PHOSPHATE REMOVAL
The Next Conquest for On-Site Waste

Here in Michigan phosphate contamination in our lakes is a big deal. There are many sources that release phosphate to our lakes but one that cannot be ignored is septic tanks. The problem with phosphate is that this chemical is an essential nutrient for algae. In most lakes the concentration is very low and it prevents algae blooms from getting out of control. If you have too much phosphate you end up with dense algae blooms that suck carbon dioxide out of the atmosphere during the process of photosynthesis. The biomass formed in this way eventually sinks to the bottom where the digestion process uses up the oxygen. Fish die, the muck becomes anaerobic and it starts to stink. What it also does is to make the phosphate load down in the sediments dissolve so it can keep feeding the algae blooms. It's a snowball effect that destroys the health of the lake.

Septic tanks are a problem for several reasons. First is that typical septic tanks let solids in the waste settle and be captured for later removal, but the liquid portion that goes to the leachfield is anaerobic and has a high concentration of nasty, smelly viscous liquid. The mucus in the waste can clog the sand and seal the trenches over time. When the system fails the liquid can rise to the surface and be washed by rain directly into the lake. Human waste also has a good deal of phosphate from urine and DNA and because it is anaerobic the phosphate stays dissolved so it moves through the soil to the groundwater and eventually to the lake. Finally, much of the soil around lakes is very sandy so the phosphate does not get bound up by the soil.

It turns out that there are several ways to solve this problem. One, which unfortunately is often extravagantly expensive, is a sewer that takes the material away from the lake. Yes, this works, but usually is well beyond most homeowners means. In order to avoid this we need to take the "septic" out of the septic tank. There really is no way to control phosphate on-site if you are dealing with anaerobic waste. Converting a septic tank into an advanced aerobic treatment system can easily be done by adding a SludgeHammer ABG. SludgeHammer's unique advantages are:

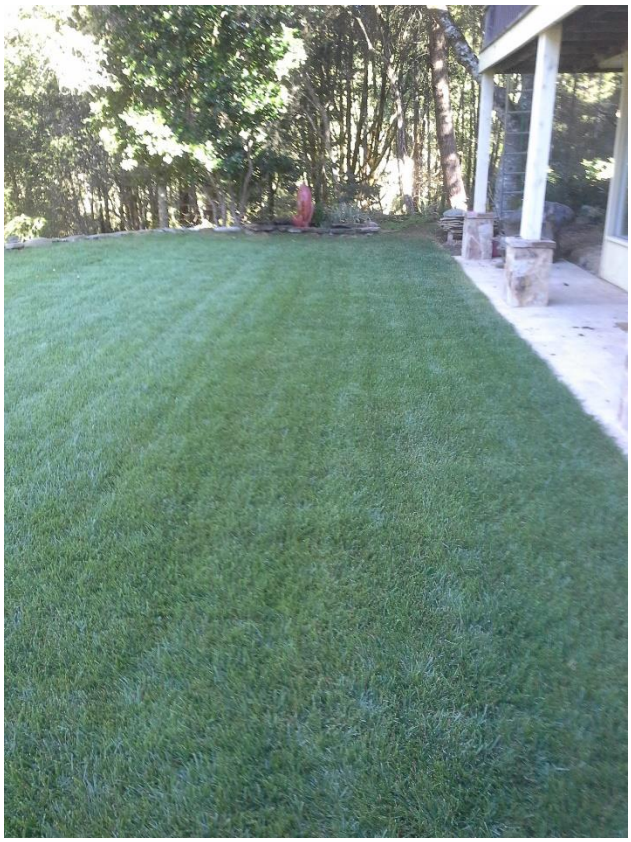
1. It can be retrofitted into any septic tank that does not leak
2. It treats to a high degree so you end up with a clean odor-free effluent.
3. Unlike many competitive systems, the SludgeHammer is certified by NSF 40, IAPMO and MARPOL so it is widely recognized by international agencies and the SludgeHammer plant is inspected annually by these organizations to ensure compliance with their standards.

The improvement in water quality leaving the tank has allowed us to use an absorbent material to sequester the phosphate in an easily-managed component before release, but another more interesting method exists in the form of "sub-surface drip." This is a technology that allows us to use biology to remove the phosphate instead of chemical systems.

