

Analysis of Recreational Vehicle Holding Tank Treatment Products

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Abstract

The University of Minnesota's Onsite Sewage Treatment Program (OSTP) conducted a brief assessment of four commonly purchased recreational vehicle (RV) holding tank treatment products to understand how these types of products can impact the wastewater characteristics of an RV dump station. The four products selected for this study were chosen based on their high Amazon sales and active ingredients. One of the products lists formaldehyde as an active ingredient. Results revealed a few areas of concern with respect to effective wastewater treatment by a septic system. One product tested had a very high Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), two of the products tested were found to have lower pH readings that could drive the overall effluent to be acidic, and one of the products was found to be high in phosphorus. These are all factors which could contribute to a negative impact on septic systems. The product containing formaldehyde resulted in high BOD and COD readings and was also found to be more acidic. RV products containing formaldehyde are banned and discouraged in many states, but regulation is near impossible. The OSTP recommends that septic system operators and designers be evaluating the waste stream levels for treatment challenges. Septic systems for RV dump stations should be designed based on mass loading versus hydraulic loading and include advanced pretreatment with size based on this loading.

Introduction

In November of 2019, the Onsite Sewage Treatment Program at the University of Minnesota Water Resources Center conducted a two-part assessment of septic systems at two state parks, both owned and managed by the Department of Natural Resources (DNR). At both sites recreational vehicle wastewater was sampled after primary treatment in a septic tank at dump stations with no additional campground wastewater. The dump station wastewater contaminant levels at each of the location was very high as shown in **Table 1** and demonstrates that the waste stream is not typical domestic-strength waste (Heger and Larson, 2019).

Table 1. Recreational Vehicle Dump Station Wastewater Concentrations of Two State Parks

Wastewater Concentrations (mg/L)	Park A (mg/L)	Park B (mg/L)	Typical Domestic Effluent (mg/L)
Biochemical Oxygen Demand (BOD)	1280	1530	140-200*
Total Suspended Solids (TSS)	230	92	50-100*
Total Phosphorus	56.4	85.5	6-12**
Chloride	395	372	18***
Total Kjeldahl Nitrogen (TKN)	769	757	60***

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

It is assumed that the elevated levels could be due to a decreased amount of graywater usage from laundry and showering, but another source that could be contributing to higher contaminant levels could be RV holding tank treatment chemicals. These chemicals are typically used by campers to control odors in a RV's holding tank. To help understand these higher levels the OSTP decided to test the BOD, Chemical Oxygen Demand (COD) and the other parameters of a few of the most common RV hold tank treatment products available at Amazon.com. The purpose of this brief study is to determine how RV chemicals may impact wastewater contaminant levels.

Methods

Four RV holding tank treatment products were evaluated in this study. See **Table 2** for a summary of these products.

Table 2. Summary of RV Holding Tank Treatment Products Tested

Product Name	Nickname	Amazon Rating	Active Ingredient	Dosing Method	Typical Dose (40-gal tank)
Happy Campers Organic RV Holding Tank Treatment	Happy Campers	4.7/ 5 stars 2,956 ratings	monohydrate blend of minerals and micronutrients	powder	one scoop
Thetford Aqua-KEM Original - RV Holding Tank Treatment - Deodorizer - Waste Digester - Cleaner -	Aqua-Kem	4.8/5 stars 281 ratings	formaldehyde and methyl alcohol	liquid	8oz.
Walex TOI-91799 Porta-Pak Holding Tank Deodorizer Drop-Ins, Sunglow Scent	Walex Porta-Pak	4.7/5 stars 5,925 ratings	2-Bromo-2-nitropropane-1,3-diol (Bronopol)	pre-packaged pod	1 pod
Walex BOI-11530 Bio-Pak Natural Holding Tank Deodorizer and Waste Digester Drop-Ins, Alpine Fresh Scent	Walex Bio Pak	4.6/5 stars 1,896 ratings	enzymes, >50% of composition is not provided (trade secrets)	pre-packaged pod	1 pod

These four products were chosen because they all have four or more stars on Amazon with a very large number of ratings compared to other brands, making it clear that many RV owners and users are purchasing these products. Aqua-Kem contains formaldehyde, Walex Porta-Pac contains Bronopol (a formaldehyde releaser), while the other two products are formaldehyde-free. There are many RV dumping stations that discourage dumping if a product contains formaldehyde and some states prohibit its use.

