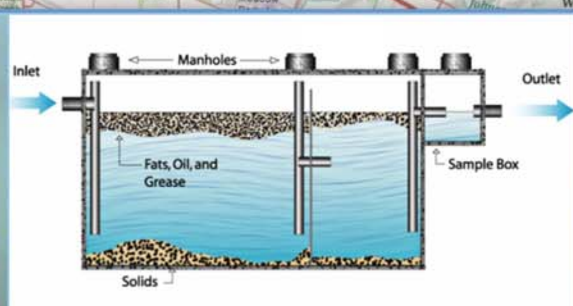
ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

Performance Evaluation of the Trapzilla® Grease Interceptor at a Retail Doughnut Bakery Production Facility in Beaverton, Oregon



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ES EXECUTIVE SUMMARY

ES.1 Purpose

The purpose of this study is to compare the effluent performance of the Trapzilla® TZ-600 separator to an existing 1,000-gallon concrete grease interceptor at a high-volume retail doughnut bakery store operation. Refer to Section 4.0, Field Activities, of the main report for a detailed description of methods as well as photographic references.

ES.2 Third-Party Performance Evaluation

Environmental Engineering & Contracting, Inc. was retained by Thermaco, Inc. to evaluate a Trapzilla® TZ-600 unit replacing a conventional 1,000-gallon concrete grease interceptor at a high-volume retail doughnut bakery store operation in Beaverton, Oregon. The study object was to evaluate three factors:

- Effluent quality
- Frequency of maintenance
- Assessment of downstream sewer material accumulation

ES.3 Conclusions

1. No significant effluent sample difference was observed that contained fats, oils, and grease (FOG) with the concrete grease interceptor vs. the Trapzilla®. The type of doughnut-production process used at this facility generates low concentrations of FOG. Due to the low FOG concentrations in the collected effluent samples, a significant difference in FOG-related performance between the two designs could not be adequately evaluated.
2. Effluent pH improved from a high acidity pH of 3.69 to a mild acidity pH of 4.8 with the Trapzilla®.
3. Effluent biological oxygen demand (BOD) concentrations were significantly lower with the Trapzilla® (2,012 milligrams per liter [mg/L] with the Trapzilla® vs. 6,674 mg/L without the Trapzilla®).
4. Effluent total suspended solids (TSS) concentrations were higher (650 mg/L vs. 387 mg/L) with the Trapzilla®.
5. Less downstream material accumulation in the sewer line was observed with the Trapzilla®.
6. *Acetobacter* bacteria were found to be the most likely causal agent for low pH conditions.

ES.4 Site Information

The doughnut bakery site is a franchise operation of a nationally recognized chain. The facility's existing concrete grease interceptor was eight years old at the time of the study. The existing grease interceptor needed to be replaced because acidic wastewater conditions had degraded the concrete. The concrete grease interceptor was being pumped every two weeks. The Trapzilla® unit was pumped every four weeks.

ES.5 Product Information

The existing concrete grease interceptor had a capacity of 1,000 gallons. The Trapzilla® TZ-600 has a capacity of 95 gallons. The Trapzilla® uses a horizontal and vertical baffling arrangement to create separation and retention within a smaller installation footprint. Trapzilla® is constructed of polyethylene, a material that would better withstand the acidic wastewater observed at this site and extend the operational life of the unit.

ES.6 Field Testing Data#

The concrete grease interceptor was evaluated during a three-month period from December 2011 to late February 2012. At the end of this evaluation period, the concrete grease interceptor was removed and replaced with a Trapzilla® TZ-600 grease interceptor. The Trapzilla® was evaluated for a three-month period from March to early June 2012. See Section 4.0 of the main performance evaluation report for a description of sample collection methods.

Table ES-1, Wastewater Effluent Laboratory Results and Analytical Methods

Device	Date	Parameter					Sample Time
		pH SU	TSS (mg/L)	BOD_5 (mg/L)	Oil and Grease (mg/L)	Total Sulfide (ppm)	
		Analytical Method					
		SM 4500 H+B	SM 25540D	SM 5210B	1664A	SM 4500 S2D	
Concrete Grease Interceptor	12/13/11	--	550	7,840	11	ND	Before pumping
	12/14/11	--	434	8,650	13	ND	After pumping
	12/27/11	3.63	272	4,400	ND	ND	Before pumping
	12/28/11	5.45	269	4,400	5	ND	After pumping
	2/27/12	3.74	412	8,080	ND	--	Before pumping
Trapzilla®	3/2/12	5.31	420	3,300	20	--	After device installation
	3/29/12	4.32	940	870	7	--	Before pumping
	3/30/12	4.86	900	3,100	ND	--	After pumping
	4/30/12	4.81	170	1,000	7	ND	Before pumping
	5/1/12	4.64	370	2,000	23	ND	After pumping
	6/4/12	4.86	1,100	1,800	58	ND	Before Pumping
	6/5/12	10.30	780	890	24	ND	After Pumping

