JUGGLER SAMPLING STUDY

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1.0 INTRODUCTION

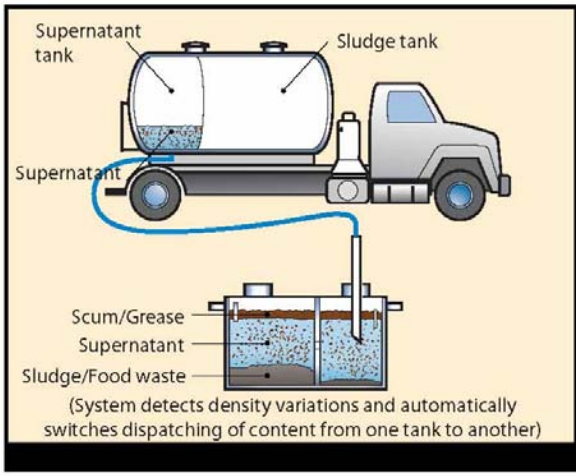
Labrie Environmental Group[1] retained Environmental Engineering & Contracting, Inc. (EEC)[2] to perform third-party sampling of multiple outdoor grease interceptors in Orange County, California to evaluate their "Juggler" vacuum truck technology. Darling International assisted in the Study by providing conventional vacuum trucks and personnel to assist in the pumping operations.

Juggler Truck

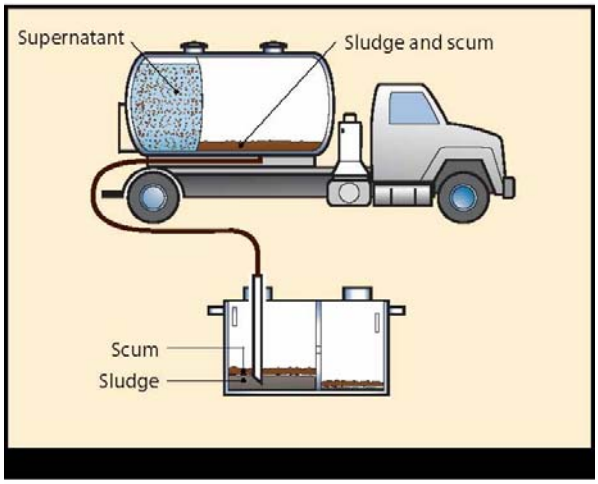
The Juggler is a specialized vacuum truck that removes all of the grease interceptor contents just like a conventional vacuum truck. However, the Juggler first pumps out the grease interceptor water layer between the settled solids layer (i.e., sludge) and floating fats, oils, and grease (FOG) layer (i.e., scum) and stores it in a separate chamber in the vacuum truck. This water layer is called the "supernatant." The Juggler then pumps out the sludge and scum. Once the grease interceptor is pumped clean, the supernatant is processed through the Juggler filtration system and returned to the grease interceptor. Reportedly, in most cases, approximately 60% to 80% of the original pumped grease interceptor volume is returned to the grease interceptor as filtered supernatant. The diagrams below depict the process.

[1] The Labrie Environmental Group (LEG) is an ISO-certified international equipment manufacturer serving liquid and solid waste industries. LEG's engineering group designed the Juggler technology.

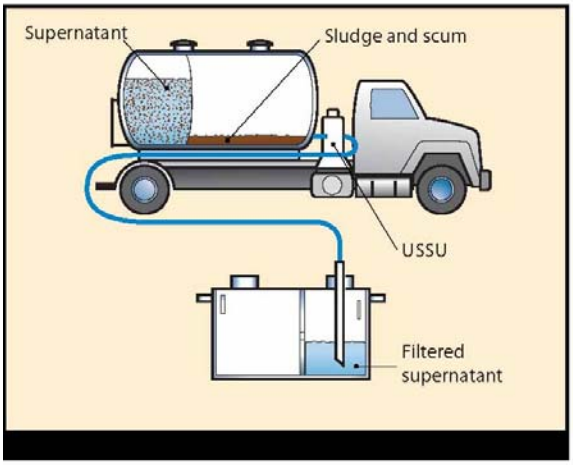
[2] EEC is an environmental engineering company that specializes in wastewater engineering and routinely performs third-party studies involving sanitary sewer and fats, oils, and grease (FOG) control issues. The grease interceptor evaluations and sampling conducted in this Study have been performed by EEC on multiple previous projects. John Shaffer is a Wastewater Chemist and Keith Armstrong is an Environmental Compliance Inspector.



Step 1
Supernatant is drawn up.



Step 2
Sludge and scum are drawn up.



