Laboratory Manufactured High Strength Waste Study

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Introduction

Onsite wastewater treatment systems (OWTS) are traditionally designed for residential strength wastewater. Waste Strength, however, is a variable characteristic of wastewater that is related to the activity and decisions within any structure being served by an OWTS. Certain facilities, such as commercial and food processing establishments, will predictably produce a high strength waste that discharges into OWTS. Most state regulations, however, do not have separate requirements for the design of OWTS or facilities with the potential for higher strength wastewater (HSW). HSW is defined by elevated levels of organics in wastewater measured as biological oxygen demand (BOD_5), total suspended solids (TSS), and/or oils and grease (O&G).

Conventional OWTS designs for commercial properties are not recommended for residential properties due to problems and experience with existing systems. Research reports have concluded that high concentrations of BOD_5, TSS, and O&G contribute to increased failure rates in OWTS. Concentrations greater than residential strength of these parameters will cause early failure by creation of a clogging mat in the dispersal component. BOD_5 in excess of 300 mg/l and O&G in excess of 25 mg/l will shorten the life of drainfields, mounds, sand filters, and some aerobic treatment devices without further treatment (Stuth and Garrison, 1997). The impact of O&G has been found to also be substantial; municipal sewer utilities place a discharge limit of 100 mg/l (Farr, 1991 and Stuth and Wecker, 1997). Minnesota defines HSW as septic tank effluent with concentrations of BOD_5 >170mg/l, TSS >60 mg/l, or O&G>25 mg/l (MPCA, 2011).

The purpose of this study was to develop a standardized high strength waste in a lab, which could then be used to test the relative effectiveness of various pretreatment devices. There is a growing understanding in the wastewater industry that both hydraulic and organic loading rates are important OWTS design parameters (CIDWT, 2009). Pretreatment technologies have been utilized to reduce waste strength, but the infinite variation of waste stream characteristics has limited the ability of manufacturer and regulators to confidently predict the effectiveness or appropriateness of any given device.

State regulators are requesting verification that these units can reduce HSW. Yet, no independent test has been developed to determine how effective pretreatment devices are at removing solids and organics. The NSF International (*NSF International is an independent, not-for-profit organization that provides standards development, product certification, auditing, education and risk management for public health and the environment*) has formed a subgroup to work on developing this standard.

The procedures developed to date to develop HSW in a lab are limited in their breadth and applicability with only one similar study in Florida (Matejcek et al, 2000). To closely mimic actual HSW, it was recommended to supplement influent residential wastewater with complex and simple proteins, sugars and O&G to achieve the suggested key characteristics for testing and treatment (Matejcek et al., 2000).

Several states including Minnesota, North Carolina, Oregon, and Washington, recognize that BOD_5, TSS, and O&G in effluent in excess of residential strength need to be addressed. No direct correlation exists among the three parameters; therefore they are independent in their role in wastewater and all need to be evaluated to characterize HSW (Matejcek et al., 2000). HSW organic values for BOD_5, TSS, and O&G vary greatly in the published data. BOD_5 was found to range from 100 – 3,685 mg/l, TSS from 142 – 4,375 mg/l, and O&G from 50 – 14,958 mg/l (Lowe et al, 2007, Lesikar et al., 2004, Siegrist et al, 1984). This study used wastewater values which are in the middle to high range of median levels in the published literature. These numbers are also recommended and agreed upon by the NSF subgroup. These values represent the wastewater that will enter the first component in the treatment train which may likely be a grease trap or septic tank. These are the target value for the HSW developed in the lab.

- BOD_5 = 2,500 mg/l
- TSS = 1,500 mg/l
- O&G = 300 mg/l

Materials and Methods

In June of 2010 the development of the synthetic HSW began. Products were chosen based on the similar study done in Florida (Matejcek et al, 2000), for their nutritional and structural makeup and their ability to replicate the wastewater characterizes of interest. The HSW was made by mixing various quantities of Armour® lard (O&G), Crisco® (O&G), dextrose (BOD_5), Purina® Puppy Chow® puppy food (TSS), NOW® non-fat dry milk (BOD_5), and Spam® (O&G) with influent wastewater supplied by the Metropolitan

Wastewater Treatment Plant (MWTP) in St Paul, MN. The nutritional content for solid materials can be found in the appendix. Influent wastewater (WWater) was kept in cold room storage ($4^{O}C$) and collected weekly from the plant. During the study fresh (less than one week old) influent wastewater was collected from the MWTP and was tested 6 times, with the results shown in Table 1 having an average TSS of 226 mg/l, BOD_5 of 411 mg/l, and an of O&G 43 mg/l.