Key: BOD_5 = biological oxygen demand
ppm = parts per million
mg/L = milligrams per liter
ND = nondetect
pH = measure of acidity or alkalinity
SU = standard unit
SM = standard method
SM 4500 H+B = Standard Method for Measuring pH
SM 25540D = Standard Method for Measuring TSS
SM 5210B = Standard Method for Measuring BOD
SM 4500 S2D = Standard Method for Measuring Total Sulfide
1664A = Standard Method for Measuring Oil and Grease
TSS = total suspended solids

The Trapzilla® unit had an average effluent pH of 4.8 versus 3.69 for the concrete grease interceptor. (This average excluded the June 5, 2012, pH reading, which was considered an outlier).

The Trapzilla® unit had lower average effluent BOD concentrations (2,012 mg/L) compared to the concrete grease interceptor (6,674 mg/L).

The Trapzilla® unit had higher average effluent TSS concentrations (650 mg/L) compared to the concrete grease interceptor (387 mg/L).

The effluent FOG measured in both devices was low and total sulfide was non-detectable. The facility's discharged solids predominately consisted of raw dough and frosting materials, which contain little oil and grease.

ES.7 Acetobacter Bacteria Causing Low PH Conditions

The whitish, clumped material found on the concrete grease interceptor wet wall surfaces was tested by Sustainable Scientific Solutions using enzymatic materials and was determined to be cellulosic matter created by *Acetobacter xylinum* bacteria. The *Acetobacter xylinum* bacterium is common and is especially proficient at converting sugars and digestible carbohydrates into cellulose and acetic acid. The production of acetic acid creates a low pH condition in the wastewater. The cellulose provides a suitable habitat for the bacteria, and the acetic acid is believed to prevent other bacteria types from growing.

Further research is needed to determine why the Trapzilla® effluent had noticeably reduced acidity. The following are possible explanations for the increased pH:

a. The slick polyethylene walls of the Trapzilla® provided less habitat for bacterial colonization.
b. The shorter hydraulic residence time of the Trapzilla® provided less opportunity for the *Acetobacter* bacteria to produce acetic acid.

ES.8 Reduced Downstream Accumulation with the Trapzilla®

The closed-circuit television (CCTV) video of the downstream sewer showed less material accumulation (potentially attributed to cellulose from *Acetobacter*) downstream of the Trapzilla® as compared to the 1,000-gallon concrete grease interceptor. The factors explained above are believed to be the cause of the decreased accumulation. Refer to Section 5.2, Closed-Circuit Television Observation, of the report for the CCTV methods and photographic references.

ES.9 Summary

While this site did not generate appreciable FOG, the Trapzilla® achieved comparable separation efficiency compared to the 1,000-gallon concrete grease interceptor. The effluent pH improved by 1.11 units (a significant reduction in acidity). The effluent BOD concentrations were reduced by 70%, while the effluent TSS concentrations were increased by 67%. The downstream sewer deposits were visibly reduced with the Trapzilla® versus the 1,000-gallon grease interceptor.

Further evaluation is required to determine if the low pH, high TSS, and downstream material accumulation is due to the conversion of sugars and carbohydrates by *Acetobacter* bacteria. Due to its acid-resistant polyethylene construction, the Trapzilla® separator is expected to have a longer operational lifetime than the replaced concrete grease interceptor.

1.0 INTRODUCTION

Environmental Engineering & Contracting, Inc. (EEC) [1] is a consulting and engineering firm that supports municipal waste pretreatment and collection system projects. EEC routinely conducts studies for public and private entities throughout California and the United States.

EEC prepared this report to document the results of a field performance evaluation of the Trapzilla®, a relatively new grease interceptor device manufactured by Thermaco, Inc. Retained by Thermaco, Inc. as an independent third-party consultant, EEC evaluated the Trapzilla® from December 2011 to June 2012. EEC compared the Trapzilla® to a conventional concrete grease interceptor traditionally used for treating wastewater discharge from a food service establishment (a shop that manufactures and sells doughnuts) in the City of Beaverton (City), Oregon (Figure 1, *Site Location Map*).

2.0 OBJECTIVES

The objective of the study was to compare the performance of the Trapzilla® to the performance of a conventional concrete grease interceptor. The evaluation is based on the following factors:

- Quality of effluent
- Visual assessment of the device
- Inspections of the downstream private lateral using closed-circuit television (CCTV)
- Frequency of maintenance (i.e., waste pumping)

EEC conducted six individual site visits to the subject facility to collect water samples, observe pumping events, and review downstream CCTV (Figure 2-1, *Site Layout*).