Most people look at wastewater from the waste angle. That is wrong. Reclaimed water is an important resource and it is time to recognize that. After all, we pay money to put nitrogen and phosphate on our lawns and gardens. And all of us with a septic tank, already have abundant water with the nutrients in it. What most do not know is that a simple technology exists that lets us use that water. Sub-surface drip involves a special drip tubing that can be buried in the root zone of vegetation. At 6" deep, it provides separation from public contact, so disinfection is unnecessary. If you put it under a lawn, the root system will reach down and fill the soil right where the water is being discharged. This strengthens

the lawn because the roots are much deeper. And the phosphate and nitrates are taken by the grass for rich growth.

This is a SludgeHammer drip irrigated lawn at the house I used to own in drought-stricken California. It does not get much greener.



Around the sensitive lakes near Petoskey we have almost exclusively gone to sub-surface drip for the express purpose of getting phosphate and nitrate away from the lake. First, we eliminate the old leachfield down by the lake front and send the water to the upper part of the property. Then with the drip just 6" from the soil surface we already are moving it another two feet or so above the ground water. Next, all summer long this liquid goes up into the lawn instead of down to the groundwater so there is virtually zero chance of the nutrients getting to the lake. In winter the system simply acts like a leachfield. In seasonal communities this means that very little is released at that time, and even then, the advantages of distance from groundwater and lakeside increases protection from nutrient contamination.

Proof of Effectiveness

In 2004 we were approached by Trout Creek Condominiums in Harbor Springs to help with their septic systems that had contaminated the groundwater with nitrates. The community had 120 residences in 9 clusters of buildings each being served by a cluster septic system. We conducted a study that compared various treatments against a controlled conventional system. The problem being addressed was nitrate pollution, but we also measured phosphate concentration at the same time. The study used vacuum lysimeters buried at 6", 12", and 24" below the discharge point where the liquid is released. One

system, again was the existing conventional septic leachfield. Another was the existing leachfield serving a septic tank that had a SludgeHammer unit installed. The third was an upgraded septic system with extra SludgeHammers discharging through a sub-surface drip irrigation field.

Table 1. Total Phosphate concentration (mg/l) from leachate at 6", 12" and 24" below the discharge point.

Phosphate Concentration (mg/l) in Leachate at Trout Creek

	SludgeHammer in Septic tank with Leachfield			SludgeHammer in Septic tank with Subsurface drip			Conventional Septic With Leachfield		
	Lysimeter depth under leach			Lysimeter depth under drip			Lysimeter depth under leach		
Date	6"	12"	24"	6"	12"	24"	6"	12"	24"
11/12/2004	0.15	0.14	0.12	0.13	0.14	0.47	1.19	1.59	0.5
12/13/2004	0	0	0	0	0	NS	1.95	NS	1.63
1/5/2005	0.12	0	0	NS	NS	0	2.96	3.23	1.89
1/10/2005	0.06	0	0	NS	NS	0	NS	3.78	1.58
1/26/2005	0.09	0	0.11	NS	NS	NS	5.12	NS	2.81
2/8/2005	0.06	0	0	NS	NS	0	6.7	NS	3.56
2/14/2005	0.09	0.05	0.07	NS	NS	0.57	6.97	7.06	4.5
2/21/2005	0.08	0	0	0.08	0	0	7.96	8.06	5.22
2/28/2005	0.27	0.07	0.32	0.09	0.25	0.08	7.05	8.51	5.28
3/7/2005	0.09	0.06	0	0.09	0	0.05	6.28	NS	4.29
avg	0.10	0.02	0.06	0.07	0.06	0.10	5.62	6.13	3.42

The concentrations beneath the subsurface drip system were very low, even though the data was taken during the winter prior to seasonal phosphate uptake by the lawn above the drip system. Of note was that the concentrations under the SludgeHammer system using the existing leachfield was just as low as the drip system. Actually, this is not so surprising since there was no nutrient uptake at that time and we would expect the phosphate to be even lower in the drip irrigation system. The difference between these and the conventional septic tank is obvious.

This suggests that probably the mechanism for the phosphate reduction is anaerobic compared to aerobic digestion. It is widely known that the phosphate in the sediments in lakes becomes soluble in lakes with anaerobic muck. One of the ways to get phosphate back into the sediment is aeration that keeps dissolved oxygen in the sediment. Septic tanks release phosphate in anaerobic conditions so it seems to move right through the soil.

The SludgeHammer treatment converts the septic tank into an aerobic treatment system and it appears to be a simple way to get the phosphate to be absorbed in the leachfield soil and prevent migration to the lakes.