Table I: Wastewater Analysis

		TSS	O&G	COD	BOD	
Date	**Sample ID**	**mg/l**	**mg/l**	**mg/l**	**mg/l**	
8/11/10	WWater			318.0		
8/19/10	WWater			305.0		
11/3/10	WWater	68.0		267.0	368.0	
12/16/10	WWater	165.0	40.0		660.5	
12/16/10	Wwater-MVTL	78.0	23.7			
2/2/11	WWater	312.5	54.0		366.0	
2/2/11	Wwater-MVTL	366.0	35.2		380.0	
5/18/11	Wwater-Pace	367.0	62.7		280.0	
		226.1	43.1	296.7	410.9	**AVERAGE**
		68.0	23.7	267.0	280.0	**MIN**
		367.0	62.7	318.0	660.5	**MAX**

Depending on the batch size being analyzed 500-1000ml of wastewater was measured using a graduated cylinder. The pH was measured and adjusted with hydrochloric acid until wastewater was at or near a pH of 7 (+/- 10%).

Approximately 100 ml of wastewater was heated on a hot plate to approximately 45-$50^{O}C$. Solid ingredients were weighed and recorded. The hot wastewater was used to dissolve the dextrose, Crisco, Spam and/or lard. The Spam was also crushed with a spoon or finger. All ingredients and wastewater was placed in the blender and processed for approximately 5 minutes.

Due to challenges with low O&G results and difficulties mixing and dissolving Spam it was replaced with Armour lard in September of 2010. Many recipes were tested in the lab to account for the challenges with uniformity, mixing, and recovery of added solids. All the recipes that were tested in the lab can be found in Table 2.

Samples were then analyzed for Chemical Oxygen Demand using a Hach DRB200 and Hach DR5000, Biochemical Oxygen Demand (EPA Method 405.1), Total Suspended Solids, (EPA Method 160.2), Oil and Grease (EPA Method 1664).

Lab Procedures

Total Suspended Solids (TSS)

Samples were first analyzed for TSS. Whatman, 47mm diameter glass microfiber filters were placed in numbered crucibles and put in the oven set at 105^0C for 24 hours. The filters and crucibles were weighed in a balance and the weights were recorded in a lab book as initial weight. Filters were placed on a glass filter holder attached with a doughnut to a two sidearm flask (Millipore filtration system, Fisher Scientific). A vacuum was turned on and 20 ml of each sample, 10 ml at a time using a pipette was poured through the filter. Once the entire sample had filtered through, the vacuum was turned off and filter was removed with a tweezers and returned to corresponding crucible. When all samples and blanks (20 ml of water run through the filter) were run, the crucibles with filters were placed back into oven set at 105^0C for 1 hour and then placed into desiccator until cool (approximately 30 minutes). Each crucible was weighed and final weight was recorded. *(Condensed description, For full details –see EPA Method 160.2).*

TSS Calculation
TSS (Non-filterable residue) in mg/l = (A-B) x 1,000 / C
where:
A = weight of filter (or filter and crucible) + residue in mg
B = weight of filter (or filter and crucible) in mg
C = ml of sample filtered

Biochemical Oxygen Demand (BOD_5)

Next the samples were prepared to measure the BOD_5. The DO meter (Geotech Environmental, Inc Oxi330I and cell Ox325), was turned on and warmed up for 30 minutes. The pH of the sample was taken with a pH strip. If the pH was not between 6.5 and 7.5, 1N sulfuric acid was added until required pH range was reached and was recorded. BOD bottles were labeled with sample ID as well as dilution amount. Sample dilutions were made and placed into labeled bottles. A blank was done in triplicate. The BOD bottles were filled to the neck with aerated water. DO meter was calibrated; temperature and slope was recorded. The BOD bottle with a stir bar was placed on a stir plate. The probe was placed in the first blank and allowed to stabilize and DO was recorded. If the BOD_5 was less than 7.0 mg/L then the sample was allowed to stir longer or was shaken for a few minutes. The remaining bottles are placed in an incubator which remains dark and was held at a constant 20^{o}+/- 1^{o}C. After 5 days of incubation the samples were removed. The DO meter was re-calibrated and the final DO was recorded. *(Condensed description, full details EPA Method 405.1)*

BOD_5 calculation

BOD_5 in mg/l = Initial DO-Final DO-seed DO (if any) x 300/Volume of sample (ml)

