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Blackwaters:

Wastewater treatment and Alternatives for Philadelphia

Human waste management is an ongoing health and environmental issue that needs constant vigilance and maintenance. The majority of people in the U.S. do not have to think about their waste. Like garbage that is whisked off the curb each week, our human waste can be washed away with one push of a handle. The path the waste travels after this is often mysterious and unknown to most. The waste is managed, monitored and cleaned so that the resulting liquid can be ejected into the river. It is generally thought a positive development that people in the U.S. do not have to think about their waste, where it goes and how it is managed. This distance, however, can create other problems – principally, when there is a breakdown in the system, demand for action can be slower or non-existent due to lack of awareness and education.

In Philadelphia, there is a breakdown in the system. Consequently, raw sewage sometimes flows directly into the river. While this problem may have more to do with stormwater management than faulty sewage treatment, it raises important concerns about how much the average Philadelphian understands the flow of water and waste in their community and what each individual can do to address this problem.

Currently, much of the older parts of Philadelphia use a combined sewer system.[1] This means that both human waste and any rainwater not absorbed by the surrounding pervious ground, eventually flow to the same pipe, which is then bound for a sewage treatment plant. At the plant, all of the water is treated to remove solids and ultimately disinfect the remaining liquid to be returned to the water cycle.

The treatment process consists of several steps within three main phases of treatment. First, the sewage is strained through a screen to remove larger solids such as trash products. Sand and grit are also allowed to settle by controlling the speed and flow of sewage into the tanks. This removal of larger trash solids and the smaller grains of sand and grit produce the first byproduct. The sand sometimes becomes part of the sludge processing procedures, but more commonly, both byproducts are sent to the landfill. Sedimentation is the last step in the first stage where sewage is passed through circular tanks so that fecal solids settle to the bottom and fats and plastics rise to the top to be skimmed off. What should result from this first stage is a homogenous liquid on top and a sludge on the bottom

[1] Glen Abrams, AICP Philadelphia Water Department, 11/22/05

– both of which are then sent through two separate processes. This primary phase should remove between 45 to 50% of the solids present in the wastewater.[2]

The secondary phase treats the left-over liquid to remove any biodegradable organic content. This is usually done aerobically by bacteria and protozoa which break down the soluble materials, and bind the less soluble materials into "floc" particles. The floc eventually also settles out of the liquid and ultimately, if the process is working well, a liquid with low levels of organic materials is left.

Before this effluent is ejected, it is filtered and disinfected in the last phase of the treatment. A number of methods are used in this process. Nutrients must be removed from the liquid, specifically nitrogen and phosphorous, and the water must be disinfected. The most common practice in the U.S. is chlorination. While this is a cheaper and effective method for disinfection, the chlorination can potentially create chlorinated-organic compounds which, when released into a river, can be carcinogenic.[3]

The above process description only addresses treatment of the resulting liquid. What has not been discussed is the additional treatment of sludge (solids and biosolids) necessary in order to dispose of it properly. Biosolids are often treated with bacteria aerobically or anaerobically and then either incinerated, sent to a landfill or composted for agricultural use. In Philadelphia, the scum and grease skimmed off in Phase 1 is sent to a landfill.[4] 70% of its composted biosolids are used for agriculture, City parks and fields, community gardens and agriculture and coal mine reclamation. The remaining 30% is sent to a landfill.[5]

As is evident, this process is this complex, labor and technology intensive, and expensive. In addition, the potential is there for older sewage pipes to leak into the ground. During heavy storms, untreated sewage will overflow into rivers and the dangers associated both with treating water with chlorine, and storing large amounts of chlorine in one place, while debated, are recognized as cause for review. While other alternatives to a traditional centralized sewage treatment plant exist, the seemingly most simple of alternatives is the composting toilet, which is often marketed as an environmentally friendly and economically sensible alternative. First developed in Sweden, composting toilet technology has grown. As a result, there are models that can be used in the home with minimum effort and can even be jointly used with a "typical-looking" flush toilet. In order to fully evaluate the viability of a composting toilet as an alternative to the sewage system, it is important

[2] http://www.phila.gov/water/urban_water_cycle.html#treatment
[3] http://en.wikipedia.org/wiki/Sewage_treatment
[4] http://www.phila.gov/water/urban_water_cycle.html#treatment
[5] http://www.phila.gov/water/brcoverview.html

to understand the composting process – how it works, what byproducts are produced and the safety of those byproducts.

While there are many different types of composting toilets, most function relatively similarly. Almost 90% of toilet waste is water, with only about 10% as organic material.[6] In the composting toilets that are marketed to be used in the home, a large percentage of the water waste is evaporated through a vent. The rest of the organic matter and liquid is composted, resulting in composted humus that can be harvested, according to the company Envirolet, as little as once a year.[7] Toilets are generally designed as "self-contained" which means that the toilet unit is connected to the composting unit, or as "remote" or "centralized", signifying that the composting unit is separate from the toilet unit and connected by way of a pipe.