[1] EEC is a wastewater consulting company with specific expertise in fats, oils, and grease (FOG) issues. In 2004 and 2006, EEC conducted two of the largest national FOG-control studies to date for the Orange County Sanitation District. EEC has conducted numerous FOG characterization studies throughout the United States that involved gathering evidence of FOG accumulation in sewer lines using closed-circuit television (CCTV) inspection and sampling of grease interceptors.

Figure 2-1, Site Layout

Layout of All Evaluation Elements at the Subject Facility

3.0 BACKGROUND

As a high-volume food service establishment, the facility generates wastewater that requires pretreatment (namely, removal of oil and grease) prior to discharge to the City's sewer system. Approximately eight years ago, an in-ground, precast, 1,000-gallon concrete grease interceptor was installed at the facility to separate oil and grease from the facility's wastewater. Prior to this study, the concrete grease interceptor in place at the facility was deteriorating and not functioning optimally. The City required that the failing grease interceptor be replaced with a new unit. Due to the nature of the wastewater discharged from this facility (further discussed in Section 5.3), a new, corrosion-resistant unit was chosen for the facility. For this purpose, Thermaco, Inc. offered to install the Trapzilla® grease interceptor.

According to Thermaco, the patented design of the Trapzilla® grease separator uses both horizontal and vertical baffling surfaces to separate and retain higher volumes of grease/oils relative to the unit's internal volume. Thermaco, Inc. tested the Trapzilla® using ASME A112. 14.3, Grease Interceptor Standard, and observed that the unit maintained a consistent (flat) separation of grease/oil up to 85% of the unit's internal volume, which is a higher retention capacity than standard-design separators that use vertical inlet and outlet baffle configurations.

The Trapzilla® unit installed at the facility is the model TZ-600 with an internal liquid volume capacity of 95 gallons. The TZ-600 was installed inside the walls of the dismantled concrete grease interceptor (see installation photos) and soil was back-filled into the surrounding open-cavity areas.

Thermaco, Inc. agreed to compensate the facility for installation and evaluation of the new grease interceptor, and retained EEC to conduct the study. The parties involved and interested in the outcome of the study include the City Public Works Department, which maintains the Beaverton municipal sewer collection system; Clean Water Services (CWS), a water resources management utility in the Oregon Tualatin River Watershed;[2] the facility owner; and Thermaco, Inc.

The concrete grease interceptor, later replaced with the Trapzilla® unit, is located immediately outside of the subject facility, north of NW Cornell Road (Figure 2-1). The entry point for CCTV inspection and jet flushing is located immediately adjacent to the grease interceptor location on the east side of the facility. The CCTV inspection and jet flushing was conducted from the cleanout point to the downstream manhole located at the east end of the facility's parking lot.

4.0 FIELD ACTIVITIES

From December 2011 to June 2012, EEC conducted six individual site visits scheduled according to the pumping frequency for each device (Table 4-1, *EEC Field Visits and Related Activities to Date*). Typically, a grease interceptor device must be pumped out before its contents reach 25% of its overall fluid capacity—this is known as the 25% rule—which is determined by using a probe or similar device to measure the floating and settleable solid materials (Appendix A, *25% Rule Example*). The total of floating and settleable solid materials is then divided by the total fluid depth to determine the percentage of accumulation. EEC used the 25% rule to establish the pumping frequency for the Trapzilla®. Field evaluations were conducted on a monthly basis to coincide with the pumping frequency for this device. Due to the level of degradation and apparent pass-through of solid materials causing downstream accumulation in the sewer system, the concrete grease interceptor had to be pumped biweekly. EEC conducted field work every two weeks to coincide with biweekly pumping of this unit.

Table 4-1, EEC Field Visits and Related Activities to Date

Task	Start	End
Grease Interceptor Performance Evaluation		
Baseline Establishment	December 13, 2011	December 14, 2011
Performance Evaluation 1	December 27, 2011	December 28, 2011
Performance Evaluation 2	February 27, 2012	February 28, 2012
Trapzilla® Unit Installation		
Installation Oversight	February 29, 2012	March 2, 2012
Trapzilla® Unit Performance Evaluation		
Baseline Establishment	March 1, 2012	March 2, 2012
Performance Evaluation 1	March 29, 2012	March 30, 2012
Performance Evaluation 2	April 30, 2012	May 1, 2012
Performance Evaluation 3	June 4, 2012	June 5, 2012

Note: Performance Evaluation 2 for the concrete grease interceptor and Baseline Establishment for the Trapzilla were conducted during the same site visit.

[2] CWS works with 12 member cities to build and maintain the public sanitary sewer and surface water management system.