Oil and Grease

Lastly, the HSW was measured for Oil and Grease. 200 ml of the HSW was acidified with HCl until the solution's pH was less < 2 (usually 2-3 ml). Acidified HSW was then poured into a separatory funnel with stopcock (funnel was previously cleaned and dried in oven). The following process was repeated three times before moving onto the next step:

1. Approximately, 30 ml of n-hexane was added to the sample.
2. The sample was shaken for 30 – 40 seconds.
3. The solution was vented between shakes.
4. The sample was then allowed to separate for about 5 minutes.
5. The hexane layer and remaining sample layer were drained into separate glass containers.
6. The sample layer was returned to the separatory funnel and the process was repeated.

All three hexane layers collected were poured into centrifuge tubes and centrifuged for 5 minutes at 500 rpm. The centrifuged sample further separated the hexane layer from organic and water material. The material was removed and hexane layer was placed into a clean container which had been weighed. The sample was put into a lab hood until the hexane was evaporated. The container was weighted again to determine remaining oil and grease of the HSW sample. *(Condensed description, full details-EPA Method 1664.)*

Oil and Grease calculation

$$HEM\ (mg/L) = \frac{W_h\ (mg)}{V_s\ (L)}$$

where:

W_h = Weight of extractable material from Section 11.4.4.1 (mg)

V_s = Sample volume from Section 11.4.5 (L)

Results

To reach the desired concentrations, many recipes were attempted in the University of Minnesota (U of M) lab (Table 2). Experimentation was influenced by U of M lab results, as the recipe formulation was honed to mimic the predetermined characteristic concentrations. Once the U of M lab identified the optimal recipe formulation, samples were also sent to two independent labs; Minnesota Valley Testing Laboratory (MVTL) and Pace Analytical (Pace), to determine variation from lab to lab. Once the recipe switched to using lard (instead of Spam), the average results were always within 10% of the desired 2,500mg/l, $BOD_{5,}$ 1,500mg/l TSS, and 300mg/l O &G.

Table 2 HSW Recipes Analyzed at U of M lab and Independent Labs

		Spam	Dog Food	Dextrose	Crisco	Dry Milk	Lard	TSS	O&G	COD	BOD_5
		g/500 ml	g/500 ml	g/ 500 ml	g/ 500 ml	g/ 500 ml	mg/500 ml	mg/l	mg/l	mg/l	mg/l
Date	**Sample ID**										
7/6/2010	A	0.28	0.43	1.44	0.01			1000.0	300.0		1000.0
7/14/2010	B	0.43	0.42	0.93	0.05	0.25		927.0	688.0	3755.0	3400.0
7/21/2010	C	0.44	0.42	0.94	0.05	0.12		1226.0	418.0	4345.0	
7/28/2010	D	0.44	0.42	0.94	0.05	0.06		950.0	236.0	4006.0	1500.0
7/28/2010	E	0.44	0.42	0.94	0.05			1071.0		4020.0	1373.0
8/4/2010	WWater									397.0	
8/4/2010	D2	0.44	0.42	0.94	0.05	0.06		1201.0	244.0	3720.0	1332.0
8/4/2010	D2	0.44	0.42	0.94	0.05	0.06			155.0	3730.0	
8/4/2010	E2	0.44	0.42	0.94	0.05			1515.0	155.0	4000.0	1369.0
8/4/2010	E2	0.44	0.42	0.94	0.05				192.0	4510.0	
8/11/2010	WWater									318.0	
8/11/2010	dextrose			1.00						2507.0	
8/11/2010	F	0.50	0.50	1.00	0.05	0.10		1324.0	216.0	4368.0	1294.0
8/11/2010	G	0.44	0.42	1.10	0.08	0.10		1475.0	172.5	4783.0	1500.0
8/19/2010	WWater									305.0	
8/19/2010	dry milk(in water)					0.20				2350.0	
8/19/2010	H	0.50	0.50	1.10	0.05	0.20		1625.0	144.5	4868.0	1859.0
8/19/2010	I	0.60	0.60	1.20	0.06	0.20		2215.0	173.5	5993.0	2130.0
9/9/2010	J	0.00	0.50	1.00	0.05	0.15	0.10	1448.0	480.0	4220.0	
9/9/2010	K	0.00	0.50	1.00	0.05	0.15	0.20	1381.0		4130.0	