Step 3
Supernatant is treated and returned to tank.

2.0 STUDY PURPOSE AND APPROACH

Returning grease interceptor contents back into a grease interceptor concerns many sewering agencies, even it is treated in some way. If this returned wastewater has a high concentration of FOG, biological oxygen demand (BOD), or total suspended solids (TSS), sewering agencies would logically be concerned that returning this wastewater back to the interceptor may defeat the purpose of pumping out the grease interceptor. On the other hand, if this returned wastewater does not increase the FOG, BOD and TSS concentrations present in the typical effluent of a well-maintained grease interceptor, then this technology would not pose a risk and would provide a significant benefit by allowing three to four times more grease interceptors to be pumped out by one truck per trip. This would reduce the amount of waste to be disposed of, reduce truck traffic and carbon emissions, and provide an opportunity for reduced pumping charges.

Therefore, the purpose of this Study is to determine whether the use of the Juggler technology increases the typical FOG, BOD, or TSS concentrations in grease interceptor effluent.

2.1 Sampling Protocol

EEC sampled multiple grease interceptors connected to a variety of food service establishments (FSEs). EEC utilized the following approach to provide comparison data:

Complete Pump-out (CP) – The effluent of three grease interceptors were sampled before being pumped in a conventional manner (i.e., complete pump-out, no wastewater return). The same grease interceptors were sampled again approximately two days and two weeks after being pumped.

Juggler (J) – The effluent of three grease interceptors were sampled before being serviced by the Juggler (i.e., complete pump-out, filtered supernatant return). The same grease interceptors were sampled again approximately two days and two weeks after being pumped.

Control Site (CS) – The effluent of three grease interceptors were sampled three times in an approximate two week period without the grease interceptors being pumped to serve as a control.

Supernatant Returned to Interceptor (SRI) – The filtered supernatant that was returned to the grease interceptors at the three Juggler sites was sampled during the Juggler servicing.

There were no interceptor flow measurements or retention time calculations conducted. All samples were grab samples collected from one of three locations, as appropriate:

1) The Grease Interceptor Effluent Tee: The samples were collected by inserting a 2"-3" diameter clean glass jar into the 4" effluent tee while wastewater was flowing through the grease interceptor (see picture below). Care was taken to ensure that no sludge that had accumulated on the inside of the tee entered the sample bottle.

2) The Grease Interceptor Sample Box: The samples were collected either directly from the sample box (or after pumping out the contents of the sample box) while wastewater was flowing through the grease interceptor (see picture below). Care was taken to ensure that a representative sample of the grease interceptor effluent could be collected without mixing with old wastewater left standing in the sample box.

3) The discharge of the Juggler hose (the filtered supernatant) as it was returned to the grease interceptor.

Samples collected from grease interceptor effluent tees and sample boxes

The samples were all collected by EEC under strict Chain-of Custody and the proper sample bottles, preservatives, temperatures, and holding times were utilized.

2.2 Sample Analysis

The samples were analyzed for the following constituents by Associated Laboratories of Orange, California, a State of California certified laboratory:

- Total Oil and Grease (O&G) by EPA Method 1664
- Biological Oxygen Demand (BOD) by Standard Method 5210B (5-day)
- Total Suspended Solids (TSS) by Standard Method 2540D

Note: pH and temperature were measured by EEC in the field using a calibrated handheld pH and temperature meter.

The results of the analyses are provided in Table 1. A copy of the laboratory results and Chain of Custodies are included as an Appendix to this report.

