

The Problems With Exterior Grease Interceptors

By Michael Frankel, CIPE

The purpose of this article is to discuss information obtained from a literature search of various sources consisting of articles appearing in engineering magazines, seminar notes, various code requirements, and also telephone conversations with, and personal correspondence from, various knowledgeable authorities. My intent is show the discrepancies between criteria acceptable to different jurisdictions, suggested parameters and conditions for design purposes based on the data found and to encourage a dialogue and discussion from all interested parties. The aim is to eventually establish standard design criteria and testing procedures that would result in providing a generally accepted sizing protocol for large grease interceptors. Please contact me at mfrankl@aol.com with comments and any test data.

General

The type of grease discussed will be food-related animal and vegetable fats, oils and grease (FOG) normally associated with the preparation and cooking of food. FOG originates from two sources: oils used in the preparation of food and the grease products resulting from the cooking of food. Modern

FOG is composed principally of complex manufactured vegetable oils intended to adhere to food. A smaller proportion is fish and animal fats and oils. A very small amount of vegetable oils will also be present. Little, if any animal fats are currently used for food preparation. Also present are food particles, detergents, sanitizing agents, suspended solids and emulsified grease particles. The FOG produced by cooking, including such things as chicken fat and animal fats from frying hamburgers, solidify in the piping network and are believed to be responsible for a majority of sewer stoppages.

Solidified grease blockages are common in many sewer systems. Smaller grease traps installed adjacent to fixtures and equipment do not adequately separate grease from the waste water due primarily to inadequate or complete lack of maintenance. As a result, FOG flows through the smaller grease trap and into the public sewer system causing stoppages. However, when recommended maintenance is provided, performance of units certified by the Plumbing and Drainage Institute (PDI) standards are excellent. There are occasions where proper maintenance is achieved and the grease traps are emptied into buckets. These buckets are in turn emptied into service sinks or water closets where slugs of water are discharged that include FOG particles.

Compared to the extensive testing, rating and certification standards for smaller grease traps originated by the PDI and the American Society of Mechanical Engineers, larger grease interceptors have not had the benefit of wide attention to research concerned with establishing design, configuration and effluent discharge standards. Smaller grease trap standards can be obtained by contacting the

organizations mentioned.

There is little agreement among various authorities on any aspect of grease interceptor sizing, configuration and design criteria. In fact, there are major disagreements on all of the pertinent information used to size and configure them. No truly scientific method has been used to establish useful criteria, only empirical observations and rules. This can only be resolved by having independent third party testing and observation of interceptors under varying temperature, inflow loading and flow rate conditions, different interceptor configurations and the testing of effluent outflow for the level of FOG under these various conditions. Only then could reliable minimum requirements for interceptors be established.

Definitions

A *grease interceptor* is a device with a capacity of more than 100 pounds of FOG intended to be installed outside a building and specifically designed to trap food-related suspended grease in a wastewater stream. It should allow adequate separation by means of gravity flotation and settlement, using no moving parts or additives to the effluent stream or interceptor, and retain the trapped grease for easy removal from the interceptor. The "clean" discharge from the grease interceptor should be directly connected to the sanitary sewer system.

Retention time is the amount of time wastewater spends in the interceptor from the instant it leaves the inlet pipe to the time it enters the outlet pipe.

Overflow is another term for the flow rate discharging from the outlet of an interceptor.

Capacity is the actual amount of retained grease, in pounds or gallons. One gallon of grease weighs approxi-

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About the Author

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mately seven pounds. This term is not intended to indicate the total size of an interceptor.

Total size is the full rated capacity of an interceptor, in gallons of water.

The *loading level* is the average amount of FOG present in one gallon of wastewater discharging into the interceptor.

A *single service facility* is where one person requires only one paper plate and cup on which to receive a meal.

Major criteria discrepancies

A. Light oils, such as olive and other vegetable oils, have been cited by some jurisdictions as being only a minor nuisance and not a problem. Only grease and oils that would congeal in the sanitary piping network are of concern.