Date	Sample ID	Spam	Dog Food	Dextrose	Crisco	Dry Milk	Lard	TSS	O&G	COD	BOD_5
9/9/2010	L	0.00	0.50	1.00	0.05	0.15	0.30	1586.0		4430.0	
9/9/2010	M	0.00	0.50	1.00	0.05	0.15	0.40	1651.0	440.0	4860.0	
9/9/2010	N	0.00	0.75	1.00	0.05	0.15	0.10	2138.0		4630.0	
9/9/2010	O	0.00	0.75	1.00	0.05	0.15	0.20	2055.0	280.0	4980.0	
9/22/2010	P	0.00	0.50	1.10	0.05	0.15	0.20	1095.0	97.8	6350.0	2162.5
9/22/2010	Q	0.00	0.50	1.10	0.05	0.20	0.20	1180.0	105.4	5950.0	2356.3
9/22/2010	R	0.00	0.50	1.20	0.05	0.15	0.10	1025.0	111.0	5980.0	2362.5
9/22/2010	S	0.00	0.50	1.20	0.05	0.20	0.10	1020.0	92.2	6590.0	2396.9
10/12/2010	T	0.00	0.50	1.10	0.10	0.15	0.20	1371.0	189.0		1627.5
10/12/2010	U	0.00	0.50	1.10	0.10	0.20	0.20	1542.0	176.0		1394.0
10/12/2010	V	0.00	0.75	1.10	0.08	0.15	0.30	1767.0	185.0		1485.0
10/12/2010	W	0.00	0.75	1.10	0.08	0.20	0.30	1869.0	223.0		1912.5
10/26/2010	X	0.00	0.75	1.20	0.10	0.20	0.40	1994.0	224.0		
10/26/2010	Y	0.00	0.75	1.20	0.10	0.20	0.40	2055.0	234.0		
10/26/2010	Z	0.00	0.75	1.20	0.10	0.20	0.40	1993.0	318.0		
11/3/2010	XYZ	0.00	0.75	1.20	0.10	0.20	0.40	1948.0	243.0	5125.0	2375.0
11/3/2010	XYZ2	0.00	0.75	1.20	0.10	0.20	0.40	1625.0	352.0	5755.0	2735.5
11/3/2010	WWater							68.0		267.0	368.0
11/17/2010	1	0.00	0.65	1.20	0.10	0.20	0.40	1820.0	179.0		2350.0
12/2/2010	1A	0.00	0.65	1.20	0.10	0.20	0.40	1470.0	408.0		2556.3
12/2/2010	2	0.00	0.60	1.20	0.10	0.25	0.40	1883.0	269.0		2881.3
12/16/2010	2	0.00	0.60	1.20	0.10	0.25	0.40	1588.5	345.0		2468.8
12/16/2010	WWater							165.0	40.0		660.5
12/16/2010	2-MVTL	0.00	0.60	1.20	0.10	0.25	0.40	1030.0	220.0		
12/16/2010	Wwater-MVTL							78.0	23.7		
2/2/2011	2	0.00	0.60	1.20	0.10	0.25	0.40	1709.0	395.0		2469.0
2/2/2011	WWater							312.5	54.0		366.0
2/2/2011	2-MVTL	0.00	0.60	1.20	0.10	0.25	0.40	1100.0	184.0		4090.0
2/2/2011	Wwater-MVTL							366.0	35.2		380.0
2/24/2011	2	0.00	0.60	1.20	0.10	0.25	0.40	1680.0	470.0		2591.6
2/24/2011	2- Dup	0.00	0.60	1.20	0.10	0.25	0.40		460.0		2258.3
2/24/2011	2-MVTL	0.00	0.60	1.20	0.10	0.25	0.40	1460.0	534.0		3460.0
2/24/2011	2-Dup- MVTL	0.00	0.60	1.20	0.10	0.25	0.40	1490.0	212.0		3290.0
2/24/2011	2-PACE	0.00	0.60	1.20	0.10	0.25	0.40	1580.0	564.0		4150.0
2/24/2011	2-Dup- PACE	0.00	0.60	1.20	0.10	0.25	0.40	2240.0	609.0		4180.0

Sample 2 with the formula of 0.60g/500ml of dog food, 1.20g/500ml of dextrose, 0.10g/500ml of Crisco, 0.25g/500ml of dry milk, and 0.40g/500ml of lard was tested four separate times on 12/2/10, 12/16/10, 2/2/11, and 2/24/11 and the results are shown in Table 3.