Table 1
Grease Interceptor Sampling Results

Associated Laboratories	Juggler			Complete Pumpout			Control Sample (Interceptor not pumped)			Supernatant Returned to Interceptor		
										67% Return	42% Return	61% Return
Sample Reference	**J01**	**J02**	**J03**	**CP01**	**CP02**	**CP03**	**CS01**	**CS02**	**CS03**	**Juggler 1**	**Juggler 2**	**Juggler 3**
Initial Sample ID	**J01-A**	**J02-A**	**J03-A**	**CP01-A**	**CP02-A**	**CP03-A**	**CS01-A**	**CS02-A**	**CS03-A**	**SRI01**	**SRI02**	**SRI03**
(prior to pumping)	6/3/2008	6/5/2008	6/5/2008	6/3/2008	6/3/2008	6/3/2008	6/3/2008	6/3/2008	6/3/2008	6/3/2008	6/5/2008	6/5/2008
Time	5:17	5:10	5:53	7:47	8:31	8:55	9:52	10:19	11:30	5:30	5:39	6:15
Temperature (F)	87	80	72	96	84	85	86	79	87	87	80.6	72.1
BOD5	670	1500	440	290	1800	1400	700	340	1300	1500	2100	860
TSS	138	549	190	66	346	229	118	68	288	599	974	759
FOG	57.3	236	39.6	22.6	133	60.2	87.8	43.3	81	2090	503	450
PH	5.6	6.08	7.25	8.3	5.4	5.1	5.6	5.8	5.8	5.6	5.96	7.71
Second Sample ID	**J01-B**	**J02-B**	**J03-B**	**CP01-B**	**CP02-B**	**CP03-B**	**CS01-B**	**CS02-B**	**CS03-B**			
(~2 days after initial)	6/5/2008	6/7/2008	6/10/2008	6/5/2008	6/5/2008	6/5/2008	6/5/2008	6/5/2008	6/5/2008			
Time	9:30	12:30	9:30	7:48	8:03	8:22	8:45	8:58	6:55			
Temperature (F)	86.4	85	77.2	86.3	78.1	76.5	83.6	81.8	82			
BOD5	1200	1200	630	380	1800	870	1100	250	2000			
TSS	218	319	101	142	218	159	146	18	365			
FOG	55.6	180	32	32.4	133	74.8	124	10.8	174			
PH	5.56	5.75	6.87	8.34	5.1	5.77	5.77	6.34	5.91			
Third Sample ID	**J01-C**	**J02-C**	**J03-C**	**CP01-C**	**CP02-C**	**CP03-C**	**CS01-C**	**CS02-C**	**CS03-C**			
(~2 weeks after initial)	6/20/2008	6/19/2008	6/19/2008	6/19/2008	6/19/2008	6/19/2008	6/19/2008	6/19/2008	6/19/2008			
Time	9:40	8:20	8:45	12:15	12:53	13:10	14:10	14:30	7:15			
Temperature (F)	86.8	86.2	80.5	93.8	88.5	83.8	82.3	83.2	85.4			
BOD5	600	1300	240	370	1400	1200	770	250	2300			
TSS	108	321	90	89	250	189	126	72	408			
FOG	55	193	16	87	100	40	108	26	279			
PH	5.81	5.66	7.04	7.45	4.5	4.82	5.46	6.1	5.37			
Location Name	Arnies	Albertson's	Albertson's	Albertson's	Champage	Fire Grill	Shared	Shared	Costco			
Address	1660 Dove	29941 Alicia	29941 Alicia	14201 Jeffrey	3909 Irvine	3909 Irvine	3988 Barranca	3988 Barranca	27220 Heather			
	Newport	Laguna Nigue	Laguna Nigue	Irvine	Irvine	Irvine	Irvine	Irvine	Laguna Niguel			
	CA 92660	CA 92677	CA 92677	CA 92620	CA 92602	CA 92602	CA 92606	CA 92606	CA 92677			
Location	front	front (#1)	rear (#2)	rear	rear	rear	rear east lot	rear west lot	rear			
Volume (gal)	1,750	1,250	1,000	1,000	1,500	1,500	3,000	2,500	1,500			

Notes:
All samples collected from the Interceptor outlet (during flow conditions) except for the supernatant samples collected from the Juggler hose
All samples collected by EEC (with chain of custody documentation)
Complete pumpouts performed by Darling International

2.3 Core Sampling

Prior to the first sampling event, EEC measured the settled solids (sludge) and floating FOG (scum) layers of each grease interceptor using a Dip Stick Pro core sampler. The purpose of this core sampling was to determine which grease interceptors had greater than a 25% accumulation of sludge and/or scum which may indicate a poorly maintained grease interceptor. If a grease interceptor is poorly maintained and has a significant accumulation of sludge and/or scum, this may result in higher FOG, BOD and TSS effluent concentrations. In addition, this would have an impact on the volume of supernatant that could be returned to the grease interceptor when the Juggler truck is used.

The results of those measurements are summarized in Table 2.

Table 2
Grease Interceptor Core Sampling Results

Grease Interceptor	Total Liquid Depth (inches)	FOG/Scum (inches)	Solids/Sludge (inches)	% Scum/Sludge Accumulation
J01	51	3	6	18%
J02	51	2.5	6	17%
J03	36.5	1	8	25%
CP01	47	1	4	11%
CP02	50	2.5	9	23%
CP03	51	1	10	22%
CS01	51	0.5	12	25%
CS02	46	2	8	22%
CS03	42	13	4	40%

Based on these results, one of the nine grease interceptors (CS03) had greater than a 25% accumulation of sludge and/or scum. Note: Grease interceptors CS01, CS02, and CS03 were not pumped out during the Study.

