system and wastewater treatment plants (WWTP), the practicality of monitoring and enforcing limits, and cost and manpower needed for monitoring. This section will discuss the different types of limits and the sampling and analysis required.

Numerical Limits vs. Best Management Practices

The most commonly used numerical limit is 100 mg/L. This limit does not appear to be based upon any empirical evidence but rather on general correlations and an industry consensus that this level limits the build up of FOG in the collection system. In 1949, the Federation of Sewage Works Associations (now known as the Water Environment Federation [WEF]) published a Manual of Practice (MOP) in which it recommended 100 mg/L as a maximum limit of oil and grease. However, the MOP did not specify the importance of the origin of the FOG, which could be either petroleum or animal and vegetable. WEF's MOP3 (1973) cited levels of FOG in domestic wastewaters to be in the range of 16 mg/L-105 mg/L. They further recommended limits on petroleum-based oil at 25 mg/L, though 40 CFR 419 (petroleum refining category) limits indirect discharges at 100 mg/L. The specific federal pretreatment regulations, 40 CFR 403.5(b)(6), prohibit "petroleum oil, non-biodegradable cutting oil, or products of mineral oil origin in amounts that will cause interference or pass through." Some municipalities specify different limits for FOG with different origins, such as 100 mg/L for petroleum-based (or mineral) FOG and 300 mg/L for animal and vegetable-based FOG. In most municipalities, FOG limits of 100 mg/L-300 mg/L are protective of the collection system, but a limit that works in one situation may not work in another situation. Limits may need to vary depending on different factors, such as the number of wet wells, type of sewers, slope of sewers, flow in sewers, O&M of the sewers, and history of grease related clogs.

In 1975, EPA concluded that animal and vegetable FOG can be metabolized by microorganisms during treatment and may be removed by up to 80%-90%. Oily material is adsorbed by the floc at a wastewater treatment plant and is slowly metabolized. This can often produce a less dense floc, which can be easily washed out of a clarifier. EPA added that activated sludge plants should be able to treat 0.1 lb of FOG per pound of mixed liquor volatile suspended solids(MLVSS), which could result in loadings as high as 375 mg/L. Normal domestic loadings other than oil and grease (BOD loadings) range from 0.1 lb/lb of MLVSS to 0.3 lb/lb of MLVSS. Adding 0.1 lb of FOG/lb of MLVSS would appear to result in significant oxygen demand and biomass yield. EPA went on to suggest that influent to biological treatment should ideally contain less than 50 mg/L of FOG and that dilution in the collection system would reduce any 100 mg/L discharges to acceptable levels for treatment at the plant, assuming the FOG gets to the plant.

A benefit of using a numerical limit is having an established, enforceable limit that can be applied uniformly to local restaurants. Unfortunately, FOG analysis is somewhat costly,

and many restaurants may be resistant to paying for sampling. (More detailed information on sampling and analysis is provided later in this section.) In addition, if a municipality with a pretreatment program establishes numerical limits for FOG, these limits are considered pretreatment local limits and thus would have to be developed as a local limit and approved by the Approval Authority. FOG surcharge limits must also have some basis; however, that basis should be the FOG levels associated with clogs. The surcharge costs should be the costs of maintenance of the sewer collection system associated with the clogs.

Another numerical limit that may be useful is setting a temperature limit for the effluent of a grease trap. Grease traps are not very effective if the temperature is too high (more information on grease trap design is in Section III); therefore, the temperature of the grease trap effluent should be less than 85°F in order to facilitate the separation of the oil fraction from the water. As with the FOG numerical limits, using this numerical limit can help the WWTP uniformly apply an established, enforceable limit to all restaurants. In addition, temperature can be easily monitored by city or restaurant personnel. The results are instantly available and are meaningful to both parties. However, monitoring temperature alone cannot guarantee that the grease trap is being maintained and operated properly. Monitoring the temperature can be part of normal operation and maintenance of the grease trap. Temperature limits can be a useful monitoring tool when used in conjunction with other control mechanisms.

Preventing FOG buildup in the collection system is the goal of FOG control measures. Many cities have found that requiring restaurants to implement Best Management Practices (BMP) is an effective tool in controlling FOG without requiring extensive monitoring. BMPs can range from posting "no grease" signs above sinks and on the front of dishwashers to requiring grease traps and undersink grease interceptors to be routinely cleaned (on a set time schedule and/or when a certain volume is reached). The following table lists many BMPs and their benefits.

BMP	Benefit
Instruct all restaurant personnel to "dry wipe" pots, pans, and dishware (scrape food and FOG into the trash and/or use paper towels to wipe away excess FOG)	This will keep food and FOG out of the sewer system to begin with.
Discontinue the use of garbage grinders (food disposals) – food waste should be deposited in the trash	This will decrease solids in the grease trap/grease interceptor, increasing efficiency of the grease trap/grease interceptor.

BMP	Benefit
Have grease traps cleaned on a regular basis – routine cleaning can be set up on a set time schedule (e.g., once a month) or based on when a certain percentage of the trap becomes full (e.g., grease trap must be pumped when 30% of it is full of grease and solids). Undersink grease interceptors must be cleaned according to manufacturers' recommendations (usually daily)	Grease traps and grease interceptors that are not maintained properly are not very effective. Mandating cleaning schedules for restaurants will ensure that grease traps and grease interceptors are maintained.
Require restaurants to keep signed copies of manifests for each time their grease trap is pumped (see example of manifest in Appendix A). In addition, the control authority may want to make provisions on the manifest for restaurant personnel to certify that they witnessed the grease trap being pumped or that they inspected it afterwards to ensure that the trap was pumped completely. The control authority may also want to provide a place on the manifest for a signature by a representative of the organization that receives the grease from the hauler (a copy of the manifest would then be returned to the restaurant after being signed by the receiving organization).	This would help the restaurants protect themselves from disreputable haulers that might take shortcuts, and it helps the restaurants realize that they are ultimately responsible to ensure that the haulers they hire legally dispose of the grease trap waste.
Create a video showing the proper handling of grease for restaurants. Distribute it to restaurants to show new employees.	Restaurants with high turnover may have a better chance of keeping grease out of the system if employees understand the importance.
Move oil recycle container to a convenient location. When inspecting restaurants, check the condition of the oil recycle container. If the oil in the container is very old or if the container is full, the Control Authority should question what is being done with the oil that should be recycled.	Restaurant personnel are more likely to put used oil in the recycle container and not down the drain.

