Composting Toilets: Alleviating Regulatory Barriers to an Integrated Green Solution

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Abstract

Traditional toilets use large amounts of clean water to transport human waste, which requires energy to clean the water to drinking standards, as well as to separate the water and the waste after transport to a centralized wastewater treatment facility. Composting toilets, alternative on-site waste treatment systems, which utilize natural processes to treat human waste, are a solution that can provide benefits in land use, water quality, water conservation, energy conservation, and nutrient managements. This paper reviews those benefits, and evaluates regulatory barriers to composting toilets in the New England area. After finding that these regulations provide significant barriers to composting toilet use without significant protection of human health and safety, we make several recommendations to alleviate these regulatory barriers: explicit regulatory approval of composting toilets, greater leachfield reductions, and less strict compost disposal regulations.

Keywords: composting toilets, on-site waste treatment, sustainability, regulatory barriers

Introduction

A composting toilet treats human waste in the simplest and oldest method possible – decomposition. Decomposing organisms transform the waste into more basic organic substances, and through competition and, to some extent heat, eliminate

pathogens. If provided the right balance of nutrients, moisture, and oxygen, composting toilets transform human excrement into a valuable soil amendment. [1]

Composting toilets may serve as a solution for a number of issues facing our society today. First, composting toilets use virtually no water. While New England does not face the water shortage caused by severe droughts in other parts of the country, the spread of the concept of sustainability encourages conservation of resources, even when they are not in extremely short supply.

Second, as sprawling land use patterns are encouraged to take a more dense form, most of New England's historic villages and new town centers are not served by conventional sewage treatment facilities. The recommended density for compact development, such as is required in Vermont's New Neighborhood statute, is a minimum of four dwelling units per acre. On site septic systems and water supply are severely constrained by isolation distances in such a village design. More alternative solutions to wastewater treatment are needed to promote smart growth patterns of development.

Additionally, composting toilets do not have any discharge into natural water systems. Nitrogen pollution from sewage is increasingly problematic in New England coastal areas.[2] Composting eliminates the nitrogen from human waste from home discharges. Instead, the remaining nutrients in the compost can be land applied. This provides a further benefit, because the composting toilet reduces nutrients into plant available forms, increasing productivity on the land. Significant energy is expended yearly into synthetic fixation of atmospheric nitrogen for agricultural purposes. However, at least elemental nitrogen is in abundant supply, readily available to any factory or

[1] David Del Porto & Carol Steinfeld, Composting Toilet System Book 19-21 (1999).
[2] See 310 MASS. CODE REGS. 15.214 (2010)(allowing designation of "Nitrogen Sensitive Areas)

organism with the capability to fix it. Phosphorus, on the other hand, is in far more limited supply prospectively. Some scientists have warned that "peak phosphorus" like peak oil, could hit society in as little as 30 years. [3] Others estimate that peak phosphorus production occurred in the late 1980s.[4] In time, failing to recycle phosphorus from human urine may become an untenable concept.

From a purely theoretical standpoint, the traditional approach to human waste management is to take two 'goods' – clean water and valuable nutrients – and mix them together to form one 'bad' - polluted water. Additionally, both common sense and the second law of thermodynamics tell us that energy must be expended to rescue either of these resources from the mix. A revamped system of human waste disposal could eliminate this inefficiency and provide significant energy conservation, although any such system would likely incorporate some form of waste transportation, which would dilute energy benefits.

Of course, composting toilets may not be the best solution for every, or even a majority of waste problems. However, the scope of this paper is the barriers to use of composting toilets, and for this purpose will assume that allowing composting toilet use is desirable.

Barriers to Composting Toilets

Composting toilets are not in extremely wide use today. There are various reasons for this. Wastewater treatment plants and septic systems dominate many areas of the country, eliminating most public demand for composting toilets, and in others, lax

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[3] Leo Lewis, *Scientists Warn of Lack of Vital Phosphorus as Biofuels Raise Demand*, The Times, June 23, 2008, http://business.timesonline.co.uk/tol/business/industry_sectors/natural_resources/article4193017.ece.
[4] Patrick Dery & Bart Anderson, *Peak Phosphorus*, Energy Bulletin, Aug. 13, 2007, http://www.energybulletin.net/node/33164

enforcement can lead to lack of any waste treatment – like straight pipes. Governments, trying to improve water quality, generally want to expand the treatment system. Case in point, Vermont was recently awarded almost $20,000,000 in stimulus money to help finance wastewater treatment facilities and associated infrastructure.[5] While this is, broadly speaking, a good idea, it does tilt the balance in favor of an expensive facility rather than on-site treatment and composting toilets.