The purpose of the first site visit (December 13 to 14, 2011) was to establish a baseline, or existing conditions, for the performance of the concrete grease interceptor. It was important to establish a baseline for each device to effectively evaluate their performance during the test period; follow-up evaluations were compared to these baseline conditions. The baseline evaluation included wastewater quality monitoring and condition assessment of the grease interceptor and the downstream private lateral. The key component of the baseline evaluation was ensuring that the concrete grease interceptor and downstream sewer lines were thoroughly cleaned in order to demonstrate that the solids accumulation and sample results were representative of the evaluation period. The baseline and follow-up site visits (from the end of December 2011 through February 2012) included the following activities (Table 4-1):

- Meeting with the staff and management of the facility
- Field analysis of the wastewater effluent (temperature, pH, and total sulfide)
- Collection of wastewater effluent samples for laboratory analysis (total suspended solids [TSS], biological oxygen demand [BOD], oil and grease, total sulfide, and pH)
- Scraping sampling of solid materials
- Visual inspection of the grease interceptor
    - Inspection of the downstream lateral using CCTV (conducted by subcontractor)
- Maintenance of the grease interceptor, including pumping and cleaning (conducted by subcontractor)
- Jet-flushing/cleaning of the private lateral line (conducted by subcontractor)

After three months of evaluation, the concrete grease interceptor was replaced with a new Trapzilla® unit on March 1, 2012. The Trapzilla® unit was installed by a contractor in the presence of EEC and representatives from Thermaco, Inc., the City, and CWS. The Trapzilla® was evaluated in the same manner as the concrete grease interceptor.

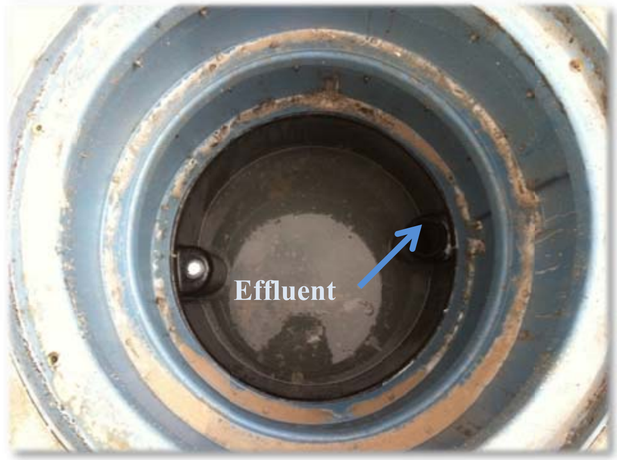
4.1 Wastewater Sampling Methods

This study consisted primarily of field and laboratory analysis of grab samples collected from the wastewater effluent. Due to the lack of a proper sample box in the existing concrete grease interceptor, EEC used best professional judgment to collect the samples. Grab samples were collected using polyethylene containers of 250 or 1,000 milliliters; the samples were then transferred to the appropriate bottles for submittal to the laboratory for analysis (Figure 4-1, *Effluent Sample Collection Points*; Appendix B, *Photos of Sample Collection and Monitoring*). EEC determined that this method was appropriate since the samples were collected for effluent comparison purposes and not for regulatory purposes. The samples were submitted to the TestAmerica laboratory[3] in Beaverton, Oregon, under appropriate chain-of-custody protocols and were analyzed per U.S. Environmental Protection Agency or standard methods.

[3] TestAmerica is a laboratory certified in the State of Oregon.

Figure 4-1, Effluent Sample Collection Points

Concrete Grease Interceptor



Trapzilla®

The samples collected were analyzed for BOD, TSS, oil and grease, pH, and dissolved sulfide.

Biological oxygen demand: BOD is the amount of oxygen taken up by microorganisms that decompose organic waste matter in water; it is used to measure the amount of certain types of organic pollutants in water. BOD is one of the most common measures of pollutant organic material in water. For untreated domestic wastewater, 200 milligrams per liter (mg/L) is considered a medium-strength concentration of BOD.

Total suspended solids: TSS is the amount of non-dissolved solid material present in water or waste water. Suspended particles are typically very small particles that remain dispersed in a liquid that has been turbulently mixed, which can create turbid or cloudy conditions. For untreated domestic wastewater, 200 mg/L is considered a medium-strength concentration of TSS.

Oil and Grease: Oil and grease typically consists of compounds such as fats, soaps, fatty acids, hydrocarbons, waxes, and oils. Oil and grease analysis attempts to quantify compounds that have a greater solubility in an organic solvent than in water, and measures the levels of oil and grease present in water.

pH: pH is a measure of the acidity or alkalinity of a fluid. The pH of any fluid is the measure of its hydrogen ion (H^+) concentration relative to that of a given standard solution. The pH may range from 0 to 14, where 0 is most acidic, 14 is the most alkaline, and 7 is neutral.

