Wastewater Characteristic Analysis of Coffee and Soda Products

Sondra Larson and Sara Heger
Onsite Sewage Treatment Program
University of Minnesota

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Abstract

The University of Minnesota's Onsite Sewage Treatment Program (OSTP) conducted a brief assessment of five different types of coffee and soda beverages sold at a typical convenience store to understand how these types of products can impact the wastewater characteristics of the store's septic system. The products chosen for this study represent the types of beverages that presumably are most often poured down the drain at convenience stores and restaurants, either by consumers or employees. Results show that these beverages will affect the waste strength of influent at commercial facilities serving or selling these types or similar beverages. How much impact will depend on the amount and type of beverages. Evaluating the establishment to determine the equipment they currently use and their management practices should be done during system design and when managing a facility served with a septic system. All existing systems should be sampled to determine wastewater characteristics.

Introduction

The Onsite Sewage Treatment Program (OSTP) at the University of Minnesota Water Resources Center conducted a brief study to understand more about the effect that coffee and soda beverages have on the functionality of a septic system. Septic professionals agree that putting coffee grounds into a septic system is a bad practice and could negatively affect its function. Coffee grounds will not break down in a septic tank, they will build up over time and the tank may have to be pumped more often. Also, because they are so acidic, they can compromise the pH of a tank. If the contents of a septic tank become too acidic, it can create an unhealthy environment for the bacteria that comprise the healthy ecosystem of the tank and help break down waste (OSTP, 2017). For this study, the OSTP is interested particularity in restaurants, convenience stores or gas stations that are serviced by a septic system and what the possible impacts could be to the system when large amounts of liquid coffee and soda are dumped down these drains every day.

Methods

Five different types of product were used for this study:

1. black coffee
2. iced coffee
3. coffee with a sweetened creamer
4. coffee with regular half and half added
5. Coke (regular)

These products were selected to represent a wide range of products offered at gas stations, convenient stores and restaurants. Products were obtained from a local chain convenience store that has over six hundred locations in ten states across the United States, with a streamlined

Figure 1: Soda Fountain, Coffee Station and Coffee Add-in Station (L to R).

product and service model. All coffees were selected from the self-serve station where one pours their coffee and then chooses from a variety of add-ins. All the coffees chosen were a medium roast. The iced coffee was made by following the directions at the station for making an iced coffee: filling a cup with ice, selecting "iced coffee" option from a coffee dispenser and then dispensing caramel flavored cream until the cup was full. One coffee beverage was mixed with three (13 mL) pods of non-dairy half and half. Another coffee beverage was mixed with three (13 mL) Hershey's Chocolate Caramel creamer pods. Regular Coke was dispensed out of the soda fountain as shown in **Figure 1** After each product was stirred thoroughly, they were placed into pre-labeled sample bottles and set into a cooler with ice to preserve them until they were picked up by Minnesota Valley Testing Lab (MVTL) courier service. A small amount from each sample was set aside and the pH of each product was measured as well. The analytes tested for are shown in **Table 1** along with the method references used by MVTL to analyze for these wastewater components.

Table 1. Lab Method Testing References

Analyte	Method References used by Minnesota Valley Testing Lab
Biochemical Oxygen Demand (BOD)	SM 5210 B-2001
Chemical Oxygen Demand (COD)	410.4
Total Phosphorus	EPA 365.1
Chloride	SM 4500 Cl E
Total Suspended Solids (TSS)	USGS I-3765-85
Total Kjeldahl Nitrogen (TKN)	SM 4500 NH3 C-97

The ingredients in coffee, creamer and regular Coke are listed in **Table 2** below. Some of these ingredients could be harmful to a septic system by inhibiting biological degradation and adding to the waste strength, especially sugar and phosphoric acid if added in large enough amounts. Of these beverages, it seemed most likely that more regular soda or black coffee would be put down the drain most often. A common scenario might be if someone pours a soda and decide they want another type, so they pour their first choice down the drain. Similarly, someone pours a coffee, and they decide they want another kind, or they pour off the top to add creamer. There are also convenience stores and restaurants that regularly dump coffee to assure freshness. It can be assumed from these inferences that most of the ingredients going down the drain would come from either the regular soda or the black coffee products.