Municipalities may want to consider surcharging restaurants for high-strength BOD and suspended solids. This would encourage restaurants to scrape food and excess FOG into the trash and not use garbage disposals.

Whether a municipality decides to implement numerical limits or BMPs, the authority to set up any FOG program will need to have the sewer use ordinance (SUO) as its basic

document. In addition, any FOG control program should not conflict with local building codes, plumbing codes, and health department regulations. The SUO and local codes may need to be revisited and changes may need to be made.

Sampling

In accordance with standardized testing methods, all samples for FOG testing must be collected as grab samples. Composite samples should not be used because of the accumulation of the FOG inside the tubing and components of the sampler, thus lowering the FOG readings. The grab sample should be collected in a specially cleaned, 1 L wide-mouth glass container. The sample should be preserved with the addition of hydrochloric acid or sulfuric acid to a pH of less than 2.0. Samples should be kept refrigerated (0-4°C), with a holding time of not more than 28 days. Establishments should construct adequate sampling facilities at each interceptor. Before sampling, the Control Authority will want to determine if they want to take samples at the effluent of the grease trap or at the end of the lateral before it empties into the POTW sewer. If the Control Authority decides to sample at the end of the grease trap, the SUO should be checked for any language that specifies enforcement at the end of the lateral. Pound limits at the end of the grease trap will require the Control Authority to determine the flow through the grease trap, which may be very difficult. If collecting from a weir outfall, collect the entire flow until the container is full, but do not let it overflow the top of the container. Ideally, the sampling point should be a specially-designed exterior structure, constructed on the effluent pipe of the trap. This structure should result in a free-falling liquid, so that a sample bottle can be held under the flow to capture a sample. Sampling from the "Tee" in the effluent end of the inside of the grease trap is not recommended. If that is the only sample point available, clean the inside of the "Tee" with a brush or scraper before lowering the sample bottle into the "Tee". If this is done, the person doing the sampling needs to be sure that the scraped material is not allowed to enter the sample bottle. Perhaps additional water may be allowed to flow into the trap so that the scraped material is flushed out of the "Tee" prior to sampling. If collecting the sample from the effluent "Tee" of a grease trap, use the widest mouth container that will fit into the "Tee". Fill by submersing.

Traditional environmental monitoring is based upon representative samples (the average concentration of a pollutant), but with FOG the samples should represent the worst-case scenario. The worst-case scenario (peak flow) is the point at which the FOG removal equipment is most likely to fail, and FOG loading of the collection system will occur. The goal of the equipment is to remove FOG even at peak flow; therefore, sampling needs to occur at peak flow to ensure that the equipment is adequate. In the case where FOG sampling is done for surcharge purposes, the sampling should represent the average flow, not peak flow.

Frequency of sampling, by the Control Authority or the restaurant, is determined by the need for data. Surcharge monitoring should be performed at least once each month. When setting a monitoring schedule to ensure that FOG or temperature limits are being met, take into account what can be reasonably managed (staff availability, cost of sampling) and the compliance history of each facility (the number of blockages or other problems

caused by the facility, if dumping at the end of each day is suspected, how often the facility pumps out its grease trap or cleans its grease interceptor). FOG sampling may be scheduled or done as part of compliance monitoring on an unannounced basis.

Analysis

Until recently, the standard method for measuring FOG was EPA Method 413.1. This method uses freon and is being phased out of use by the USEPA in order to meet the chlorofluorocarbon (CFC) phaseout agreed to in the Montreal Protocol and required in the 1990 Clean Air Act Amendments. Much of the existing data on FOG and FOG limits for categorical industries are based on this method. The new EPA-approved FOG method is Method 1664. This method uses hexane and has similar, but not exactly the same, results to method 413.1. Method 413.1 has a slightly higher reading of animal and vegetable FOG than method 1664; and Method 1664 has a slightly higher reading of petroleum oil. In addition, Method 1664 is more labor intensive than Method 413.1, yet the average price for analysis is similar for both methods (price of analysis in Tennessee for both methods range between $25-$50 in 1999/2000).

SECTION II: PREVENTING GREASE FROM ENTERING THE SEWER COLLECTION SYSTEM

The most economical and prudent method for dealing with the growing grease problem is proper pretreatment of waste streams to reduce or eliminate the introduction of grease into the collection system. There is no simple solution to this challenge, as virtually every discharger's waste stream is unique in many ways. These variations can be caused by building layout, property location, wastewater volume, staff training, management, cleaning practices, maintenance chemicals, pretreatment systems, monitoring and maintenance of the pretreatment system, and preparation/serving volume of different menu items. What might be effective for reducing grease discharges in one location may be inadequate in another, even among restaurants in the same restaurant chain. This variation in waste streams creates a situation in which many different treatment options should be considered. This section will discuss different aspects of FOG production and ways of keeping it out of the sewer.

Zero Discharge of FOG

The most effective way to prevent FOG from causing problems in the collection system is to keep it from entering the collection system in the first place. Some ways to do this are as follows:

1) The person who removes plates from dining tables should be responsible for scraping all left-over food into a container for disposal as a solid waste. Some sewer agencies actually provide semi-flexible scrapers or spatulas for this purpose. Both sides of each plate should be scraped.

2) All cookware should likewise be scraped before being washed.

3) Garbage grinders should not be used.

4) Restaurant managers and personnel should be trained to dispose of cooking oil properly in recycling containers and not pour it down the drain as a short-cut. If necessary, some restaurants may need to consider installing a video camera to show drains and any potential misuse.