Table 3 Sample 2 U of M analysis

Date	Sample ID	Dog Food g/500 ml	Dextrose g/500 ml	Crisco g/500 ml	dry Milk g/500 ml	Lard g/500ml	TSS mg/l	O&G mg/l	COD mg/l	BOD_5 mg/l
12/2/10	2	0.60	1.20	0.10	0.25	0.40	1883.0	269.0		2881.3
12/16/10	2	0.60	1.20	0.10	0.25	0.40	1588.5	345.0		2468.8
2/2/11	2	0.60	1.20	0.10	0.25	0.40	1709.0	395.0		2469.0
2/24/11	2	0.60	1.20	0.10	0.25	0.40	1680.0	470.0		2591.6
2/24/11	2- Dup	0.60	1.20	0.10	0.25	0.40		460.0		2258.3
						AVERAGE	1715.1	387.8		2533.8
						MIN	1588.5	269.0		2258.3
						MAX	1883.0	470.0		2881.3

Sample 2 was then sent to two independent labs for analysis, with the results shown in Table 4. Sample 2, when tested at the U of M lab, had an average TSS of 1715 mg/l, BOD_5 of 2534 mg/l, and O&G of 387mg/l. Sample 2, when tested at the independent labs, had an average TSS 1483 mg/l, BOD_5 3834 mg/l, and O&G 387 mg/l.

Table 4 Sample 2 Independent Lab analysis

Date	Sample ID	Dog Food g/500 ml	Dextrose g/500 ml	Crisco g/500 ml	dry Milk g/500 ml	Lard g/500ml	TSS mg/l	O&G mg/l	COD mg/l	BOD_5 mg/l
12/16	2-MVTL	0.60	1.20	0.10	0.25	0.40	1030.0	220.0		
2/2	2-MVTL	0.60	1.20	0.10	0.25	0.40	1100.0	184.0		4090.0
2/24	2-MVTL	0.60	1.20	0.10	0.25	0.40	1460.0	534.0		3460.0
2/24	2-Dup-MVTL	0.60	1.20	0.10	0.25	0.40	1490.0	212.0		3290.0
2/24	2-PACE	0.60	1.20	0.10	0.25	0.40	1580.0	564.0		4150.0
2/24	2-Dup-PACE	0.60	1.20	0.10	0.25	0.40	2240.0	609.0		4180.0
						AVERAGE	1483.3	387.2		3834.0
						MIN	1030.0	184.0		3290.0

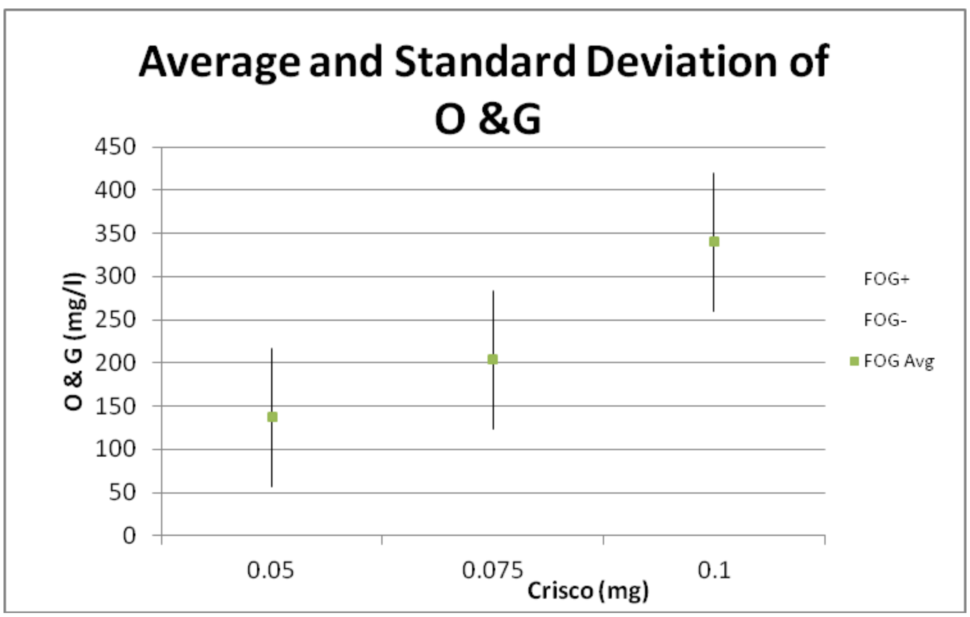
When comparing the U of M results to the independent lab results the TSS results are within 15%, the BOD_5 was within 51%, and the O&G are within 0.2%. The U of M results versus the desired results were; TSS within 14%, BOD_5 1%, and O&G 29%. The independent lab results versus the desired results were; TSS within 1%, BOD_5 within 53%, and O&G within 29%. See table 5.

