The Onsite Wastewater Industry and Our Carbon Footprint

Jessica L. Kautz

ABSTRACT

Why do you do what you do? Why are you in the decentralized wastewater industry? I joined the wastewater industry to interact directly with society and protect public health. I joined the decentralized wastewater industry because it is the most environmentally-sound, passive form of wastewater treatment and recycling. But what is truly saved by using decentralized wastewater treatment? And what can we do as an industry to help negate the growing environmental and fiscal problems facing society today?

The environmental and economic benefits provided through the manufacture and construction of onsite (decentralized) wastewater systems versus centralized wastewater treatment plants were quantitatively examined through an analysis of embodied energy, embodied carbon, and the cost of each system type. The average decentralized system versus connecting to a sewer extension were found to reduce embodied energy, embodied carbon, and cost by 75% (117,538 MJ), 73% (5,099 kg CO₂), and 68% ($12,636) respectively.

With the clear environmental and economic benefits associated with decentralized wastewater treatment systems, it is imperative that local, state, and national regulators shift the focus of wastewater treatment from centralized sewer systems to the more sustainable decentralized model. Doing so will greatly aid in the efforts to reduce the carbon footprint associated with development as well as reduce the cost of development for both government entities and end users.

In addition, the environmental impacts of both a precast concrete septic tank and gravel/pipe drainfield (conventional) onsite systems and systems using recycled thermoplastics were evaluated. Water consumption, electricity consumption, fuel consumption, and carbon emissions were evaluated through raw material production, product manufacturing and transportation for both systems. It was determined that when transporting a recycled thermoplastic system 1,030 miles and a conventional system only 30 miles, the recycled system reduced electricity consumption by 88% (7,418 kWh saved), fuel consumption by 67% (4,480 kBtu saved), water consumption by 97% (1,010 gal saved), and carbon emissions by 44% (220 kg C saved).

Our everyday choices as members of the decentralized wastewater industry have an impact on the environment around us. What if we, as an industry, stood up through our local representatives and legislators to push for more funding of decentralized systems? What if we made daily choices that expressed our concern of the environment and chose to operate sustainably? We, as an industry, have the opportunity to lead – to build a sustainable and inspiring industry that gathers young, eager minds, ready to change the world. Let’s grasp the opportunity. Let’s start with Why.

1 Jessica L. Kautz, Project Engineer, Infiltrator Water Technologies, LLC, 4 Business Park Rd, Old Saybrook, CT 06475, jkautz@infiltratorwater.com
Why do you do what you do? In his book, *Start with Why: How Great Leaders Inspire Everyone to Take Action*, Simon Sinek discusses the importance of not only knowing what you do and how you do it, but why you do it. Sinek discusses in his book that every single organization on the planet, even our own career, always functions on three levels. What we do, how we do it and why we do it. When these pieces are aligned, it gives us a filter through which to make decisions; it provides a foundation for innovation. When all three pieces are in balance, others will say, with absolute clarity and certainty, “We know who you are,” and, “We know what you stand for.”

He goes on to state that every person, company, or organization knows what they do. These are the products we sell or the services we provide. For our industry, it might be installing septic systems, pumping tanks, designing systems, writing regulations, inspecting systems, or even manufacturing septic products.

Some companies and organizations know how they do what they do. These are the things that set us apart from our competition; the things we think make us special or different from everyone else. Maybe it’s how quickly you can get a system in, or the latest equipment that you use; maybe your regulations are more stringent or up-to-date than your neighboring provinces, or perhaps you’re known for manufacturing the highest quality septic product.

But very few people and organizations can clearly articulate why they do what they do. Why is a purpose, a cause or a belief. It provides a clear answer to why we get out of bed in the morning, why our company or organization even exists and why that should matter to anyone else. To be clear, making money is not and cannot be a why. Revenues, profits, salaries, and other monetary measurements are simply results of what we do. The why inspires.

Sinek says that we naturally communicate from the clearest thing to the fuzziest thing. We tell people what we do, we tell them how we’re different or special and then we expect a behavior like a purchase, a vote or support. But the problem is that what and how do not inspire action. Facts and figures make rational sense, but we don’t make decisions purely based on facts and figures, do we? How many times have we made a decision because it “feels right”, regardless of what the facts show?