Dissolved sulfide: Dissolved sulfide describes any of three classes of chemical compounds containing the element sulfur: inorganic sulfides, organic sulfides, and phosphine sulfides. Organic sulfides were the most common types of dissolved sulfides identified in the study. A low concentration of dissolved sulfide (i.e., 20 mg/L or less) indicates a low probability of generating hydrogen sulfide and odors; a high concentration of dissolved sulfide (i.e., 50 mg/L or more) indicates a high probability of generating hydrogen sulfide and odors.

5.0 SAMPLING RESULTS

5.1 Wastewater Quality

The laboratory results of the wastewater samples collected are summarized in Table 5-1, *Wastewater Effluent Laboratory Results and Analytical Methods*.

Table 5-1, Wastewater Effluent Laboratory Results and Analytical Methods

Device	Date	Parameter					Sample Time
		pH SU	TSS (mg/L)	BOD_5 (mg/L)	Oil and Grease (mg/L)	Total Sulfide (ppm)	
		Analytical Method					
		SM 4500 H+B	SM 25540D	SM 5210B	1664A	SM 4500 S2D	
Concrete Grease Interceptor	12/13/11	--	550	7,840	11	ND	Before pumping
	12/14/11	--	434	8,650	13	ND	After pumping
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	2/27/12	3.74	412	8,080	ND	--	Before pumping
Trapzilla®	3/2/12	5.31	420	3,300	20	--	After device installation
	3/29/12	4.32	940	870	7	--	Before pumping
	3/30/12	4.86	900	3,100	ND	--	After pumping
	4/30/12	4.81	170	1,000	7	ND	Before pumping
	5/1/12	4.64	370	2,000	23	ND	After pumping
	6/4/12	4.86	1,100	1,800	58	ND	Before Pumping
	6/5/12	10.30	780	890	24	ND	After Pumping

Key: BOD_5 = biological oxygen demand
ppm = parts per million
mg/L = milligrams per liter
ND = nondetect
pH = measure of acidity or alkalinity
SU = standard unit

SM = standard method
SM 4500 H+B = Standard Method for Measuring pH
SM 25540D = Standard Method for Measuring TSS
SM 5210B = Standard Method for Measuring BOD
SM 4500 S2D = Standard Method for Measuring Total Sulfide
1664A = Standard Method for Measuring Oil and Grease
TSS = total suspended solids

The results of wastewater sampling show a general improvement in the quality of the wastewater collected from the Trapzilla® unit versus wastewater collected from the concrete grease interceptor. The pH of effluent from the Trapzilla® was, on average, 1.11 SU higher than the pH of effluent from the concrete grease interceptor; the average pH was 4.8 for the Trapzilla® effluent versus 3.69 for the concrete grease interceptor effluent. A higher pH indicates a less acidic, and therefore higher quality, effluent.

Effluent from the Trapzilla® unit also had lower BOD concentrations compared to the effluent samples from the concrete grease interceptor. On average, the study observed a decrease of 4,662 mg/L in the concentration of BOD with the Trapzilla® in place; the average BOD concentration was 2,012 mg/L for the Trapzilla® versus 6,674 mg/L for the concrete grease interceptor.

Effluent from the Trapzilla® unit had generally higher TSS concentrations compared to effluent from the concrete grease interceptor. The study observed an average increase of 263 mg/L in TSS concentrations with the Trapzilla® in place; the average TSS concentration was 650 mg/L for the Trapzilla® versus 387 mg/L for the concrete grease interceptor.

Oil and grease measured in the effluent from both devices was generally low; most likely, this is because the facility generally uses materials, such as raw dough and frosting materials, that inherently contain very little oil and grease. Sulfides were not detected in any of the samples collected throughout the study. With the sulfide results being less than 20mg/L, any odors or corrosion is not directly linked to the presence of sulfides.

5.2 Closed-Circuit Television Observations

Drain Away Rooter of Gladstone, Oregon, conducted CCTV inspections at the facility. The CCTV inspections were conducted in the downstream private sewer line for both the concrete grease interceptor and the Trapzilla® unit. The CCTV camera is operated by pushing the camera through the sewer line and then recording the observations as the camera is smoothly pulled back through the line. The camera was inserted into the sewer line through a cleanout access just downstream of the device locations (Figure 1-1). Although the distance between the device and the downstream manhole is approximately 240 feet, the CCTV reel is approximately 200 feet in length, so only 200 feet of downstream sewer was televised at a time. The grease waste and sanitary sewer join 20 feet downstream of the device.

The private sewer line was jet flushed/cleaned prior to the initial CCTV inspection to establish a baseline for observations. The jet flush/cleaning was also conducted by Drain Away Rooter. The contents of the cleaning were captured in the downstream manhole by a certified pumping company. Since the concrete grease interceptor was pumped biweekly, the follow-up CCTV inspection was conducted two weeks after the baseline was established.