Table 5 Percent difference between U of M, Independent Lab, and Desired

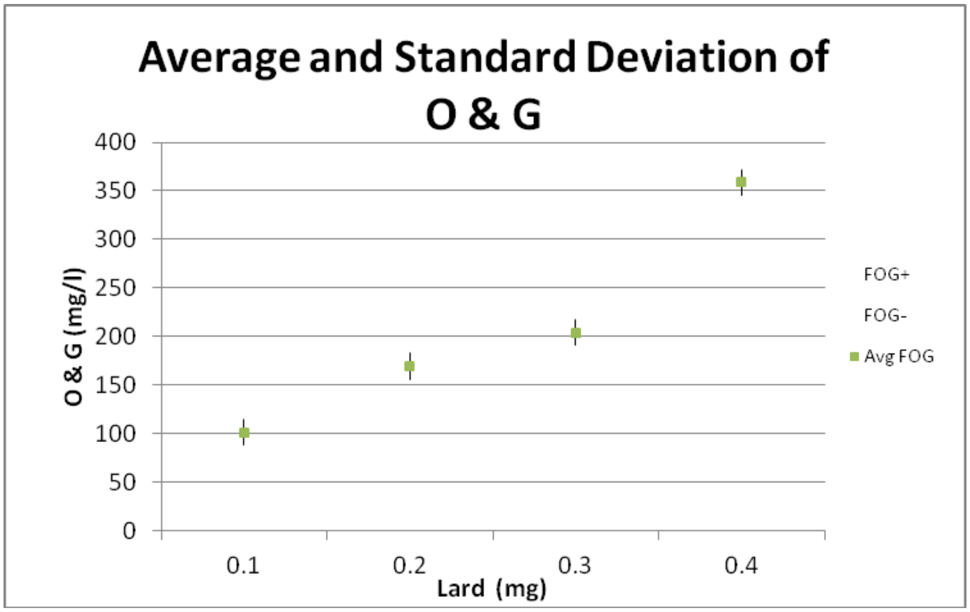
	U of M lab	Ind Lab	Desired	U vs Ind lab	U vs desired	Lab vs Desired
	average mg/ml	average mg/ml	average mg/ml	percent difference	percent difference	percent difference
TSS	1715.1	1483.3	1500	16%	14%	1%
BOD_5	2533.8	3834	2500	51%	1%	53%
O & G	387.8	387.2	300	0%	29%	29%

While each solid material influenced each concentration value; it was assumed that the dog food primarily influenced TSS, Dextrose primarily influenced BOD_5, Crisco primarily influenced O&G, dry milk primarily influenced BOD_5, and lard primarily influenced O&G. Graphs 1-5 highlight how each solid material influences the respective concentration values.