Leaders and organizations with the capacity to inspire, think, act, and communicate starting with why. When we communicate our purpose or cause first, we communicate in a way that drives decision-making and behavior: a vote, a purchase, a promotion, or awarding a bid (Sinek, 2011).

So why do you do what you do? I joined the wastewater industry to interact directly with society and protect public health. I joined the decentralized wastewater industry because it is the most environmentally-sound, passive form of wastewater treatment and recycling. But what is truly saved by using decentralized wastewater treatment? And what can we do as an industry to help negate the environmental and financial problems that are arising and protect the environment around us?
CENTRALIZED VS DECENTRALIZED WASTEWATER MANAGEMENT STUDY

Introduction
The environmental benefits of operating decentralized over centralized wastewater management have long been cited. Decentralized management is most often passive, allowing for groundwater recharge with little to no operational energy consumption. Decentralized systems require little maintenance and, with proper care and design, perform equally to centralized treatment processes (Kautz, 2015a).

While there are areas where decentralized wastewater treatment is not a viable option due to lot size or geologic conditions, the first reaction to sewage problems is usually to connect the area to an existing WWTP through centralized sewer line extensions. However, before reaching this conclusion, the environmental, economic, and cost impacts of each project should be more clearly assessed to ensure it is the best solution (Kautz, 2015a).

Overview
An analysis was performed to quantitatively determine the environmental and fiscal costs associated with the materials and construction of 40 sewer extension projects in Southwest Virginia. Environmental costs were defined as the embodied carbon and embodied energy of manufacturing and installing the materials (total primary energy consumed or carbon released over a material’s life cycle).

The sewer extension projects were identified and individually defined through the Southwest Virginia Regional Wastewater Study; each project was delineated within the report by a breakdown of material and construction costs. The breakdown of materials was used to determine the environmental costs of the materials in the project. The construction equipment used to install the materials associated with each project and the related fuel efficiencies and production rates were estimated through literature review.

These values were then used to determine the average resource consumption per connection to the sewer extension and compare it to the average resource consumption of a typical decentralized wastewater treatment system (connecting one home to a sewer extension vs. an average decentralized system). A 3-bedroom septic system (concrete septic tank and gravel and pipe drainfield) was used as the model for the decentralized systems, as it is the most common form of decentralized wastewater treatment in the US (Kautz, 2015a).

Results
The average per connection resource savings are shown in Table 1 and Figure 1. As shown, there’s a 75% savings in embodied energy, 73% savings in embodied carbon, and 68% cost savings on average through the construction of decentralized wastewater systems over the centralized sewer extensions.
Table 1. Comparison of average per connection resource consumption for centralized and decentralized wastewater management.

<table>
<thead>
<tr>
<th></th>
<th>Centralized Per Connection</th>
<th>Decentralized Per Connection</th>
<th>Difference</th>
<th>Percent Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Embodied Energy (MJ)</td>
<td>157,563</td>
<td>40,025</td>
<td>117,538</td>
<td>75%</td>
</tr>
<tr>
<td>Embodied Carbon (kg CO₂)</td>
<td>7,006</td>
<td>1,908</td>
<td>5,099</td>
<td>73%</td>
</tr>
<tr>
<td>Cost (USD)</td>
<td>$18,590</td>
<td>$5,954</td>
<td>$12,636</td>
<td>68%</td>
</tr>
</tbody>
</table>

Figure 1. Comparison of Average per Connection Resource Consumption for Centralized and Decentralized Wastewater Management

The savings associated with each decentralized system is significant; the energy savings of 117,538 MJ is equivalent to the energy content of 969 gallons of gasoline – enough to take 2,093 cars off the roads for a day, the carbon savings (5,099 kg CO₂) is equivalent to the savings associated with 133 CFL lightbulbs, and the monetary savings ($12,636) would allow 3 decentralized systems to be put into the ground for the same price as hooking one home up to the sewer extension (Kautz, 2015a).