Baseline CCTV inspection of the concrete grease interceptor was conducted on December 14, 2012. Two weeks after the private sewer line was cleaned, a noticeable accumulation was observed in the private sewer line downstream of the concrete grease interceptor (Figure 5-1, *CCTV Observations of Concrete Grease Interceptor*). CCTV inspection was conducted before the concrete grease interceptor was removed on February 28, 2012, but that CCTV recording was lost due to technical difficulties. The Drain Away Rooter representative stated that significant accumulation was observed in the downstream private sewer line.

Figure 5-1, CCTV Observations Downstream of the Concrete Grease Interceptor

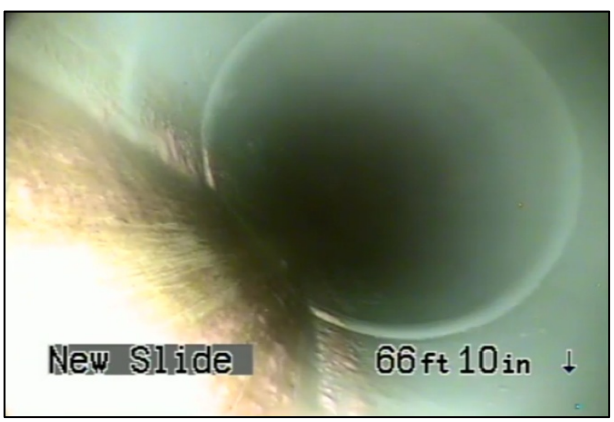
Private Sewer 51'1" Downstream of Concrete Grease Interceptor Immediately After Cleaning on 12/14/2011[4]

Private Sewer 51'2" Downstream of Concrete Grease Interceptor Two Weeks After Cleaning on 12/28/2011

The baseline CCTV inspection of the Trapzilla® was conducted on March 2, 2012. For the Trapzilla® baseline, the downstream private sewer line was also cleaned prior to CCTV. Since a one-month pumping frequency was established for the Trapzilla®, the follow-up CCTV inspections were scheduled on one-month intervals.

Figure 5-2, *CCTV Observations of the Trapzilla® Unit*, below compares the condition of the private sewer line 66 to 67 feet downstream of the Trapzilla® immediately and two months after the installation and cleaning.

Figure 5-2, CCTV Observations Downstream of the Trapzilla® Unit



Private Sewer 66' 10" Downstream of Trapzilla® Immediately After Installation and Cleaning on 3/2/2012[5]

Private Sewer 67' 5" Downstream of Trapzilla® Two Months After Installation and Cleaning on 5/1/2012

The amount of accumulation observed in the downstream private sewer line was similar for both devices. However, CCTV Figures of the concrete grease interceptor taken two weeks after baseline conditions and Figures of the Trapzilla® unit taken two months after baseline conditions show less accumulation in the downstream sewer line after the installation of the Trapzilla®.

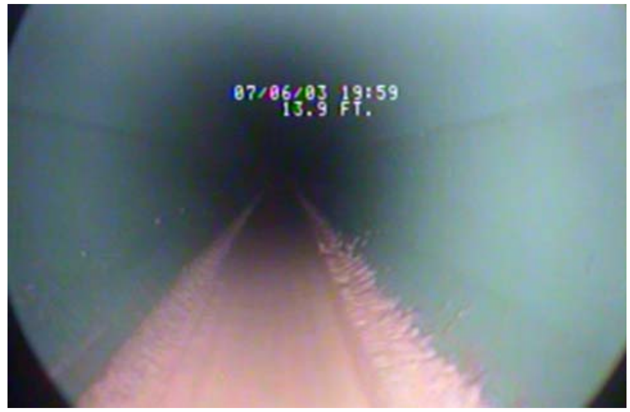
[4] The CCTV image is not high quality. Water shown in the picture is relatively clear with no apparent accumulation.

[5] The CCTV image is not high quality. Water shown in the picture is relatively clear with no apparent accumulation.

The City also conducted CCTV inspections of its downstream sewer lines in May 2012, three months after the installation of the Trapzilla® unit. Figure 5-3, CCTV Observations Conducted by the City of Beaverton, shows the sewer line immediately downstream and two segments downstream, respectively, of the facility's private sewer line.