3.0 DISCUSSION AND CONCLUSIONS

3.1 FOG Concentrations

Evaluating each grease interceptor on a case-by-case basis did not reveal any consistent pattern of increasing or decreasing effluent FOG concentrations from the first sample to the third sample. The one exception was grease interceptor CS03 where the effluent FOG concentrations increased from 81 mg/L to 174 mg/L to 279 mg/L from the first sample to the third. This is not surprising since this interceptor was never pumped out during the Study and had a 40% scum/solids accumulation when the Study started. Although case-by-case evaluations did not reveal much information, the averages of the grease interceptor effluent FOG concentrations and the supernatant FOG concentrations did provide some valuable information.

Juggler Sites

- The average grease interceptor effluent FOG concentration before the pump-out was 111 milligrams per liter (mg/L).
- The average grease interceptor effluent FOG concentration 2-5 days after the pump-out was 89 mg/L.
- The average grease interceptor effluent FOG concentration 14-17 days after the pump-out was 88 mg/L.

Complete Pump-out Sites

- The average grease interceptor effluent FOG concentration before the pump-out was 72 mg/L.
- The average grease interceptor effluent FOG concentration 2 days after the pump-out was 80 mg/L.
- The average grease interceptor effluent FOG concentration 16 days after the pump-out was 76 mg/L.

Control Sites (No Pump-out)

- The average grease interceptor effluent FOG concentration at the initial sampling was 71 mg/L.
- The average grease interceptor effluent FOG concentration two days after the initial sampling was 103 mg/L.
- The average grease interceptor effluent FOG concentration 16 days after the initial sampling was 138 mg/L.

Filtered Supernatant Samples

- The FOG concentrations of the three filtered supernatant samples were 2,090 mg/L, 503 mg/L, and 450 mg/L, respectively.

Based on the averaging of the effluent results, the FOG concentrations at the Juggler sites decreased after the pumping and the overall average FOG concentrations at the Juggler sites were similar to the overall FOG concentrations at the Complete Pump-out and Control Sites. This limited data suggests that the filtered supernatant that was returned to

the grease interceptors by the Juggler did not increase the FOG concentration of the grease interceptor effluent. Note: This is true even though each of the supernatant samples had higher FOG concentrations than the effluent samples and one of the supernatant samples (SRI01) had a FOG concentration of 2,090 mg/L.[3] EEC visually inspected this supernatant sample when it was collected and observed that the FOG/solids were large and rapidly floated to the top of the sample bottle. This appears to indicate that the FOG that was present in the returned supernatant separated in the grease interceptor as it did in the sample bottle.

3.2 BOD Concentrations

Similar to the FOG evaluation, evaluating each grease interceptor on a case-by-case basis did not reveal any consistent pattern of increasing or decreasing effluent BOD concentrations from the first sample to the third sample. The BOD concentrations in the grease interceptor CS03 effluent increased from 1,300 mg/L to 2,000 mg/L to 2,300 mg/L from the first sample to the third. Again, this is not surprising since this interceptor was never pumped out during the Study and had a 40% scum/solids accumulation when the Study started. Although case-by-case evaluations did not reveal much information, the averages of the grease interceptor effluent BOD concentrations and the supernatant BOD concentrations did provide some valuable information.

Juggler Sites

- The average grease interceptor effluent BOD concentration before the pump-out was 870 mg/L.
- The average grease interceptor effluent BOD concentration 2-5 days after the pump-out was 1,010 mg/L.
- The average grease interceptor effluent BOD concentration 14-17 days after the pump-out was 713 mg/L.

Complete Pump-out Sites

- The average grease interceptor effluent BOD concentration before the pump-out was 1,163 mg/L.
- The average grease interceptor effluent BOD concentration 2 days after the pump-out was 1,017 mg/L.
- The average grease interceptor effluent BOD concentration 16 days after the pump-out was 990 mg/L.

Control Sites (No Pump-out)

- The average grease interceptor effluent BOD concentration at the initial sampling was 780 mg/L.
- The average grease interceptor effluent BOD concentration two days after the initial sampling was 1,117 mg/L.

[3] Labrie Environmental Group evaluated the cause of the unusually high FOG concentration and determined that an electrical malfunction caused a lower than normal filtration rate and that the same malfunction triggered the unit to shut down automatically. After re-setting the Juggler system, the FOG concentrations of the other two supernatant samples were significantly lower.

- The average grease interceptor effluent BOD concentration 16 days after the initial sampling was 1,107 mg/L.