Grease Removal Devices

Ideally, FOG would never go down the drain. However, at this time, most restaurants cannot keep 100% of FOG out of the collection system. This is why FOG removal devices and proper maintenance of these devices are so important.

It is important that an FOG removal device be able to remove emulsified as well as free-floating FOG. FOG removal devices are usually one of the following types: passive under-sink devices, large outside passive devices, and mechanical devices. These devices will be described in greater detail in section III.

Kitchen Sources and Operation/Maintenance

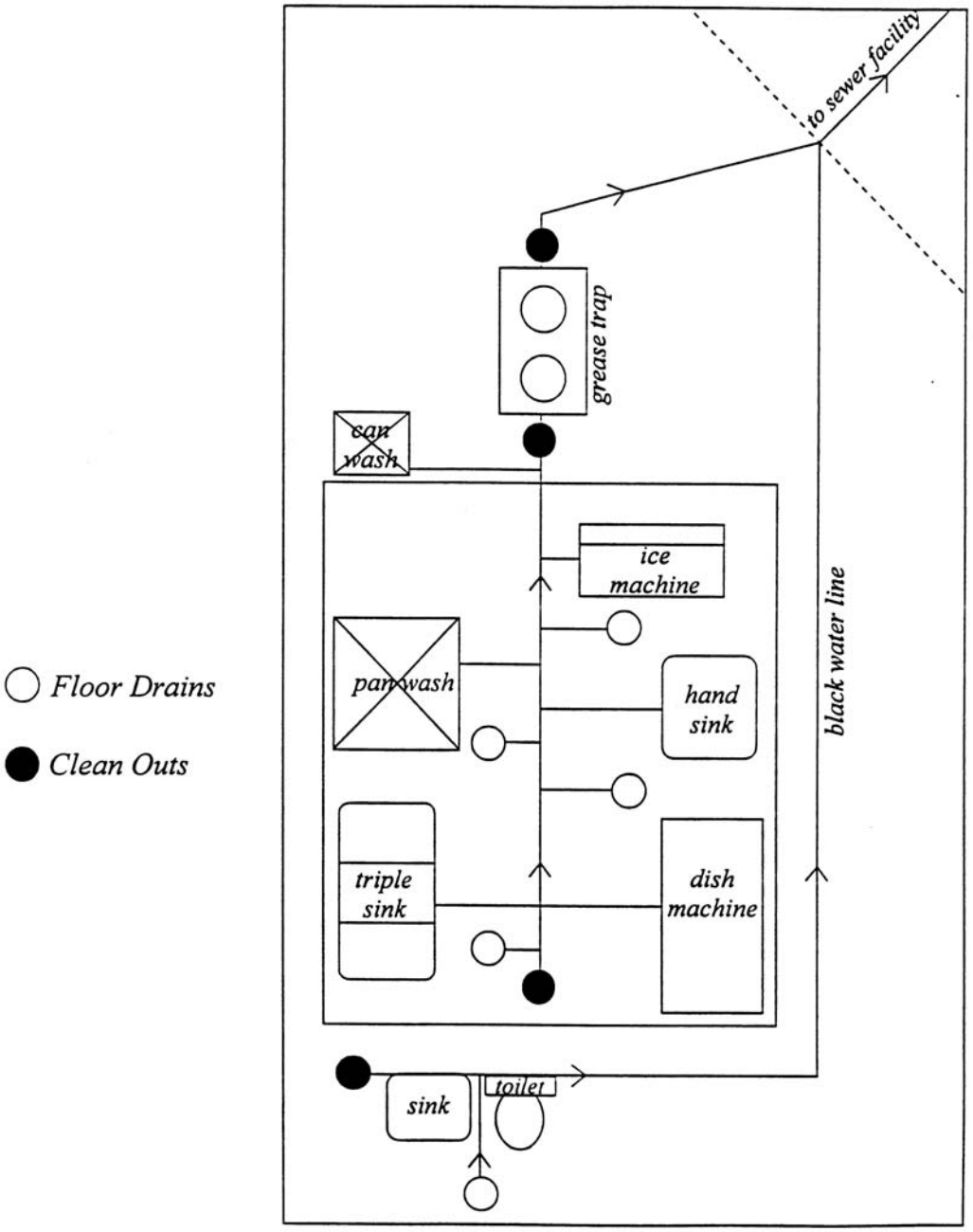
There are multiple sources of FOG in restaurant kitchens. FOG from some of these sources can be recycled and should never be discharged to the sewer system. Waste cooking oil is one of the major sources of FOG that can be recycled, and recyclers may pay the restaurant a small fee for the waste oil in some areas. Restaurants should ensure that personnel are trained to properly store waste oil for recycling and not pour it down the sink or floor drain.

Kitchen sources that discharge to the sewer system include pre-wash sinks, garbage grinders, dishwashers, prep sinks, floor drains, can-wash sinks, steam trays, tilt kettles, floor drains, floor sinks, and hood-cleaning residue (see Figure 1). **Ideally, garbage grinders should not be used at all.** They greatly increase the amount of solids and FOG discharged to the sewer system. If they are used, they must discharge into a grease trap/interceptor, not directly to the sewer. Use of a garbage grinder will most likely increase the frequency of maintenance needed for a grease trap/interceptor. Disposal of food as solid waste (in the trash) should be encouraged instead of using garbage grinders. The Control Authority may consider going as far as forbidding the use of garbage grinders in restaurants. For discharges from dishwashers, there is general agreement that grease interceptors (the under-counter devices) are too small to handle the hot temperatures from dishwashers. However, observers disagree on whether discharge from dishwashers should go through a grease trap or not. Some feel that the discharge from dishwashers should not go through a grease trap because the temperature from a dishwasher is so hot it can cause the FOG to emulsify and pass through the trap. Further, they say that, ideally, grease will have been dry wiped from pots and pans or rinsed in a pre-wash sink, decreasing the amount of FOG from the dishwasher. Many others believe that the amount of wastewater discharged from dishwashers is very small going into a large grease trap; therefore, it does not significantly impact the temperature of the grease trap. Many dishwashers utilize an internal water recycling system and, therefore, do not discharge a large volume of hot (180° F) water. The smallest commercial dishwashers discharge 1.6 gallons/rack (up to 85 gallons/hour). The largest commercial dishwashers run continuously and use 7 gallons/min (420 gallons/hour). The decision to let restaurants connect their dishwashers to grease traps may need to be made on a case-by-case basis. Ideally, if a restaurant dishwasher discharges large volumes of water, the grease trap will be sized to handle these excessive volumes. The Control Authority will need to make sure local building and plumbing codes are in agreement with the FOG control program (e.g., hook-up of garbage grinders and dishwashers to grease traps).