Most home systems are also "active" rather than "passive", meaning that they use some combination of activities such as mixing, fans or heaters to assist in the composting process. Some of these active mechanisms are electric features on some models, other mechanisms still rely on maintenance by a person. Sun-Mar, a popular composting toilet company, has many models that must be manually turned to provide oxygen within an internal drum as well as have a chimney for air circulation[8], and peat mix must be added intermittently throughout use. The Envirolet toilet uses dual electric fans to continuously circulate air. An aeration basket, designed to maximize the surface area of the waste, lines the inside of the unit and allows air to circulate through a larger volume of waste.

The amount of time it takes to generate complete compost depends upon the unit being used. Some units recommend emptying the finished product every few months. Others say only a few times a year is necessary. The most high-scale models of the Envirolet reportedly need to be emptied once a year.

Compared to a conventional sewage system and treatment system, composting toilets will greatly reduce a household's potable water use. In addition, they avoid the need to construct complex sewer piping and treatment plants (which also reduces the possibility of sewage pipe leakage into the ground). Toilets also eliminate the need for effluent releases into the waterway and thus would reduce the overall need for chlorine as a treatment product.[9]

Are they the answer to our waste treatment problems? Most likely the answer is no. There are a number of other issues associated with composting toilet use that are compounded by the location of

[6] http://www.envirolet.com/enanden.html
[7] http://www.envirolet.com/enanden.html
[8] http://www.sun-mar.com/technology/how_composting_actually_works.php
[9] http://compostingtoilet.org/compost_toilets_explained/the_benefits_of_composting_toilets/index.php

the user (urban, suburban or rural) and the knowledge or commitment of the user to correctly maintain their unit. In urban areas, the issue does arise of where to put the composted material. Some blocks in the city do not have any trees, nor residents with land. Even with a unit that must be emptied once a year, this still poses a disposal problem.

Composting toilets are also not as easy as a flush and a whoosh. They need maintenance – first to make sure the unit is installed and working correctly and, secondly, to make sure it is composting in a healthy and productive manner. The toilets that have a drum which must be rotated regularly, in conjunction with the addition of peat bulking material. Then, the compost must be monitored for levels. When the unit is ½ full, the drum must then be rotated backwards which dumps compost into the finishing drawer. The compost must then be left there for two to three weeks to finish fully composting. This involves a fair amount of daily and monthly tracking – thought that most people in the U.S. are not used to putting into their toilets.

The risks of poor installation or use are great, as with regular toilets and sewer systems, however in this case, there are far fewer professionals who could assist and fix a poorly performing or broken toilet. Once a toilet's warranty runs out, and without a solid base of qualified professionals, it is up to the individual owner to educate her or himself about the unit, how it works, and perform any necessary repairs if necessary. The toilet itself also necessitates regular maintenance just to perform at an optimal level. Any laziness on the part of the owner could put the household at risk for germs or diseases.

Many of the toilets now use electrically powered fans to reduce the responsibility of the owner. The most popular sites, however, did not go into much detail on how much electricity is used by these fans or how often they must be on. This information is important in properly analyzing the energy input needed to use a composting toilet. Most likely this energy is more than off-set by the savings in water, but for the consumer to make an educated decision, this information should be collected and more readily accessible.

Lastly, individual waste management raises issues about detection of improper use by individual households. For example, some models do not fully evaporate the liquid in the chamber, so this must be disposed of using either an overflow hose connected to a drain, holding tank or recycling bed or using a removable tray.[10] Improper disposal by households could be difficult to monitor or discover.

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[10] http://shop.altenergystore.com/itemdesc~product~Centrex+2000+Mdcp+Lwflsh+Hsys115ac%2F12dc+~ic~SUMCENT2000ACDC~eq~~Tp~.htm#excess

For people who are committed to learning more about the composting process, how the units function, and how to keep them in good working order, composting toilets are a positive and viable alternative. The water savings alone is reason to take a closer look at these systems. In addition, as these units are designed to better resemble what people are accustomed to (regular toilets with the composter underneath) and if demand were to rise, the potential for new and even more user friendly technologies would be great.

In addition, if more people were to adopt composting toilets, households could begin to work under a more biodynamic system. The potential for this to cause us to re-think the way in which we dispose of all of our waste is immense. What if individual waste was completely managed by each individual? What if each person had to maintain their own system of disposal within their own personal urban environment? Our awareness of our own waste and our understanding of how the natural world can cycle (or not cycle) based upon what is put into it could allow us to step away from our consume and dispose culture. While this is not something that is likely to happen in the near future, composting toilets could bring us a step closer to a new way of envisioning waste management.

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