So again, why do we do what we do? We work in this industry because decentralized wastewater management is passive with little operational cost, provides equal or better treatment, can be adapted to both large and small flow situations, and provides resource savings that greatly aid government efforts in environmental preservation and budgeting. But what about our day-to-day decisions in this industry? How do our day-to-day choices impact the environment, and what can we do better as the decentralized industry?
**CONVENTIONAL VS. RECYCLED PLASTIC SYSTEM STUDY**

**Introduction**
When decentralized wastewater system installers, distributors, and regulators are asked how they make daily operational choices, we often hear the phrase, “This is how we have always done it.” This phrase is often used to remain complacent and comfortable in the way we operate businesses and organizations. It is easy to be comfortable with how things are done – change often requires hard work and persistence.

But what if other industries did the same thing? Three industries are presented in Figure 2 – three industries that have refused to remain complacent and instead have chosen to move forward as an industry to provide society with the best possible solution for their needs. The clothes washing, cell phone, and automobile industries.

![Figure 2. Representation of historical technologies (from left to right: washing machine, mobile phone, covered wagon)](image)

What if we still had to wash clothes using a washboard or manual device? What if the cellphone industry remained complacent and the phone shown in Figure 2 was still the only mobile phone option? The same can be said for the automobile industry. But, thankfully, these industries made the decision to move forward – not to say, “This is how we have always done it,” but to say, “How can we do it better.”

Onsite wastewater treatment systems have historically been composed of concrete septic tanks and stone/pipe drainfields. However, the processes and materials used to manufacture conventional systems consume a large amount of resources (aggregate, water, fuel, electricity) and emit a large amount of CO₂. Alternatively, other materials have been increasingly substituted for conventional materials, including recycled thermoplastic septic tanks and chambers. These materials have qualitatively been considered more environmentally friendly, but no quantitative comparison has been evaluated in regards to resource consumption and carbon emissions (Kautz, 2015b).

**Overview**
An analysis was performed to quantitatively determine the resource usage and carbon emitted in the manufacture and transport of both a conventional septic system and a system utilizing recycled thermoplastic products. The conventional system was defined as a 1,000-gallon, precast
concrete septic tank and a 1,000-sf stone drainfield using 4-inch PVC piping for distribution. The recycled thermoplastic system was defined as Infiltrator Water Technologies’ (Infiltrator’s) IM-1060 septic tank and a 1,000-sf drainfield of Quick4 Standard chambers. The analysis included raw material processing, manufacture of the finished product, and transportation of the product to the field site. Resources compared were water, electricity, and fuel. The installation of each system was not included in this study (Kautz, 2015b).

For the conventional system, the transportation distance was assumed to be 30 miles to account for availability of local materials; for each conventional system, one truck carrying one tank and one truck carrying the amount of stone required for the drainfield each travelled 30 miles to deliver the conventional system to the worksite. Material properties and coefficients for emissions, water, fuel, and electricity consumption were found through literature review. The majority of conventional system consumption coefficients were sourced directly from the concrete industry (Kautz, 2015b).

In calculating resource consumption of the recycled thermoplastics system, a flatbed transportation distance of 1000 miles was used to represent shipping from the manufacturing plant to distributors in flatbed shipping densities. A distance of 30 miles was then used to calculate the distance traveled from distributor to the installation site in two pickup trucks total, one transporting the tank and one transporting the chambers. The recycled thermoplastics system analysis was calculated using a drainfield sized 1:1 with a conventional system; while sizing reductions are common throughout US regulations, the 1:1 drainfield sizing gives a more direct correlation between the two systems. Resource consumption, carbon emissions, and number of products produced were monitored over six months of production at the Infiltrator Winchester, KY manufacturing plant. This data was used to determine the resource consumption and carbon emission coefficients.

**Results**

The recycled thermoplastic system consumes significantly less resources and emits less carbon than the conventional system. When comparing the transportation distances of 1,030 miles for the recycled plastic system and 30 miles for the conventional system, the combined manufacture and transportation of the thermoplastic system still consumes 88% less electricity, 67% less fuel, 97% less water, and emits 44% less carbon than the conventional system (Table 2, Figure 3) (Kautz, 2015b).