Filtered Supernatant Samples

- The BOD concentrations of the three filtered supernatant samples were 1,500 mg/L, 2,100 mg/L, and 860 mg/L, respectively

The BOD concentrations at the Juggler sites increased slightly two days after pumping and then decreased significantly 14-17 days after the pumping. Additionally, the overall average BOD concentrations at the Juggler sites were similar to the overall BOD concentrations at the Complete Pump-out and Control Sites. This data suggests that the filtered supernatant that was returned to the grease interceptor by the Juggler did not significantly increase the BOD concentration of the grease interceptor effluent. Note: This is true even though two of the supernatant samples had higher BOD concentrations than the grease interceptor effluent samples.

3.3 TSS Concentrations

Similar to the FOG and BOD evaluations, evaluating each grease interceptor on a case-by-case basis did not reveal any consistent pattern of increasing or decreasing effluent TSS concentrations from the first sample to the third sample. The TSS concentrations in the grease interceptor CS03 effluent increased from 288 mg/L to 365 mg/L to 408 mg/L from the first sample to the third. Again, this is not surprising since this interceptor was never pumped out during the Study and had a 40% scum/solids accumulation when the Study started. Although case-by-case evaluations did not reveal much information, the averages of the grease interceptor effluent TSS concentrations and the supernatant TSS concentrations did provide some valuable information.

Juggler Sites

- The average grease interceptor effluent TSS concentration before the pump-out was 292 mg/L.
- The average grease interceptor effluent TSS concentration 2-5 days after the pump-out was 213 mg/L.
- The average grease interceptor effluent TSS concentration 14-17 days after the pump-out was 173 mg/L.

Complete Pump-out Sites

- The average grease interceptor effluent TSS concentration before the pump-out was 214 mg/L.
- The average grease interceptor effluent TSS concentration 2 days after the pump-out was 173 mg/L.
- The average grease interceptor effluent TSS concentration 16 days after the pump-out was 176 mg/L.

Control Sites (No Pump-out)

- The average grease interceptor effluent FOG concentration at the initial sampling was 158 mg/L.
- The average grease interceptor effluent FOG concentration two days after the initial sampling was 176 mg/L.
- The average grease interceptor effluent FOG concentration 16 days after the initial sampling was 202 mg/L.

Filtered Supernatant Samples

- The TSS concentrations of the three filtered supernatant samples were 599 mg/L, 974 mg/L, and 759 mg/L, respectively.

The TSS concentrations at the Juggler sites decreased after the pumping and the overall average TSS concentrations at the Juggler sites were similar to the overall TSS concentrations at the Complete Pump-out and Control Sites. This data suggests that the filtered supernatant that was returned to the grease interceptor by the Juggler did not increase the TSS concentration of the grease interceptor effluent. Note: This is true even though the three supernatant samples had higher TSS concentrations than the grease interceptor effluent samples. This appears to indicate that the TSS that was present in the returned supernatant was further treated in the grease interceptor.

3.4 pH and Temperature

The pH and temperature data did not reveal any changes caused by returning the treated supernatant to the grease interceptors. Note: Many of the grease interceptor effluent pHs were below 6.0 and two were below 5.0. This is typical based upon EEC's sampling of other grease interceptors.

3.5 The Bottom Line

Based on the data from this limited Study, there was no evidence that the filtered supernatant that was returned to the grease interceptor (treated by the Juggler technology) caused an increase in grease interceptor effluent FOG or TSS concentrations and there was potential evidence of a slight increase in BOD concentrations. This apparent lack of impact on the grease interceptor effluent is interesting considering that the filtered supernatant returned to the grease interceptors had higher FOG, BOD, and TSS concentrations than the grease interceptor effluent. This appears to indicate that the filtered supernatant was further treated by the gravity separation in the grease interceptor.

Based on this limited data, the Juggler technology appeared to adequately treat the supernatant before returning it to the grease interceptor because the additional FOG, BOD and TSS in the returned supernatant had an opportunity to be further removed in the grease interceptor.

4.0 DISCLAIMER

This was a limited sampling study based on a sampling of nine grease interceptors, each sampled three times. Only three Juggler sites were sampled. Eight of the nine grease interceptors in this Study were also verified by EEC to be well maintained prior to the initial sampling and pump-out. Additionally, the Juggler was being operated by a trained and experienced operator and EEC recognizes that the Juggler equipment must be operated correctly and conscientiously in order for it to be effective. Therefore, the results of the Study may have been different if the Study had included a larger sampling effort, if the grease interceptors had started with a larger accumulation of settled solids or floating FOG, or if a less skilled operator had operated the equipment. Regardless, EEC was able to develop defensible conclusions based on the limited data in this Study.