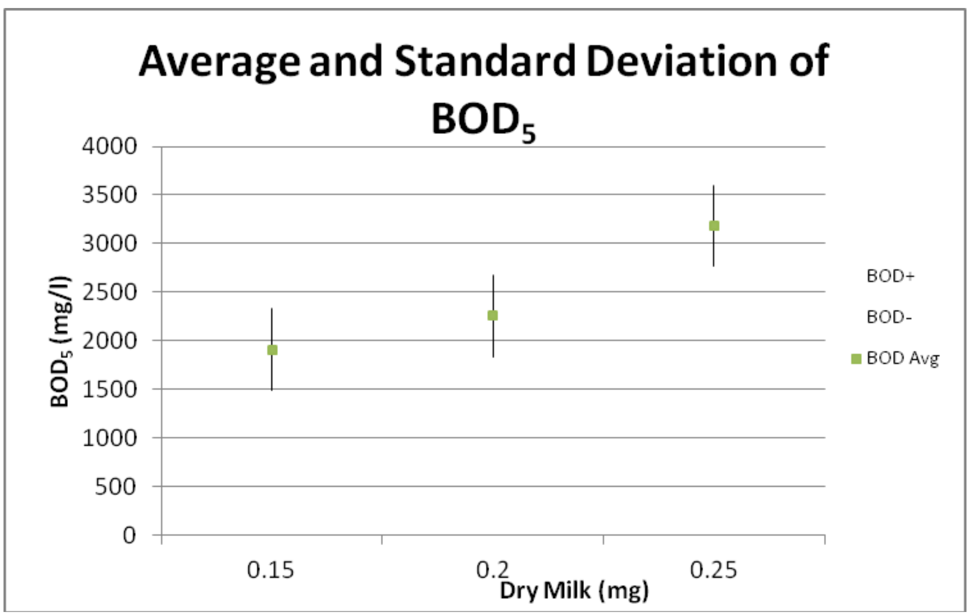
Graph 1 Crisco and O&G



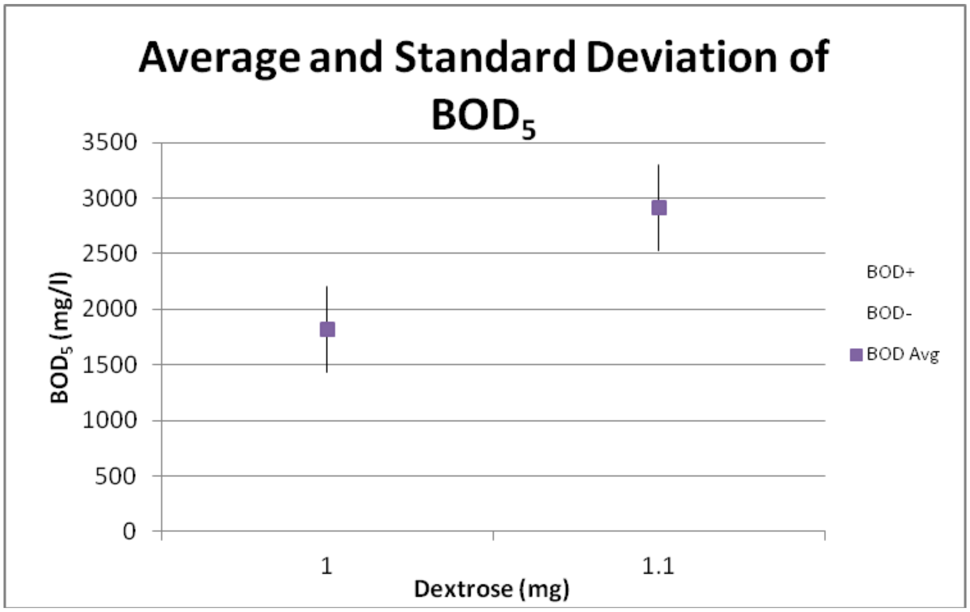
Graph 2 Lard and O&G



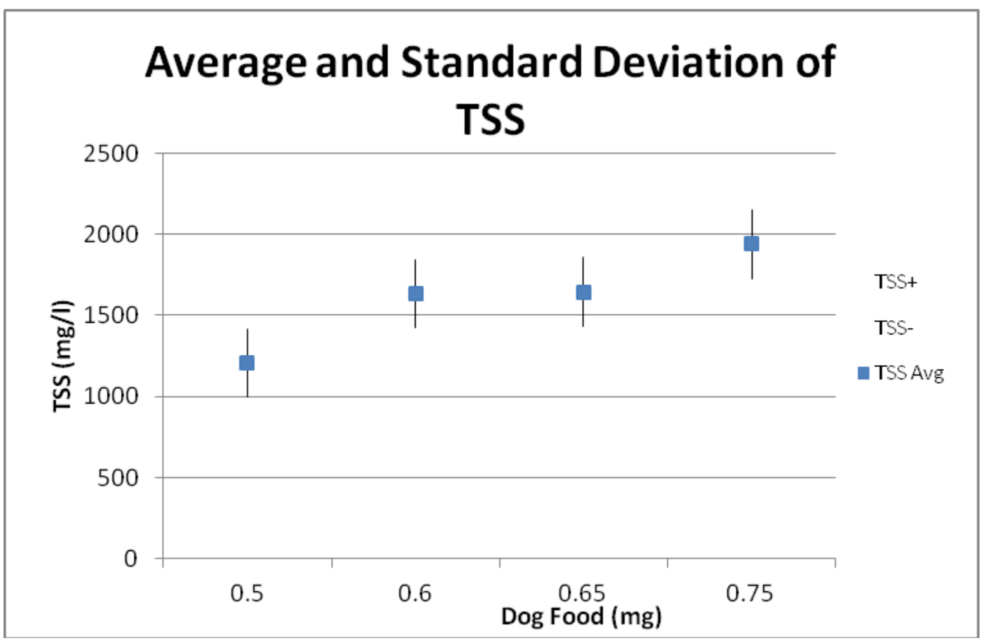
Graph 3 Dry Milk and BOD_5



Graph 4 Dextrose and BOD_5



Graph 5 Dog Food and TSS



Discussion and Conclusions

It was challenging to find a formula that met the desired level of 2,500 mg/l BOD_{5}, 1500 mg/l TSS, and 300 mg/l O&G. Matching the desired BOD_5 proved to be the most difficult, with the U of M and independent lab having a 51 percent difference between the average results and the independent lab versus the desired BOD_5 having an average difference of 53 percent. It is suspected that temperature fluctuations while conducting the BOD_{5}, tests are the reason the U of M lab consistently had lower BOD_5 results. TSS and O&G concentrations were more consistent between labs and closer to the desired concentrations.

Using the supplied graphs and data, an independent lab will be able to determine how much solid material; dog food, dextrose, Crisco®, dry milk, and lard they need to add to approach the desired concentration values. It is recommended that a lab starts with the sample 2 recipe and adjust accordingly. Given the fact that variability in the wastewater used to make the HSW is inevitable, the amounts of solid material added will need to be adjusted to get the desired levels of BOD_5, TSS and O&G. Therefore testing the influent wastewater before determining how much solid material to add is necessary in the devolvement of standard HSW.

Once the HSW is made in a laboratory setting then tests on pretreatment devices to determine their ability to remove BOD_5, TSS an O&G can take place. This will be helpful when trying to compare different products and types of pretreatment devices.

Appendix

Nutritional information for solid materials used

NOW® Non-fat Dry Milk
Serving Size: 1/4 Cup (25g) = 8 oz Milk
Servings Per Container: 15

	Amount Per Serving	% Daily Value*
Calories	90	
Calories from fat	0	