Socially, flushing toilets are the accepted standard, and the idea of collecting excrement in the basement does not exactly square with the modern paradigm of gracious living. Additionally, many manufactured composting systems are costly.

However, decisions are being made to install composting toilets for various reasons, some of which begin as regulatory – such as Vermont Law School, which faced a shortage in the town's water supply, an issue which arose in hearings conducted under the state's planning statute, Act 250[6], or to home-sellers in Massachusetts who have insufficient septic systems under Title V requirements. When these people seek to get state approval for composting toilets, they run up against regulatory systems that provide significant barriers.

Composting Toilet Regulation in New England States

State health and environmental regulations in New England vary between states when it comes to permitting the use of alternative systems such as composting toilets.

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[5] Recovery Accountability and Transparency Board, Project Summary, http://www.recovery.gov/Transparency/RecipientReportedData/pages/RecipientProjectSummary508.aspx?AwardIdSur=12414&AwardType=Grants, Accessed Jan. 21, 2010.

[6] Vt. Stat. Ann. tit. 10, § 6001-6108 (2009). Act 250 required Vermont Law School to obtain a permit from a district board to build a large new classroom building. The board was required to consider, *inter alia*, if sufficient water was available (§ 6086(a)(2)). Because the town of Royalton said there was not enough water to service the new building, Vermont Law School installed composting toilets, which drastically reduced water usage.

Additionally, the regulations generally apply most strictly to residential installations, whereas commercial installations are allowed more flexibility. Overall, while there is difference in states' treatment of these systems, there is not a large scope of variation; three main issues differentiate the states: approval of the toilet itself, leach field reductions, and compost disposal.

Regulatory approval of composting toilets

Most New England states explicitly approve of composting toilets in their waste disposal regulations; Connecticut alone neglects to mention composting toilets, which are presumably funneled through general state processes for innovative or alternative waste treatment approvals. However, states do differ as far as design requirements. Vermont does not specify requirements for the design in its regulations[7], while Massachusetts regulations stipulate that the toilet must be designed to contain the waste for at least two years[8], and Rhode Island mandates that the toilets meet the NSF standard (NSF-41)[9]. While New Hampshire regulations do not explicitly mention composting toilets, the Department of Environmental Services has indicated that composting toilets are approved.[10]

Disposal of Compost

States are very cautious in their regulation of disposal of compost from composting toilets. The New England states generally treat the compost as a pathogenic material, and require that it be disposed with the same rules as other materials containing

[7] 12-033-001 Vt. Code R. § 1-922 (2010).
[8] 310 MASS. CODE REGS. 15.289(1)(c) (2010)
[9] 12-120-002 R.I. Code R. § 36.1 (2010).
[10] New Hampshire Department of Environmental Services, *Approved Technologies for Septic Systems*, 2003, http://des.nh.gov/organization/commissioner/pip/factsheets/ssb/documents/ssb-12.pdf, Accessed Jan. 21, 2010.

human excrement. Disposing of the waste in certified landfills is usually approved, and some states, such as Vermont and Massachusetts, additionally allow on-site disposal. Both of these states require that the compost be buried six inches below the surface, and Vermont additionally requires that the site meet all the requirements for leach fields in the state.[11]

Leach Field Reductions

Leach field reductions for greywater systems are another important part of composting toilet regulation. By removing human excrement from a building's wastewater, the remaining water should drastically increase in quality and decrease in quantity. [12] As a rule, the remaining greywater is pumped through a more or less traditional septic system. However, the system does not need to be as large as a system with a traditional flush toilet installed. Multiple states acknowledge this by providing a percentage reduction for the design of the septic system. (Table 1). Although Massachusetts allows for a significant leachfield reduction, the state still requires that sufficient land be available for a 100% design flow leach field, in case traditional toilets are later installed.