Figure 5-3, CCTV Observations Conducted by the City of Beaverton

Public Sewer Immediately Downstream of the Facility Private Sewer Line, May 2012

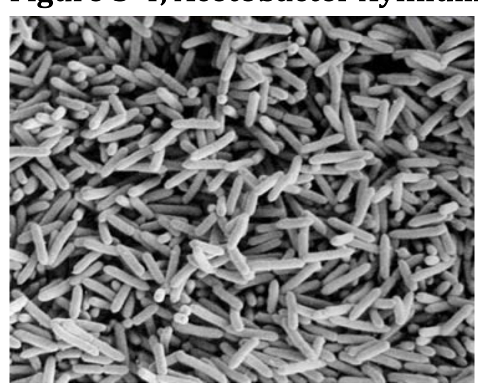


Public Sewer Two Segments Downstream of the Facility Private Sewer Line, May 2012

In Figure 5-3, the image on the left shows significantly less accumulation immediately downstream of the facility's private sewer line, whereas the image on the right shows higher accumulation two segments downstream of the sewer line. Higher accumulation further downstream could be due to sagging in the downstream sewer line or settling of the materials over time. Since CCTV inspection was conducted only after the concrete grease interceptor was removed, the accumulations observed during CCTV observations could not be compared to accumulations that occurred while the concrete grease interceptor was in place.

5.3 Scraping Sampling

Figure 5-4, Acetobacter Xylinum



Acetobacter Magnified 10,000 Times

Another potential explanation for accumulation observed in the downstream sewer line is the presence of *Acetobacter*.[6] Scraping samples of the materials accumulated in the devices and downstream sewer line were collected periodically during the study period. The samples were sent to Sustainable Scientific Solutions for analysis, which confirmed the presence of *Acetobacter* in the samples. *Acetobacter* typically attaches to the walls of the devices and sewer lines in the form of cellulose. The *Acetobacter* breaks down the sugars and produces acetic acid. This could also account for the low pH discussed in Section 5.1.

The low pH of the wastewater in the grease interceptor (i.e., pH less than 5.0[7]) is most likely the cause for the deterioration of the concrete grease interceptor. Acid

[6] A genus of acetic acid bacteria characterized by the ability to convert ethanol to acetic acid in the presence of oxygen.

[7] A pH above 5.0 is the national pretreatment standard for wastewater discharge from facilities.

typically will attack concrete's composition and weaken it over time. This process is accelerated when the concrete mix quality is low or if limestone, which is inherently soft, is used as the aggregate. The quality of construction materials used for the concrete grease interceptor is unknown. Certain measures can be taken to enhance the quality of the concrete (e.g., admixtures, coatings, and higher fly ash concentrations), but these measures generally will only slow down the deterioration over time. A typical concrete gravity grease interceptor in normal pH conditions (i.e., pH above 6.5) should last 30 to 40 years, but the concrete grease interceptor at this location failed after only eight years. For these reasons, a pretreatment device that is made of a synthetic or polypropylene plastic material would be more appropriate for low pH conditions. These types of materials are far more resistant to acidic water conditions.

5.4 Dye Testing

Dye testing investigations were conducted within the facility to determine if the necessary grease-bearing drains were connected to the grease-control devices. Liquid, fluorescent-green dye was applied to each sink and drain within the facility's kitchen area. Observations were then made within the concrete grease interceptor and downstream manhole to observe where the dye appeared. Sufficient time was provided between dye applications to ensure that the discharge path of each drain was clear.

Dye testing was important because the absence of a connection between a grease waste drain and the grease control device could lead to accumulation of grease or solids in the downstream sewer system. Typically, proper measures are taken at the time of construction and plan review to ensure that the proper drains are connected, but for the purposes of the study and in the absence of as-built plumbing drawings, dye testing was necessary.

Figure 5-5, *Dye Testing Observations*, shows the presence of dye in the sewer system and concrete grease interceptor. The results of the dye test indicated that the majority of the grease wastes drained properly to the grease-control devices; one area of the facility's kitchen, however, drained directly to the sewer system. This area was identified as the station where coffee, cappuccino, and ice cream are made. The wastewater discharged in these drains could be a potential cause of accumulation in the downstream sewer system, and could account for the material accumulation seen in the CCTV images.

Figure 5-5, Dye Testing Observations

Dye Observed in Inlet of Concrete Grease Interceptor

Dye Observed in Downstream Manhole of Private Sewer Line

5.5 Pumping Observations

Darling International of Portland, Oregon, pumped and cleaned the concrete grease interceptor and the Trapzilla® unit. The pumping was conducted at midnight to avoid interference with the facility's normal operations. An EEC representative was present on-site to inspect and document the condition of the device by taking photographs after each pumping event.

The City required the concrete grease interceptor to be pumped biweekly due to the deteriorated condition and apparent pass-through of solids from the unit. Figure 5-6, *Concrete Grease Interceptor Observations*, taken after pumping of the grease interceptor, shows the deterioration of the concrete walls and exposed rebar inside the concrete grease interceptor. Even with the deteriorated concrete and exposed rebar, Darling International was able to clean the concrete grease interceptor efficiently.