B. There is a lack of consistent allowable levels of FOG in the effluent discharge from an interceptor. Following is a short listing:

1. NYC: Interceptor must remove an average of 90 percent of grease and other extractable matter in the effluent. There is no requirement for FOG level in discharged effluent.
2. Toronto and the Environmental Protection Agency: 150 mg/l.
3. Dallas and others: 200 mg/l.
4. Austin, Texas: 100 mg/l FOG.

C. There is no consistency as to the number or arrangement of baffles inside the interceptor. A small number of jurisdictions recommend two sets, others recommend a single baffle and some recommend no baffles at all.

D. The shape requirements of the unit itself (length, width and height ratios) also differ significantly among various authorities.

E. The minimum retention time is another point of contention. Some jurisdictions recommend a minimum time of 12 minutes, others 15 minutes and some recommend only five minutes.

F. The application of Stokes Law to the separation of FOG is not possible if there are baffles in the interceptor.

G. If cleaning frequency is a primary factor, general industry practice recommends cleaning when 50 percent of the height from the bottom of the interceptor to the invert of the outlet pipe contains grease. Another recommends cleaning when 25 percent of the wetted height contains grease. The EPA recommends cleaning when 75 percent of the wetted height contains grease. A frequency of between 60 and 120 days is generally accepted practice. There is no scientific basis for these figures.

H. An accepted engineering principle states that separation time increases as water temperature decreases. With a larger interceptor volume, a greater mass of cooler water acts to further slow separation. However, a report of tests performed by the city of Toronto, Canada, contradicts this principle by stating that a lower temperature of the wastewater in the interceptor causes the grease particles to clump together making them easier to separate.

I. I have not found much information for the study of the amount of FOG produced by various establishments per day, per customer or meal served. I believe that consider-

able progress would be made toward interceptor design if the amount of FOG emanating from different establishment types was established by test.

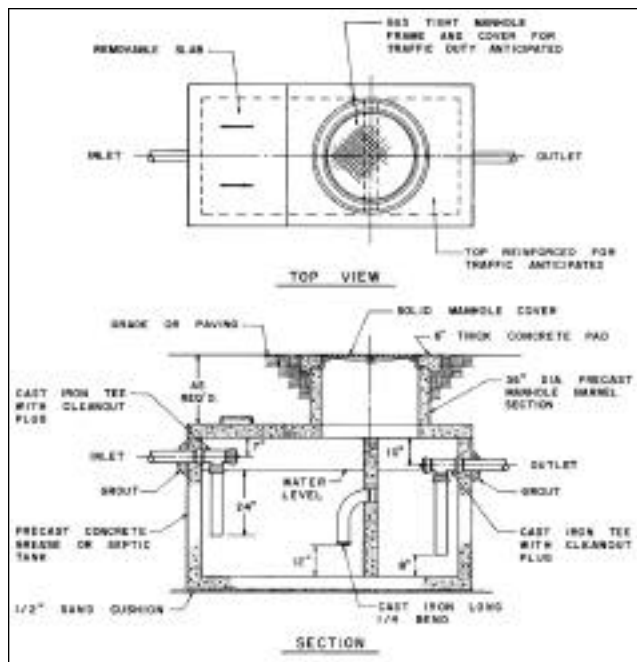
Interceptor design considerations

The following are general design requirements:

- A. Flow control devices should not be used.
- B. Only gravity separation should be considered.
- C. No moving parts should be permitted within the interceptor.
- D. No additives or enzymes should be used.
- E. Solids interceptors should not be considered.
- F. An inlet diverter will reduce eddy currents and avoid short circuiting.
- G. A grease particle size of 100 microns, rather than 130 microns, should be used for design purposes based on an average size of emulsified oil.

Suggested interceptor configuration criteria

- A. A rectangular interceptor is believed to be the optimum shape.
- B. There should be at least four inches above the water level for venting.
- C. An allowance of 12 inches should be provided on the bottom for sludge accumulation.
- D. 50 percent of the wetted height of the whole interceptor (all compartments) should be allowed for the storage of grease.



Basic Detail P-9, from *Plumbing Engineer*, May 1999.