Table 1: Percentage Leach Field Reductions for Composting Toilets in New England States

State	Leach Field Reduction
Connecticut	None specified
Maine	30%[13]
Massachusetts	50%[14]

[11] See footnotes 7, 8.
[12] Even low flow toilets generally use over a gallon per flush.
[13] 10-144 Me. Code R. Ch. 241, Ch. 10 § 1009.5 (Weil year)
[14] 310 MASS. CODE REGS. 15.262 (1)(a) (2010)

New Hampshire	None[15]
Rhode Island	40%[16]
Vermont	25%[17]

A Vermont Case Study

One example of how the regulatory framework affects users is the story of the construction of Cobb Hill Co-housing in Vermont. Cobb Hill was built in 2002, with 22 housing units, and shares some land with dairy and community supported agriculture (CSA) farms. Despite the expense and difficulty, Cobb Hill remained determined to install the composting toilets to meet their goals of a sustainable community. Unlike Vermont Law School, Cobb Hill's primary regulatory issues were not with water supply, but instead with the sizing of the septic leach field system for the development's remaining gray water and for the disposal of the final product, compost. At the time, there was no allowance in the Vermont regulations for a deduction in design flow for having a composting toilet.[18] Working with design engineers, Cobb Hill was able to obtain a 40% deduction for their gray water septic leach field system from the state's department of environmental conservation under the ANR, which permits such systems in the state of Vermont. However, this was principally achieved through studies of flow reductions in other co-housing units developed with waterless, rather than conventional toilets.

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[15] New Hampshire Department of Environmental Services, *Approved Technologies for Septic Systems*, 2003, http://des.nh.gov/organization/commissioner/pip/factsheets/ssb/documents/ssb-12.pdf, Accessed Jan. 21, 2010.

[16] 12-120-002 R.I. Code R. § 36.2 (2010).

[17] 12-033-001 Vt. Code R. § 1-922 (2010).

[18] The reason for this may be related to a phenomenon in the late 80s where developers or homeowners, in order to build homes in areas of sensitive water quality, would install composting toilets and proportionally designed gray water systems and then retrofit the homes immediately with conventional toilets. It logically follows that this process was catastrophic to water quality, and state regulators could be reluctant to allow the opportunity for disasters like this.

The residents at Cobb Hill were initially required via permit condition to have the output from the composting toilet hauled to a certified hazardous materials landfill. Cobb Hill located the nearest such landfill – in Maine. The cost of a certified hauler was prohibitive. On alerting the state, they were advised to bag it and take it to a normal landfill.[19] Finally, the Cobb Hill residents were able to get a burial site approved on their own property.

Cobb Hill residents seemed to have had only trivial issues with the composting toilets themselves. On the other hand, they have had significant problems with clogging in its greywater septic system. While the cause of this issue is not definitively known, one consultant speculated that it may have to do with the overdesign of the septic system. Even under the 40% leach field reduction, the system was designed for 4900 gpd (gallons per day). However, through the use of the composting toilets, as well as other water conservation devices such as low-flow showerheads, the total water usage for the entire facility was only 1200 gpd. The overdesign of the system may mean that greywater is stagnating in the system, causing clogging by anaerobic growth. The problem may also be related to the low volume of water creating higher concentrations of fats, oils, and greases (FOGs) which can also clog septic leachfield systems.

Today in Vermont, due to 2007 regulatory changes, Cobb Hill would not face quite the struggle it did when it was built. Now, the regulations would automatically allow for the septic greywater system to be designed on a flow of around 3600 gpd. Notably, this would still be three times the actual water use of Cobb Hill, and it is unclear whether that reduction would prevent the clogging issues. Although Vermont's

[19] This information is from an interview with a Cobb Hill resident who graciously shared their experience with the process. It is not meant as an accusation of the Vermont ANR.

regulations have changed to prevent some of the barriers Cobb Hill faced, other states still have many of those barriers, and Cobb Hill had the advantage of having a dedicated, unified, and continuous voice in the process, which many homeowners do not have. However, though a struggle, Cobb Hill is still a somewhat encouraging story because of how well the composting toilets reduced the overall water use for the development.

Discussion: Alleviating Regulatory Barriers

While regulations on the use of composting toilets serve an important function, some of these regulations could be altered to level the playing field for composting toilet installation, and still protect public health and safety.

Specifically allowing composting toilets through the regulations is an important step to increasing their use. Explicit approval of composting toilets removes the uncertainty from the process, and has minimal risk. However, the product from a composting toilet that did not properly function could propose a serious health risk. This risk can be managed by regulating the design of the toilet itself, and by regulating both maintenance and the disposal method. Theoretically, a state could allow virtually any kind of non-leaking tank as a composting toilet, if the state tightly controlled the disposal of the output. On the other side of the spectrum, a state could probably allow limited surface application if it required significant overdesign of the toilet itself. For instance, Vermont does not strictly regulate the design of the toilet itself, but provides strict regulation of allowable disposal sites, where Massachusetts imposes fewer requirements for the disposal site but stipulates that the composting toilets must be designed to contain the waste for two years.