Table 21 – 1000-mile vs 30-mile transportation distance comparison – no drainfield area reduction

<table>
<thead>
<tr>
<th></th>
<th>Conventional</th>
<th>Recycled Thermoplastic</th>
<th>Percent Reduction</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to Site</td>
<td>30</td>
<td>1,030</td>
<td>-</td>
<td>mi</td>
</tr>
<tr>
<td>Electricity Consumption</td>
<td>8,383</td>
<td>965</td>
<td>88%</td>
<td>kWh</td>
</tr>
<tr>
<td>Fuel Consumption</td>
<td>6,674</td>
<td>2,194</td>
<td>67%</td>
<td>kBtu</td>
</tr>
<tr>
<td>Water Consumption</td>
<td>1,043</td>
<td>33</td>
<td>97%</td>
<td>gal</td>
</tr>
</tbody>
</table>

The calculations presented in Kautz, 2015b use 3-inch PVC piping rather than 4-inch. After multiple suggestions, this part of the study has been updated to use 4-inch PVC in conventional drainfields.
Figure 3. Comparison of Resource Consumption for Conventional and Recycled Thermoplastic Septic Systems

The savings associated with each decentralized system is significant; the electricity savings (7,418 kWh) is equivalent to the average daily residential electricity usage of 250 people, the fuel savings (4,480 kBtu) is equivalent to the average daily fuel use of 33 people, the water savings (1,010 gal) is equivalent to the average daily supply for 13 people, and the carbon savings (220 kg C) is equivalent to the amount of carbon sequestered by a tree over its entire lifespan (U.S. EIA, 2015; U.S. EIA, 2014; U.S. EPA, 2015; U.S. Census Bureau, 2014; Eco Preservation Society, 2008).

**CONCLUSIONS**

So why do you do what you do on a daily basis? Do the decisions you make on a daily basis align with your Why? Or do you base your decisions on your Whats and Hows?

Decentralized wastewater management provides both environmental and economic benefits for new communities and those looking to update their current wastewater management systems. They are often passive systems, requiring little to no operational costs, and can provide similar treatment levels to centralized systems when properly designed, sited, and maintained. The materials and construction associated with decentralized wastewater managements consume far less embodied energy, embodied carbon, and capital than centralized systems. The average resource savings per connection was calculated to be 75% in embodied energy, 73% in embodied...
carbon, and 68% in capital. These savings have the potential to add up quickly with the large number of sewer extensions and new developments being installed each year (Kautz, 2015a).

In addition, the results from the conventional vs recycled thermoplastic system analysis showed systems using recycled thermoplastic consume fewer resources and emit less carbon into the atmosphere. When comparing the transportation distances of 1,030 miles for the recycled plastic system and 30 miles for the conventional system, the thermoplastic system still consumes 88% less electricity, 67% less fuel, 97% less water, and emits 44% less carbon than the conventional system. It can therefore be concluded that the use of recycled thermoplastic septic system products over conventional products is a more sustainable approach to onsite wastewater treatment (Kautz, 2015b).

The onsite wastewater industry is at a pivotal moment in our history.

Regulations are becoming more stringent; higher expectations are continuously placed on the industry as a whole to lessen the pollution load placed on surface and ground waters. At the same time, legislation is being pushed nation-wide to move more toward a centralized approach for wastewater treatment. What if we, as an industry, stood up through our local representatives and legislators to push for more funding of decentralized systems instead of standing by idly watching it unfold?

What if we made daily choices that expressed our concern of the environment and chose to operate sustainably? Our industry could be a leader of recycling and reducing natural resource consumption, to preserve the environment that is quickly fading around us while reducing the amount of waste in landfills worldwide.

What if we decided to make these changes together instead of settling for how it has always been done? Our industry has the opportunity to lead and inspire – to build a sustainable and inspiring industry that gathers young, eager minds, ready to change the world. This can only be done by leading with Why – this must be the future of our industry.
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