To obtain a representative sample of each product for lab analysis, each product was added to a five-gallon bucket of water and mixed thoroughly. Then the solution was placed into the sample bottles. Extra sample was set aside to obtain a pH reading. The sample bottles were analyzed by the Minnesota Valley Testing Lab (MVTl). See **Table 3** for the method references used by MVTl. The results for the wastewater concentrations for the holding tank treatment products in **Table 4** were obtained using a dilution calculator of mass concentration in order to represent what the data would look like if the products were mixed into a 40 gallon RV holding tank versus the five gallon bucket used. This is the typical size of a RV holding tank and 40 gallons is the volume that each product specified one dose should be used to treat. The pH reported was not adjusted for the additional 35 gallons of wastewater that could be potentially added to the RV holding tank. It should be noted that sometimes campers will dump a tank before it is at its full 40-gallon capacity so concentrations of these chemicals in the tank will likely be higher than reported here. It is also important to note that there was no actual human wastewater associated with these results as the product alone was being evaluated.

Table 3. 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

Results and Discussion

Table 4 shows the same wastewater concentration results from the November 2019 study that are in **Table 1** next to the results of the RV holding tank treatment products for comparison.

Table 4. RV Dump Station Wastewater Concentrations vs. RV Holding Tank Treatment Product Concentrations

RV Dump Station Wastewater Concentrations vs. RV Holding Tank Treatment Product Concentrations							
	Previous RV Data (See Table 1)						
	Park A	Park B	Typical Domestic Effluent	Happy Campers	Aqua-Kem	Walex-Porta Pak	Walex-Bio Pak
Wastewater Concentrations (mg/L)							
Biochemical Oxygen Demand (BOD)	1280	1530	140-200*	<1	1209	55	23
Chemical Oxygen Demand (COD)	NA	NA	389***	6	2738	121	46
Total Suspended Solids (TSS)	230	92	50-100*	6	1	3	6
Chloride	395	372	18***	5	6	8	5
Total Phosphorus	56.4	85.5	6-12**	<1	<1	4.7	57.5
Total Kjeldahl Nitrogen (TKN)	769	757	60***	<1	<1	1	<1
pH****	NA	NA	7.3***	5.2	5.7	6.3	6.1

*USEPA (2002) **Siegrist (2017) ***Lowe (2009) **** Not adjusted for 40 gallons

The Happy Camper product had the lowest reported levels of all contaminants evaluated. The only concern would be the pH which was the lowest recorded and could drive the effluent overall to be acidic which could negatively impact the bacteria needed for wastewater treatment.

The Aqua-Chem liquid product had a very high value of BOD and COD indicated it will add a considerable load to a wastewater treatment system if used by most RV users at a particular dump station. The sample dissolved in five gallons of water also was on the acidic side which could negatively impact the microbial community needed in a septic system.

Both Walex products were relatively low in all contaminants evaluated aside from the phosphorus of the Bio-Pak at 57.5 mg/L indicating it will add a considerable phosphorus load to a wastewater treatment system if used by a majority of RV users at a particular dump station.

Based on this evaluation, the chemicals used to preserve the waste and control odor until the tank is pumped could contribute to elevated effluent levels found in RV dump station waste. One of the active ingredients included in some RV treatment products is formaldehyde. A study done for the Washington State Department of Transportation, reported that formaldehyde can create a toxic environment for the anaerobic and aerobic bacteria in septic systems, impeding the ability of these bacteria to effectively treat effluent. If campers are using products that contain formaldehyde it can negatively affect the septic system. The study ruled that treatment products such as dyes, perfumes, enzymes, and detergents do not have a strong negative effect on a septic system as does formaldehyde (Kiernan, 1983). It would be wise for RV parks connected to septic systems to educate campers to not add formaldehyde-based products to their holding tanks. However, knowing it is difficult to control the chemicals are used by RV users, septic system operators and designers should be evaluating the waste stream levels including pH for treatment challenges. The concentration of this type of waste stream, which is less diluted due to limited graywater from showering and laundry, means that septic systems for RV dump stations should be designed based on mass loading versus hydraulic loading and include advanced pretreatment sized based on this loading. If excessive organic material or solids reach the soil system, the biological clogging mat can become restrictive to the point of hydraulic failure.

Flow data and more wastewater sampling for sites with RV dump stations and the RV chemicals should be done to fully understand the general contaminant mass loading at RV campgrounds. It also must be noted that this assessment only included one round of sampling and the numbers represented in **Table 1 and 4** should not be used the sole characterization of the wastewater/RV chemical characteristics.

References

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