Commercial/residential Sources

When developing an FOG control plan, the Control Authority should keep in mind that restaurants are not the only sources of FOG. Other commercial sources include food manufacturers, food processors, and large-volume lipid lubricant users (wire drawing, bottlers). Control Authorities should also keep in mind food providers in schools, hospitals, hotels, correctional facilities, churches, nursing homes, and other such

Figure 1: Kitchen Sources



facilities. Some of these will already be permitted under a pretreatment program. If they are not already covered, the Control Authority will need to consider how these commercial industries will fit into their FOG control program. In addition, residential properties contribute FOG to the sewer system from normal cooking and cleaning. Further, in some residential areas, "cottage industries" have arisen, where many individual home owners use their kitchens to cook food which is then taken to specific restaurants. A public education program may help decrease the amount of FOG contributed by residential sources. A public education program may include inserting pamphlets in water/sewer bills, talking to local school and civic groups, and asking local newspapers and TV news stations to do a segment on FOG problems and what residents can do to minimize impact on "their" sewer system.

Solvents, Enzymes, Detergents, and Bacteria

Solvents, caustics, and acids may dissolve FOG and transport it out of the facility, but they can have harmful effects on the treatment system. They may also pose a potential hazard to WWTP employees. The use of these chemicals for control of grease in the sewer collection system should be absolutely prohibited by the sewer agency.

Some people swear by enzymes; other people swear at them. Basically, an enzyme is a protein that will act on a compound and break it into several smaller compounds. Enzymes are compound specific; in fact, there are enzymes that will work only on the compounds found in FOG. Although the actual enzymatic action is quite complex, the end result is that the fatty acids are severed from the glycerol base. This allows the FOG to dissolve and move downstream. However, enzyme reactions are all reversible chemical reactions. The free fatty acids can re-join the glycerol base and become FOG, complete with the same characteristics it once had. While this may be beneficial to the restaurant owner, in that the grease interceptor or trap may not need to be pumped as frequently, the FOG problem is just moved downstream and may re-appear in a sewer or a pump station wet well. In addition, enzymes do not replicate themselves. They will be carried out along with the dissolved grease. As a result, enzymes must be frequently introduced into the grease interceptor/trap, representing a continual operation and maintenance aspect of restaurant management.

Detergents are not an effective treatment option, either. They break up grease deposits, but the grease can re-congeal further downstream in the collection system. This may clean blockages from the restaurant's lines, but creates other problems for the WWTP.

Using bacteria to consume sewer grease is effective only when the proper microorganisms are used and applied through a highly developed service system. Bacteria products commonly sold with "do-it-all" claims typically give facility managers a false sense of security. Many distributors of biological liquifiers, enzymes, and other such products claim that their products will eliminate the need to pump a grease trap ever again. This defeats the purpose of a grease trap. Some of the products that claim to be bacterial products are actually inactive forms of bacteria packed in solvents such as

kerosene, toluene, terpene, surfactants, etc. It is actually the solvent, not the bacteria, that dissolves the grease. This may move it out of the food processor's grease trap, but the grease can recongeal in the POTW's collection system. If the Control Authority allows the use of bacteria and/or enzymes, the Control Authority may want to require food processors to get permission on a case-by-case basis. The Control Authority will want to review packing labels or material safety data sheets (MSDS) for information on what is in the product.

SECTION III: GREASE SEPARATION DEVICES

A grease trap or interceptor consists of an enclosed chamber, which is designed to separate and retain oil and grease from the kitchen wastewater. Separation is accomplished by virtue of the fact that fats and grease have a lower specific gravity (are less dense) than water and rise to the surface under favorable conditions. Treated wastewater passes through the chamber and on to the sewer. In order to ensure efficient operation, the separation device must be cleaned periodically to remove the accumulated grease and settled solids and to restore required separation volume.

Often, the words "grease trap" and "grease interceptor" are used interchangeably. Generally, however, a grease interceptor refers to a separation device installed indoors at or near the kitchen fixtures with a design flow rate of 50 gallons per minute (gpm) or less. The term grease trap usually refers to an outdoor separation device with a design flow rate of more than 50 gpm and/or a capacity of at least 750 gallons (The Universal Plumbing Code is opposite of this and refers to interceptors as the large in-ground type of passive devices.)

Grease traps and interceptors must be designed to satisfy three basic criteria in order to ensure effective separation: these are time, temperature, and turbulence.

1) *Time.* The separation device must provide sufficient retention time for emulsified grease and oil to separate and float to the surface of the chamber.

2) *Temperature.* The separation device must provide adequate volume to allow the wastewater to cool sufficiently for emulsified grease to separate.

3) *Turbulence.* Turbulence through the device must be controlled so that grease and solids are not kept in suspension in the wastewater. Turbulence must be controlled, especially during high discharge rates associated with draining a triple sink or multiple fixtures simultaneously.

In addition, the grease trap or interceptor must provide sufficient storage capacity for accumulated grease (the floating particles) and solids (the settling particles) between cleanings.