Table 2. Ingredients in Coffee and Coke Beverages

Product	Ingredients
Coffee	water, 2-Ethylphenol, quinic acid, 3,5 Dicaffeoylquinic acid, Dimethyl disulfate, acetylmethylcarbinol, putrescine, trigonelline, niacin
Coke	carbonated water, sucrose or high-fructose corn syrup, caffeine, phosphoric acid, caramel color, natural flavorings
Half and Half	milk, cream, 2% or less of sodium citrate, datem, tetrasodium pyrophosphate, carrageenan
Sweetened Creamer	water, cane sugar, palm oil, contains 2% or less of: cocoa (processed with alkali), sodium caseinate* (a milk derivative), dipotassium phosphate, natural and artificial flavors, mono and diglycerides, sodium stearoyl lactylate, polysorbate 60, carrageenan, salt

Results and Discussion

As can be seen in **Table 3**, the beverages all had contaminant levels significantly higher than septic tank effluent. Generally black coffee had the lowest levels and if cream or flavor were added to the coffee the waste strength increased. Iced coffee is a product that is becoming more common at convenience stores and had very high levels. For comparison of wastewater characteristics, data was included in **Table 3** that was collected by Siegrist (2017) in 2003 and 2004 to understand the composition of septic tank effluent from commercial and industrial sources. It is understood that when coffee or soda is dumped down the drain it enters a large septic tank where dilution with other wastewater occurs.

Table 3. Wastewater Concentrations in Coffee and Soda Beverages

	Black Coffee	Iced Coffee	Soda-Regular Coke	Coffee with Hershey's Creamer	Coffee with Half and Half	Typical Domestic Septic Tank Effluent	Convenience Store Septic Tank Effluent (Siegrist, 2017)	Restaurant Septic Tank Effluent (Siegrist, 2017)
Wastewater Concentrations (mg/L)								
Biochemical Oxygen Demand (BOD)	5,560	168,000	84,400	53,000	19800	140-200*	610	400
Chemical Oxygen Demand (COD)	12,700	321,000	110,000	46,000	32,100	389***	NA	NA
Total Suspended Solids (TTS)	260	960	265	1150	667	50-100*	263	255
Chloride	127	760	27.3	374	383	18***	NA	NA
Total Phosphorus	28.9	155	159	88.9	52	6-12**	24.2	15
Total Kjeldahl Nitrogen (TKN)	331	547	42.3	347	531	60***	NA	NA
pH	5.6	5.8	1.9	6.5	6.3	7.3***	6.6	6.9

*USEPA (2002) **Siegrist (2017) ***Lowe (2009)

To understand the impact of these products draining into a typical septic tank, a dilution calculation was applied and shown in **Table 4.** This represents the increase in wastewater concentrations from soda and black coffee diluted into a 1,000-gal septic tank during one day of use. Soda and black coffee were chosen for this table because these products are more likely to be added to the septic tank throughout the day in large quantities than the others. It should be stressed that because septic tanks are not uniformly mixed and operate more similarly to a plug flow model, the values in **Table 4** are estimates and are not an exact reflection of how large influxes of soda or coffee would impact the effluent levels.

Table 4. Wastewater Concentrations in a 1000-gal tank, one day of use (mg/L)

Wastewater Concentrations in a 1000-gal tank, one day of use (mg/L)		
	Black Coffee (12 gallons into the tank per day)	Soda- Regular Coke (2 gallons into the tank per day)
Biochemical Oxygen Demand (BOD)	67	1,688
Chemical Oxygen Demand (COD)	1,524	220
Total Suspended Solids (TTS)	3	<1
Chloride	2	<1
Total Phosphorus	<1	<1
Total Kjeldahl Nitrogen (TKN)	4	<1

It should be noted that this was one round of sampling from one store and to fully understand the effect of liquid coffee and soda waste in septic systems further sampling is needed. The numbers represented in this study should not be used for the sole characterization of coffee and soda beverage characteristics.

For septic system designers this data indicates it is important to characterize the facility to determine if there are self-serve soda or coffee dispensers. The CIDWT forms for Analyzing Wastewater Treatment Systems for High Strength Waste and Hydraulic Loading available on the UMN website at septic.umn.edu/ssts-professionals/forms-worksheets are useful in performing these characterizations. After this assessment, it is worthwhile to discuss with the facility owner/manager if changes can be made to the equipment or management practices to reduce the amount of beverage waste entering the system. During design or management for all existing facilities, several samples should be taken and analyzed, as the influent levels are likely to be variable.

References

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