Total fat	0 g	0%
Saturated Fat	0 g	0%
Cholesterol	0 mg	0%
Sodium	130 mg	6%
Total Carbohydrate	12 g	4%
Dietary Fiber	0 g	0%
Sugars	11 g	

Protein	9 g	
Vitamin A		0%
Calcium		30%
Vitamin C		0%
Iron		0%

* Percent Daily Values are based on 2,000 calorie diet.
† Daily Value not established.

Other Ingredients: 100% Non-Fat Dry Milk

Armour® Lard Nutrition

Nutrition Facts Serving Size 1 serving (g)

Amount per Serving
Calories 120
Calories from Fat 117
% Daily Value*Total Fat 13.0g
20%Saturated Fat 6.0g
30%*Trans* Fat 0.0g
Cholesterol 10mg
3% Sodium 0mg
0% Total Carbohydrates 0.0g
0% Protein 0.0g
* Based on a 2000 calorie diet

SPAM®

Serving Size: 56g

Amount per Serving

Calories: 180

Total Fat: 16g

Saturated Fat: 6g

Cholesterol: 40mg

Sodium: 790mg

Total Carbs: 1g

Fiber: 0g

Sugars: 0g

Protein: 7g

Purina® puppy chow puppy food

Guaranteed Analysis

Crude Protein (Min)	27.0%
Crude Fat (Min)	12.0%
Crude Fiber (Max)	5.0%
Moisture (Max)	12.0%
Linoleic Acid (Min)	1.6%
Calcium (Ca) (Min)	1.1%
Phosphorus (P) (Min)	0.9%
Iron (Fe) (Min)	150 mg/kg
Vitamin A (Min)	10,000 IU/kg
Docosahexaenoic Acid* (DHA) (Min)	0.05%

Crisco®

NUTRITION FACTS

- Serving Size 1 Tablespoon (12g)
  Servings Per Container About 48

  Amount per Serving

Calories 110
Calories from Fat 110% Daily Value*

- **Total Fat** 12g18%
  - Saturated Fat 3g16%
  - Trans Fat 0g
  - Polyunsaturated Fat 6g
  - Monounsaturated Fat 2.5g
- **Cholesterol** 0mg0%
- **Sodium** 0mg0%

- **Total Carbohydrate** 0g0%

  Protein 0g

  - Vitamin E15%

Not a significant source of dietary fiber, sugars, vitamin A, vitamin C, calcium and iron.

*Percent Daily Values are based on a 2,000 calorie diet.

Ingredients: Soybean oil, fully hydrogenated palm oil, partially hydrogenated palm and soybean soils, mono and diglycerides, TBHQ and citric acid (antioxidants).

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<u>EPA Methods</u>

Total Suspended Solids EPA Method 160.2

Biological Oxygen Demand EPA Method 405.1

Oil and Grease EPA Method 1664