A rectangular interceptor is believed to be the optimum shape, with at least four inches above the water level for venting and an allowance of 12 inches on the bottom for sludge accumulation. Two appears to be the optimum number of compartments, with a baffle installed to divide the compartment into approximate 2/3 and 1/3 sections.

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- E. Six to 12 inches on the bottom should be allowed for the accumulation of settled solids. The smaller figure should apply to interceptors smaller than 1,000 gallons.
- F. The invert of the inlet pipe should be six to 12 inches off the bottom, clear of the settlement zone. An inlet baffle should be provided, such as a tee facing sideways, to direct flow to the side of the interceptor or other acceptable method.
- G. There should be four inches freeboard above the top of the outlet pipe as a vent space.
- H. Two appears to be the optimum number of compartments. A baffle should be installed to divide the compartment into approximate 2/3 and 1/3 sections.
- I. A 30-inch manhole should be provided.

Suggested interceptor sizing guidelines

Again, the suggested guidelines are my own and presented as alternative to where no codes exist. The maximum probable flow rate can be based on the following table:

Maximum Flow Rate		
Drain outlet or fixture trap size, inches	Drainage Fixture Unit value	Peak flow, gallons per minute equivalent
1-1/2	3	22.5
2	4	30
2-1/2	—	35
3	6	45
4	8	60
<i>Dishwasher</i>		
Up to 30 gallon water capacity		15
Up to 50 gallon water capacity		25
Up to 100 gallon water capacity		40

Sizing procedure based on maximum flow rate

For establishments other than restaurants, the following method is suggested. This was chosen from some of the jurisdictions that sent information to me and because it relates the flow rate of the fixtures to the size of the interceptor.

1. Determine the type of fixtures and the size of a dishwasher (if any) in the establishment discharging into the interceptor.
2. Determine the dishwasher flow rate (if any) and the flow rate of the single largest of all the sinks based on trap size. Use the highest gpm found for either the largest trap size or the dishwasher. This is the maximum probable flow rate into the interceptor.
3. Multiply the maximum probable flow rate by 30 to calculate the minimum interceptor size, in gallons. Pick the standard size with a capacity equal to or larger than the calculated size.
4. A minimum size should be chosen on a sliding scale based on the size of the establishment, as follows:
 - a. For small shops, such as a pizza parlor or other simi-

lar establishments: 200 gallon capacity.

- b. For medium size shops and those with higher FOG potential, such as meat markets, etc: 500 gallon capacity.
- c. For larger size establishments, such as regular supermarkets: 1,000 gallon capacity.
- d. For very large supermarkets and other similar establishments: 1500 gallon capacity.

Sizing procedure based on number of seats

For eating establishments and restaurants of any size, use the following formula, which is adapted from the EPA manual. This was chosen because it is based on the number of seats and appears to have the most realistic sizing criteria of all methods reviewed.

$$TS = D \times GL \times HR/2 \times LF \quad \text{Eq. 1}$$

where

- TS = total size of interceptor, in gallons
- D = number of seats in dining room
- GL = gallons of waste per meal, 5 gallons/meal
- HR = number of hours restaurant is in open
- LF = loading factor
 - 0.8 for active facility or when open more than 8 hours/day
 - 0.5 for light activity or when open less than 8 hours/day

Sizing procedure based on number of meals

The following formula is adapted from the EPA manual and is for use when designing eating establishments and restaurants of any size, but is based on the number of meals.

$$TS = M \times GL \times LF \times SF \quad \text{Eq. 2}$$

where

- TS = total size of interceptor, in gallons
- M = meals prepared per day
- GL = gallons of waste per meal, 4.5 gallons/meal
- LF = loading factor
 - 1.25 with garbage disposal and dishwashing machine
 - 1.0 without garbage disposal
 - 0.75 without dishwashing machine
 - 0.5 without dishwashing machine and garbage disposal
- SF = storage capacity factor
 - 1.7 minimum
 - 2.5 for onsite disposal

The minimum size interceptor should be 750 gallons.

Conclusion

In conclusion, the purpose of this article has been to have a discussion of other systems that work in areas where there is no code mandated requirements. The methods chosen are the result of my own personnel experience and represent a suggested method that has worked in the past with no harmful results. □