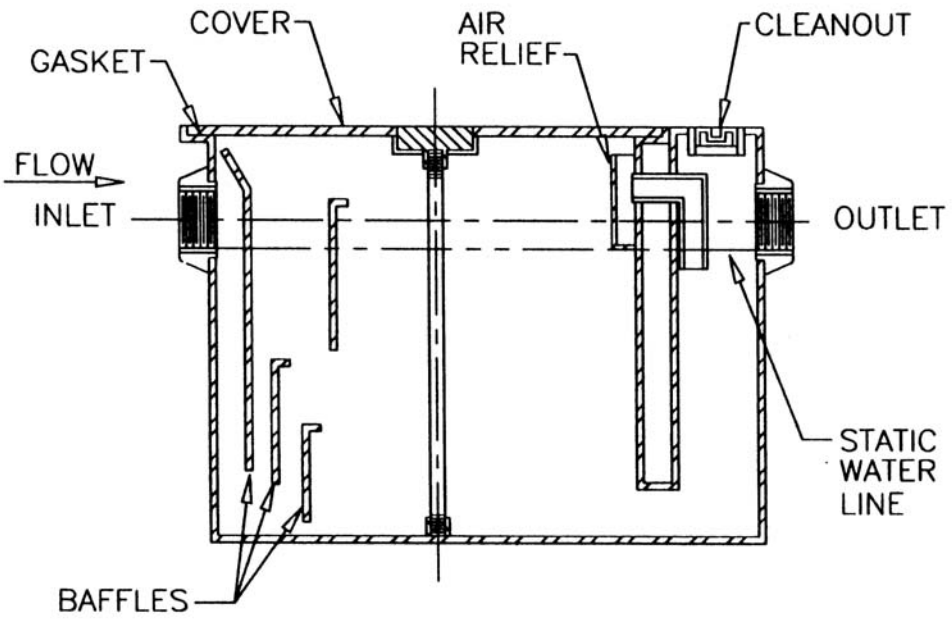
There are two basic categories of grease separation devices: passive and automatic. Passive devices have no moving parts and simply trap and retain grease and solids until physically accessed and cleaned. Automatic or electromechanical devices typically use a heating element to melt the accumulated grease and an automatic skimmer or dipper to periodically remove melted grease to a separate storage compartment. These are discussed in greater detail in the following paragraphs.

Passive Separation Devices

Small Point-of-Use Interceptors

Small interceptors are designed to be installed under the counter or in the floor adjacent to the source of the wastewater, such as a sink or dishwasher. Such devices are typically small (less than 50 gallons capacity, about the size of a 2-drawer file cabinet), are usually constructed of fabricated steel, and are equipped with a vented flow control device and internal flow-diffusing baffle (see Figure 2). They are classified in terms of rated flow and grease storage capacity. Sizes range from 4 gallons per minute with 8 pounds of grease storage capacity up to 50 gallons per minute with 100 pounds of grease storage capacity. New installation costs range from $1,000 to $1,500.

Figure 2: Example Grease Interceptor



These devices are often certified with respect to flow and grease capacity by the Plumbing and Drainage Institute or other such entities. However, it should be understood that certification testing is performed under controlled conditions with clean devices, hot water (150°-160° F), and no detergents. The controlled testing does not reflect the actual

operating conditions in a restaurant kitchen. Most interceptors have flow restrictors on the influent pipe to control flow, which minimizes turbulence. Many restaurants, frustrated with slow-draining sinks, remove the flow restrictors. Needless to say, this keeps the interceptor from working well. In addition, due to their small size, interceptors take a fair amount of maintenance (frequent grease and solids removal – as often as daily). Some jurisdictions no longer permit the use of small point-of-use interceptors as an alternative to larger in-ground traps. In some cases, due to lack of space, some restaurants cannot utilize a large, outdoor, in-ground grease trap and prefer to use a point-of-use interceptor. The best advice that can be given to restaurant owners/managers is to **do your homework!** Evaluate several vendors and call current and/or previous clients of vendors to see how well the equipment works and how much maintenance is required. The Control Authority may not want to be in the position of recommending specific vendors, in case a restaurant uses a recommended vendor and then continues to have problems. Instead, the Control Authority may be willing to make their research available and let the restaurant decide or have the restaurant research the vendors themselves. In either case, the Control Authority should make sure the restaurant realizes that, even if a vendor's equipment does not support the vendor's claims, the restaurant is still responsible for meeting FOG limits. The restaurants must bear the burden of choosing and maintaining equipment so that limits are met.