Over-regulation in either case has disadvantages. Requiring overdesign of the composting toilet can increase the price, and the amount of space necessary to install a composting toilet. Mandating that disposal be taken to certified landfills can also be serious expense, and additionally restricts nutrient recycling, which is a major benefit of composting toilets.

NSF standards may be a good starting place for regulatory requirements. However, even NSF standards may fail in unpredictable real world conditions. In a centralized system, the variations of a single household's use over time will average out when compounded with every other wastewater source. One study of several alternative on-site wastewater treatment systems showed that performance under controlled NSF standards did not correlate with performance under actual conditions, which may vary greatly. [20]While composting toilets should be able to cope with changing volumes or rates of accumulation, other variables may affect its ability to kill pathogens, such as temperature and moisture. Some of these conditions require some knowledge on the part of the user, for example, recognizing when wood shavings or water need to be added in order to provide a more compost-friendly moisture level.

Many of safety issues for disposal disappear with the development of sufficient operation and maintenance (O & M). As long as a licensed operator is responsible for taking the composted waste elsewhere to ensure complete decomposition and sanitation, public health is protected without rigid requirements on the design of the composting toilet.

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[20] New England Interstate Water Pollution Control Commission, *Variability and Reliability of Test Center and Field Data: Definition of Proven Technology from a Regulatory Viewpoint*, September 2005.

Additionally, such an operator may have an incentive to go through the rigorous testing required to obtain an Exception Quality Biosolids qualification under EPA biosolids regulation, generally known as Part 503. This would allow the finished compost to be distributed generally, and for most any purpose, thus allowing the nutrient recycling potential of composting toilets to be fulfilled. This process involves monitoring, record-keeping and reporting, as well as testing for a number of pollutants, which would be too expensive for a single landowner. However, this whole concept would require a large number of composting toilets to be reasonably successful.

On the other hand, while many studies have indicated that sanitary conditions in compost are achievable through very reasonable means (3 days at 55 º C)[21], pathogens are not the only potential harm that may come from human waste. Even with the EPA's rigorous testing requirements for sewage sludge, there have been a number of issues with land application of sludge from wastewater treatment facilities.[22] Some of the problems have stemmed from industrial pollutants that would not occur in compost from toilets, such as radioactive Thallium, or perfluorooctanoic acid, an ingredient in manufacture of Teflon.[23] Pharmaceuticals, on the other hand, could end up in composting toilets, and research is both limited and inconclusive about the fate of those products in the composting process.[24]

A more immediately viable option would be for states to require service contracts with the composting toilet. Regular inspections by an expert would help insure that the

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[21] Phil Jones & Marc Martin, *A Review of the Literature on the Occurrence and Survival of Pathogens of Animals and Humans in Green Compost* (The Waste and Resources Action Programme 2003).
[22] Josh Harkinson, *Sludge Happens*, Mother Jones, May/June 2009, http://motherjones.com/environment/2009/05/sludge-happens
[23] This recalls a variation on the theme from the beginning of this paper – that mixing excrement, which can be valuable as fertilizer, with chemically toxic effluent water, is a waste of a resource.
[24] Kang Xia, Alok Bhandari, Keshav Das & Greg Pillar, *Occurrence and Fate of Pharmaceuticals and Personal Care Products (PPCPs) in Biosolids*, 34 J. Environ. Qual. 91 (2005).

composting toilets are functioning properly and that the compost is safe. However, this option could also provide a cost disincentive.

Leachfield reductions are also essential to encouraging the use of composting toilets. In addition to the significant cost issue, part of the benefit of composting toilets is to create denser developments by decreasing the amount of land necessary for a home. Requiring that enough land be available for a conventional toilet system, as in Massachusetts, creates the same problem. Such a requirement is somewhat logical in that if a subsequent owner decides to install a conventional toilet, the damage could be extreme, if the property's capacity to treat wastewater was limited to the reduced leachfield. However, this issue is basically one of enforcing the law. If a prospective buyer knows that there is not an option of installing a conventional toilet in the home, state penalties for doing so and violating the permit should be sufficient discouragement.

Conclusion

While composting toilets may be a helpful tool in creating sustainable developments, especially as water supplies drop and older septic tanks reach the end of their lifetimes, state regulations would need to change in order to better allow the use of composting toilets. Changing the regulations to include explicit approvals of composting toilets, leach field reductions, and less control over compost disposal could all be accomplished without endangering public health and safety.

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Kang Xia, Alok Bhandari, Keshav Das & Greg Pillar, *Occurrence and Fate of Pharmaceuticals and Personal Care Products (PPCPs) in Biosolids*, 34 J. Environ. Qual. 91 (2005).