Figure 5-6, Concrete Grease Interceptor Observations

Concrete Grease Interceptor Immediately After Pumping on 12/14/2011

Concrete Grease Interceptor Immediately After Pumping on 12/28/2011

The Trapzilla® unit was pumped on a monthly basis since installation. The pumping frequency was determined by using an Environmental Bio Solutions, Inc. Dip Stick Probe to measure the settled solids and floatables in the Trapzilla® (see Appendix B). To date, there has been no need to increase the pumping frequency.

Figure 5-7, *Trapzilla Unit After Pumping*, shows the inside of the Trapzilla® after thorough pumping; the photo on the left shows the pumping of the solids compartment of the Trapzilla®. The materials did not adhere to or solidify on the walls of the Trapzilla® unit, and the sloped funnel shape of the Trapzilla® forced the solid materials to the center, where they could be removed by the suction nozzle. However, due to the configuration of the Trapzilla®, it was difficult to see whether all residual solids were removed during pumping.

Figure 5-7, Trapzilla® Unit After Pumping

Interior of the Trapzilla® Immediately After Pumping on 3/30/2012

Interior of the Trapzilla® Immediately After Pumping on 5/1/2012

6.0 CONCLUSIONS

Based on evidence from the evaluation, EEC determined the following differences in performance between the Trapzilla® and the standard concrete grease interceptor:

- **BOD:** On average, BOD concentrations were lower in the Trapzilla® effluent than in the existing grease interceptor effluent, indicating that the Trapzilla® performed better in reducing the concentration of BOD discharged.

- **pH:** On average, pH levels were higher (indicating lower acidity) in the Trapzilla® effluent than in the existing grease interceptor effluent. The Trapzilla® is composed of synthetic material that appears to be more suitable for this particular facility, considering the lower pH conditions inherent in the wastewater discharged at the facility, and should last longer than a typical concrete grease interceptor at this facility. The facility owner is currently researching possible solutions to the low pH levels of its wastewater discharge.

- **Downstream Accumulation:** As observed through CCTV inspections, less residual material accumulated in the downstream private sewer line with the Trapzilla® in place. The study indicated that accumulation is occurring in the City's downstream public sewer line and not in the facility's private sewer line. Since CCTV inspection was not performed on the City's sewer line for comparison while the concrete grease interceptor was still in place, a definitive conclusion could not be made. The evidence suggests that the Trapzilla® was more effective at preventing material from passing into the downstream public sewer line. However, there was some accumulation observed downstream of both devices.

  It should be noted that the downstream accumulation could be due to discharge from the grease waste drain in the facility's kitchen area that was not connected to the grease-control devices (see Section 5.4). The facility will make the necessary plumbing changes to redirect the unconnected drain to the Trapzilla®.

The *Acetobacter* developing in the concrete grease interceptor and the Trapzilla® is likely the cause of the material accumulation in the grease interceptor device and in the downstream sewer system; further investigation is needed to determine whether *Acetobacter* is the culprit.

- **Maintenance Frequency:** During the study, the Trapzilla® required less frequent maintenance (once per month) than the concrete grease interceptor (biweekly). A properly functioning concrete grease interceptor would likely require less frequent pumping.

- **TSS:** On average, TSS concentrations were higher in the Trapzilla® effluent than in the existing grease interceptor. The study could not determine whether TSS concentrations are the cause of the downstream accumulation observed in the CCTV inspections.

- **Oil and Grease:** Oil and grease concentrations are significantly lower in the facility's effluent than in wastewater from other food-service establishments, such as restaurants; this suggests that separation and removal of oil and grease may not be an issue of concern with the facility's wastewater.

FIGURE 1

Legend

Site Location

0 0.75 1.5 3 Miles

N

SITE LOCATION MAP

Subject Facility
Beaverton, OR

Project Number:	W-2263
Date:	9/13/2012

Figure 1

ENVIRONMENTAL ENGINEERING & CONTRACTING, INC.

File:	PM:	Author:
SiteLocation.mxd	JS	RG

APPENDIX A
25% RULE EXAMPLE

25% RULE

Typically a device is required to be pumped out prior to its contents reaching 25% of the overall fluid capacity (the 25% rule). This is determined by using an Environmental Bio Solutions, Inc. Dip Stick Pro or similar device to measure the floating and settleable solid materials. The total materials are then divided by the total fluid depth to determine the percentage of accumulation:

Floatable Materials + Settled Solids = Total Accumulation

Total Accumulation / Total Fluid Depth = Percentage

25% Rule Examples

Accumulation Is Less Than 25%

Accumulation Is Greater Than 25%

APPENDIX B
PHOTOS OF SAMPLE COLLECTION AND MONITORING

1,000 mL Container Used to Collect Wastewater Samples from the Trapzilla®

1,000 mL Container Submerged in the Trapzilla® Effluent Pipe

Dip Stick Probe Used to Verify the Pumping Frequency

Level of Solids Accumulated at the Bottom of the Dip Stick Probe