Precast (or Prefabricated) In-Ground Traps

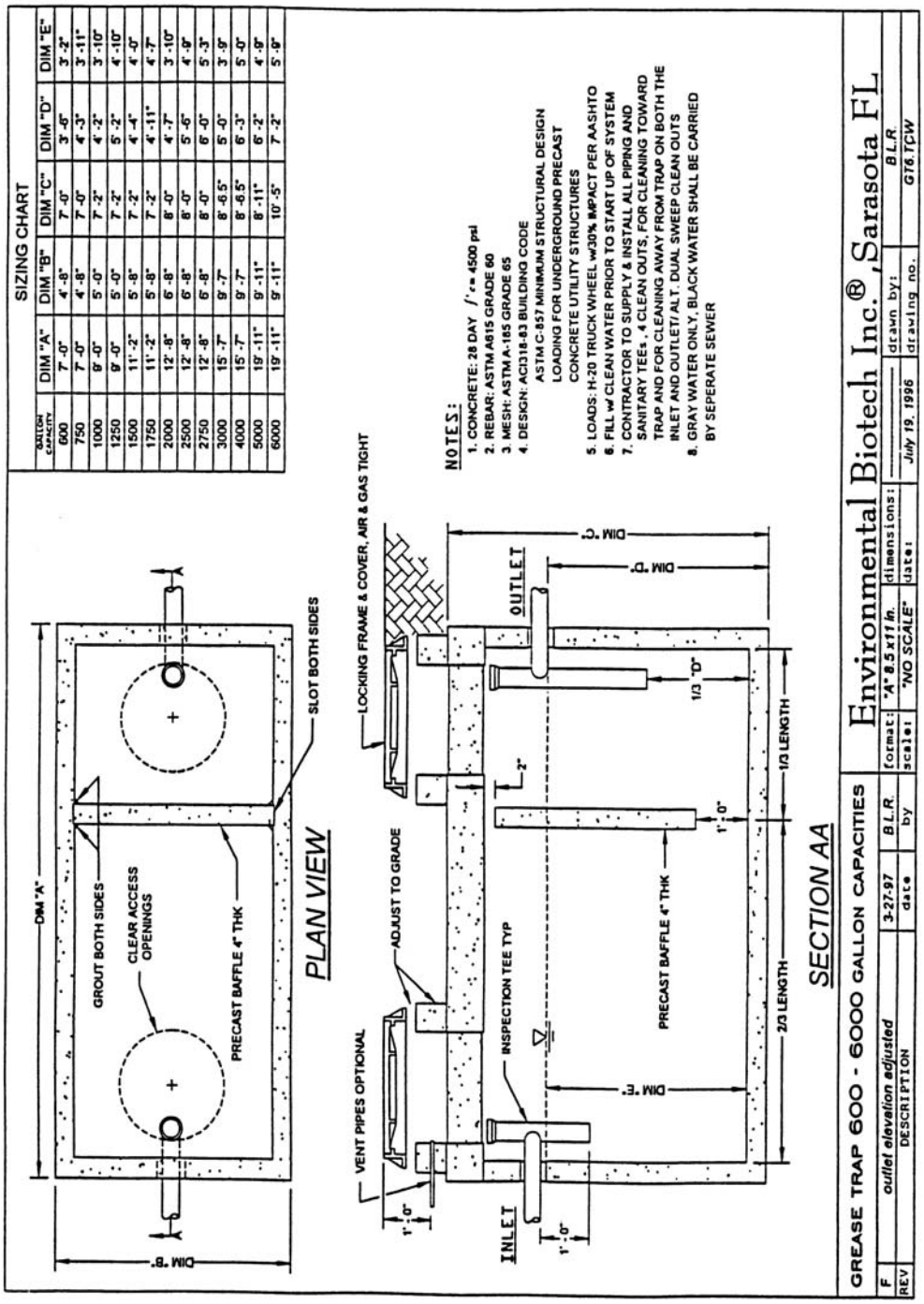
The typical in-ground trap consists of a pre-cast concrete chamber with a liquid volume of 750 to 3,000 gallons (a grease trap with a useable capacity of 1,250 gallons is actually about the size of a box that could hold a Volkswagon Beetle). Such traps are designed to be installed in the ground just outside the restaurant or kitchen (see Figure 3). Design features include the following:

1) *Construction*. Traps must be constructed of durable, watertight materials, usually concrete, with sufficient structural load-bearing capacity for use in traffic areas. Traps should be designed with at least two compartments separated by a full-width baffle. The baffle should be located 2/3 to 3/4 from the influent wall and extend above the liquid level. Liquid depth in the trap should be at least 42 inches.

2) *Access.* Access for cleaning should be provided by two 24-inch diameter manholes terminating 1 inch above finished grade with sealed cast iron frames and cover. Manholes should be located above the inlet and outlet tees.

3) *Inlets and Outlets.* Sanitary tees should be installed vertically on the inlet and outlet pipes. Tees should be the same size as the inlet and outlet piping, but not less than 4 inches in diameter. A pipe nipple with open top should be installed in the top of the tee and should terminate 6 inches below the roof of the trap. The inlet tee should have a vertical pipe drop extending 12 inches below the water surface. The outlet tee should have a vertical pipe drop extending to 1/3 of liquid level capacity from the floor. The elevation of the inlet pipe should be approximately 2.5 inches above the elevation of the outlet pipe.

Figure 3: Example Grease Trap



4) *Location.* Traps should be located just outside the restaurant or kitchen in an easily accessible location out of the way of normal traffic. However, the trap should not be located near the flow from rainwater down spouts or other storm water conveyances. The trap must not be located in flood prone areas. Outdoor installation is preferred due to accessibility. However, indoor installation may be approved by the Plumbing Official in special circumstances.

5) *Prohibited Discharges.* Sanitary wastewater (blackwater) shall connect to the drain line downstream of the grease trap. Garbage grinders are not recommended. If garbage grinders are allowed, they should be connected to the grease trap and the size of the trap increased accordingly

6) *Sizing*. Traps should be designed to provide at least 2 hours detention time at the design flow rate, modified by a loading factor that takes into account the type or location of the restaurant. Several methods of sizing grease traps are available. See Appendix B for examples of grease trap sizing formulas.

7) *Cleaning.* Traps must be inspected and cleaned at regularly scheduled intervals as dictated by on-site experience, but generally not less than monthly. If cleaning is found to be necessary within less than a month, then the grease trap is probably undersized. This could be possible for large buffet or cafeteria-style facilities. It is also a problem when housekeeping BMPs are not used.

8) *Sampling Cleanouts.* Sampling cleanouts should be provided in the inlet and outlet piping just upstream and downstream of the grease trap. In addition, a sampling port should be provided at the point after which the facility sanitary sewer line is combined with the grease trap effluent line before it connects to the POTW sewer. If no combination of the lines occurs before the connection with the POTW sewer, then a sampling port should be installed between the effluent outlet of the grease trap and the POTW connection (Additional sampling information can be found in Section 1.)

Use of pre-engineered fabricated steel grease traps is usually subject to the approval of the Plumbing Official. Such traps must have internal baffles, approved flow control device or flow control means, a vent, and a gas-tight removable cover. Prefabricated steel grease traps must be designed, sized, built, and installed to a standard established by a recognized authority such as the Plumbing and Drainage Institute. More detailed descriptions of sizing methods for grease traps can be found in Appendix B.

When sizing a grease trap, keep in mind that some experts recommend using two or more grease traps in a series instead of one large trap if the sizing formula requires a grease trap of around 2000 gallons or more. Having two smaller grease traps in a series is easier to pump and maintain. Also keep in mind that there may be some old established sections of a town where there is absolutely no space to put in a regularly-sized grease trap. The POTW might consider other options if a grease trap is needed. Rather than a box shaped

like a septic tank, with a certain length, depth, width ratio, the POTW might suggest something oddly shaped, to fit the given space. Further, several sources might be connected to a pipe which, in turn, leads to a grease trap that is located some distance away. POTWs may also need to deal with the question of "grandfathering" facilities under any FOG control program. Some POTWs might opt to allow restaurants currently without a grease trap to continue operation and only require a grease trap to be installed if the current operation goes out of business and a new restaurant moves in. Other POTWs might opt to require all restaurants to install grease traps, regardless of their status.

Installation costs for new in-ground grease traps range from $2,500 to $4,000.

Automatic Separation Devices

Automatic or electromechanical grease interceptors are designed to automatically trap and remove free-floating (non-emulsified) grease and oils (and, in some cases, accumulated solids). These devices usually consist of a prefabricated steel or stainless steel enclosure with internal baffles, removable solids separator screen, grease level sensing probe, electric heater elements, and a skimming or dipper device. The electric heating elements periodically energize to heat the accumulated grease to 115°F to 130°F so that it melts and can be dipped or skimmed off to a separate storage container. Flow ratings and grease accumulation capacities are similar to those for small point-of-use, passive grease interceptors. Interceptor rating is based on controlled testing conditions similar to those used for passive interceptors described above. Again, the best advice that can be given to restaurant owners/managers is to **do your homework!** Costs for new installations range from $3,500 to $4,500.

Properly sized automatic interceptors may effectively trap free-floating grease and oils. However, detention times are generally inadequate to break hot, detergent-laden grease and water emulsions. Therefore, most manufacturers do not recommend use of automatic interceptors downstream of dishwashers. Likewise, because of limited solids retention capacity, manufacturers recommend against use of garbage grinders upstream of the devices.

SECTION IV: DISPOSAL OPTIONS

Pumping

The ultimate disposal of FOG is an important part of an FOG control program. If grease trap pumpers do not do an adequate job of cleaning a grease interceptor/trap or if they discharge the contents of the grease trap into a manhole, the other aspects of the grease control program cannot be effective. When dealing with the issue of grease trap pumping, it is important to remember the following:

1) Generally, grease traps should be pumped when the grease and solids combined measure 30% of the depth of the tank. If a grease trap is not designed well, it may be necessary to consider a smaller percentage. Never allow the grease layer to extend below the bottom of the effluent tee.

2) There are three ways grease traps are usually pumped.

    a. Pumping the entire contents of the grease trap removes the grease layer, solids layer, and water. The sides and bottom are cleaned with a scraper. Tees, baffles, and the bottom can be inspected for problems. This is the method recommended by the Department of Environment and Conservation.

    b. Grease layer pumping removes only the grease layer, leaving the solids and water in the trap. Leaving the solids in the trap does not restore the free water volume necessary to ensure FOG separation. In addition, it will lead to a buildup of solids, which may wash out. Solids accumulation will also reduce hydraulic flow and restrict flow under baffles, creating turbulence. Decaying accumulated solids can lower the pH of the trap, which can corrode the bottoms and baffles of concrete traps. In addition, the interior of the trap cannot be inspected. It is recommended that this method of pumping not be allowed.

    c. Separator trucks pump the contents of the grease trap into the truck, separate the water layer from the FOG, then return the water to the grease trap. Hauling costs tend to be lower with this method, but it returns a highly emulsified liquid to the grease trap. By the very nature of the operation, the holding tank in the truck does not provide all three of the "T"s needed for FOG to separate from water (time, temperature, and turbulence). Some states have outlawed separator trucks. In some areas, there are haulers using trucks that are more technologically advanced than the basic separator truck. These trucks require a certain amount of settling time and in addition use polymers,

filters, and the ability to see where in the truck the separation of the oil/water layers occurs. If the Control Authority allows use of the more technologically advanced separator trucks, they should carefully inspect all separator trucks that want to operate in the area and consider permitting only those that can prove adequate separation. Use of the basic separator trucks that do not allow adequate separation is not recommended.

The Control Authority and restaurants should be wary of disreputable haulers that practice illegal operations such as the "dump and pump". These companies will empty their current truck load into a grease trap, forcing what is in the trap into the collection system. The hauler then pumps what is left in the trap, goes to the next restaurant, and repeats the process.

Whatever means are used to manage haulers, the Control Authority will need to be diligent in enforcing any rules applicable to the haulers. Disreputable haulers not only can cause problems in your collection system, but those that falsify records and/or dump grease-trap waste into the sewer have a competitive advantage over reputable haulers. A properly developed and implemented manifest system could be invaluable in minimizing the problems associated with disreputable haulers.

Recycling Options

If a restaurant recycles all of the oil that can be recycled, relatively small amounts of FOG should actually get to the sewer system. Waste cooking oil (e.g., from deep fryers) can be recycled. However, because the waste oil must be kept outside in a storage tank to be picked up by the recycler, it is not unheard of for a restaurant employee to take a "shortcut" and pour this waste oil down a drain or a sink instead of taking it outside to the storage container, especially in bad weather and when the container is not located conveniently. The Control Authority needs to encourage restaurant managers to do all that they can to keep this from happening. The following are examples of things Control Authorities can do to encourage proper recycling of FOG:

1) Require restaurants to post signs reminding employees not to pour grease in floor drains or in the sink

2) Require restaurants to train employees on FOG disposal

3) Surcharge restaurants for FOG

4) Inspect restaurants, paying careful attention to the condition of floor drains and other areas where FOG may be poured

In addition, some vendors can recycle grease trap waste. The grease trap waste must not be contaminated with sewage (grease traps should not have sewage going through them anyway). Recycled grease trap waste can be used as a dust suppressant, as a binder for

pesticides and fertilizers to help them stick to plants when sprayed on a field, and as a manufacturing lubricant. Some grease renderers have even used recycled cooking grease and recycled grease trap waste as a fuel substitute for natural gas. Some FOG recyclers have been known to use grease trap waste in animal feed, although this practice is not recommended by the USDA due to uncertainties of possible contamination by pesticides, chemicals, and viruses not destroyed in the rendering process. Local grease trap pumpers and grease recyclers can usually be found in the yellow pages under "grease traps."

Sewage Treatment Plant Options

Some sewage treatment plants have the ability to treat grease trap waste hauled to the plant. Animal and vegetable FOG is degradeable by wastewater microorganisms, but there are problems associated with this treatment. The BOD level of FOG is 10,000-30,000 mg/L. The sewage treatment plant must have an aeration system that is capable of supplying the additional oxygen necessary for treatment. A longer solids detention time is also required; and there will be a greater biomass yield. FOG in an activated sludge system will contribute to the growth of *Nocardia* and *M. Parvicella* filamentous bacteria. As fats are broken down, they will adsorb to the floc, making it more buoyant and more prone to clarifier washout. Because of these characteristics, treatment in the aerobic digester is the better choice, provided capacity is available. Anaerobic digestion is also an option, although there is the possibility of increasing the scum layer formation and foaming.

Land application of grease and/or the contents of grease traps is not allowed under rules from the Division of Ground Water Protection. Landfilling of grease waste is allowed if the grease can pass the paint filter test. Most grease trap waste contains free water and will not pass the paint filter test straight out of the pumper truck. It must be dewatered by some method. The methods most feasible are as follows:

1) The addition of an absorbent to the waste to tie up the free water. An example of this would be the addition of sawdust, straw, or other natural absorbent.

2) The evaporation of free water by the addition of heat. This can be done by either sun-drying the material on a drying bed or through some type of mechanical drying.

3) The dewatering of grease by means of mechanical dewatering equipment. Some examples are gravity dewatering with polymer addition, specialized belt filter presses, and vacuum filtering.

For example, Jackson Energy Authority (JEA), in Tennessee, purchased equipment that dewaters grease trap waste using gravity draining and vacuum filtration with polymer injection. The equipment allows JEA to accept grease trap waste from haulers without any grease going through the WWTP. The grease trap waste is dewatered, with the solids going to the landfill and the water going to the head of the WWTP.

SECTION V: EDUCATION

Education of restaurant personnel and the public at large can be an important part of a FOG control program. Education may lead to greater support of the program, thereby increasing the chance of success.

Benefits of Education

Part of an education program is alerting the audience, from restaurants to POTWs to the general public, of the benefits of an FOG control program. Some of the benefits waste generators and handlers can experience by increased awareness and proper training are as follow:

1) Restaurants – Restaurants suffer from grease-related wastewater backups that create health concerns, employee safety issues and expenses to correct these situations. Proper disposal and handling of FOG wastes are predictable and allow management to schedule preventive maintenance. These preventive measures can easily be included in current training programs or presented as stand-alone training sessions for employees. The training will carry over into the homes of the restaurant employees and impact practices in the disposal of domestic wastes.

2) POTW – Proper awareness and handling of FOG by those producing the waste and those treating the waste will allow more cost-effective practices for the POTW. Decreases in sewer collection system blockages will save the POTW time and money.

3) Environment – Sewer blockages caused by grease can cause raw sewage to back up into restaurants, homes, and streets, contaminating these areas. The overflows are considered violations of NPDES and state operating permits. Proper disposal of FOG will decrease blockages and sewer back ups. This will, in turn, decrease the amount of harsh chemicals used to clear blockages in the sewer system.

4) Recyclers – Stressing to restaurants the importance of keeping FOG out of the sewer system should increase the amount of FOG recycled, benefiting recyclers as well as the environment.

5) Public – Blockages in sewer collection systems can cause sewage to back up into houses, destroying personal property and jeopardizing the health of the public. Control of FOG by restaurants and the public can greatly reduce blockages. In addition, savings by the POTW will ultimately be passed on to the public. Having a progressive program to combat FOG problems would be a bonus from a public relations standpoint.

Steps in an Education Program

The Control Authority will need to take several steps to guarantee a successful education program. First, they must do their homework. Determine how many blockages occur each year due to FOG and how much is spent to clean these blockages. Estimate what the FOG control program will cost per year, not only to the sewer agency, but also to restaurants and other regulated entities. Take pictures of sewer overflows, damaged property due to overflow, and/or the inside of a blocked pipe. Consider highlighting areas on a map with frequent FOG blockages.

The second thing the Control Authority will need to do is educate public officials. Give them detailed information, such as budgets and reports. The most effective way to get the support of the administration is by showing a budget reduction (i.e., how much money can be saved long-term). If the public officials are interested, the Control Authority may want to take them to see trouble areas. The Control Authority should have a detailed plan and be able to answer questions such as "where will the waste go if not down the drain?" and "are there concerns created by this alternate disposal method?" Also, be prepared to answer questions about funding the program initially. Sampling and inspections will take time and money. Some POTWs might include the costs of operating an FOG program through the general sewer fund, by passing the costs along to all its users. Other POTWs might assess each restaurant a flat monthly fee, or adopt a sliding scale, based on the size of the facility or its water usage.

Third, the Control Authority will need to educate the restaurants and other permitted industries. If possible, the Control Authority should go by and discuss the FOG control program with restaurants individually or have group meetings where the program can be explained and restaurant representatives can get their questions answered. Working with the local restaurant association may be beneficial in getting information distributed. Sending flyers is another educational tool. Control Authorities should consider assisting restaurants and industries in establishing an employee education program. The Control Authority employees may conduct part or all of the program. Alternatively, the Control Authority could provide training to a single representative from each facility, who, in turn, could share that information with their co-workers. There are consultants and educational seminar companies that may be utilized as part of a training program.

If FOG from the residential sector is a problem, the Control Authority may want to consider educating the public. This can be done with water bill inserts, meetings with civic groups and school groups, and enlisting the help of the local media. Distributing educational materials at local schools is a means to reaching residential customers. Another possibility would be to get scout troops or various environmental clubs involved.