

## **TITLE: COMPOST-BASED SANITATION IN POST-EARTHQUAKE HAITI IN URBAN AND RURAL LOCATIONS**

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**ABSTRACT:** After Haiti's devastating earthquake in January, 2010, many people were left without homes. Sanitation, already a problem there, became non-existent in many places. In March and again in May of 2011, the author travelled to Port-au-Prince, Haiti, in association with two non-governmental organizations (GiveLove.org and SOIL), for the purpose of teaching local personnel how to establish sanitation systems that utilize thermophilic composting and waterless toilets. Subsequent visits to Haiti by the author documented these systems after they had become established in schools and orphanages by GiveLove.org. The self-managed systems utilize sugar cane bagasse and sawdust left over from the manufacture of amyris oil as the primary carbon-based cover materials. The toilets are designed with either 20 liter or 60 liter plastic receptacles and their contents are composted in bins located on-site near the toilet stalls. No urine separation is utilized. Food materials are also added to the compost matrix. Temperatures of the compost piles reached over 75C at times and maintained over 55C for periods of six months or more. The compost system was designed by the author and requires no turning of the piles. The bins are made of shipping pallets turned on edge and are approximately 1.5 meters wide, 2 meters long and 1 meter deep, although larger bins were also used (2 meters wide).

The sanitation system is based upon the utilization of the thermophilic, or heat-producing composting process, which has been shown to be effective in eliminating human pathogens. The objective is to create an above-ground static organic mass, made primarily of material collected in toilets, that reaches a temperature of at least 55C (131F) sustained for at least three days throughout the entire mass. The US Environmental Protection Agency requires a three day period at 131F for static aerobic compost piles to be considered hygienically safe, as this time and temperature combination has been shown to be deadly to a host of human disease organisms. Our research is showing that our compost piles are sustaining temperatures at or above 55C for months, much more than the required three days. The compost mass is contained inside an easy to build and inexpensive pallet structure and covered or insulated with local carbon-based materials such as sugar cane bagasse, which minimizes surface area exposure and maximizes heat retention. This containment system also eliminates odors and flies and prevents vermin such as dogs and other animals from disturbing the compost. Toilet cleaning soap and water are added to the compost piles to create a closed system with no environmental contamination or ground water pollution.

The sanitation systems were put in place by GiveLove.org in a number of locations, including in at least two schools in Port-au-Prince and in a school/orphanage in Leogane, the epicenter of the earthquake. The system relies on local management by Haitians, compost training, a dedicated compost management crew, public education, access to and transport of carbon-based cover materials to the toilet sites, and constructive use of the finished compost.

**KEYWORDS:** humanure, Haiti, thermophilic composting, compost toilet, sanitation

## MAIN TEXT:

### *Introduction*

A compost sanitation system is based on the concepts and principles of thermophilic (hot) composting. There are three basic components required for such a system to successfully operate: 1) the toilet itself; 2) the carbon-based cover materials; and 3) the compost bins.

**Component #1 - The Toilet:** The toilet is simply a collection device. Its purpose is only to collect human excrement, both urine and feces unseparated, in a waterproof container or "toilet receptacle." The "toilet material" is collected in the receptacle before it comes into contact with the environment -- human excrement does not contact soil or water. The toilet material is not referred to as "human waste" because nothing that goes into a humanure toilet becomes waste. It is all constructively recycled via composting. Hence, the word "humanure" has become popular when referring to human excrement that is recycled through composting systems. The term "waste" is not used, associated with, or appropriate when discussing humanure toilet systems. This is a sanitation system that involves neither waste nor disposal.

The size and type of toilet receptacle can vary from place to place, depending on availability and purpose. Five-gallon (20 liter) plastic receptacles are commonly used and are attractive for a small-scale system because the receptacle can be easily emptied by a single person. They can also be inexpensive or free, are water proof, can have tight lids, and can last a long time. This system is not to be confused with a "bucket toilet," which is human excrement deposited into a bucket without cover material, then discarded into the environment as waste. Bucket toilets, however, can easily be converted into humanure toilets by adding the other two components of the system (cover materials and compost bins).

Larger toilet receptacles can also be utilized in humanure systems. In Haiti, both 20 liter and 60 liter receptacles are in use. The 60 liter receptacles require two persons to handle, although they can be slid out of a toilet and replaced by one person.

The purpose of the toilet is to collect feces, urine, paper, and sawdust (or other cover material) so as to prevent unsanitary contact with the environment. In addition, the toilet allows for the collection of toilet materials in such a manner that the human excrement is primed for thermophilic composting because it is combined inside the toilet with a carbon-based organic material by the simple act of covering the toilet contents. The purpose of thermophilic composting is to subject the toilet materials to robust microbial activity which produces heat generated by thermophilic microorganisms. This process has been scientifically proven to destroy human pathogens<sup>i</sup>, rendering the toilet material hygienically safe and achieving the true essence of "sanitation."

Human excrements will not compost on their own because they're too wet and too high in nitrogen. By adding a carbon-based material to the toilet after each use, the toilet contents can become balanced in carbon and nitrogen and the moisture level optimized for composting, while blocking unpleasant odors.

"Urine diversion," the practice of diverting urine from the solids inside a toilet, is counter-productive to compost sanitation because urine provides essential moisture and nitrogen required to offset the dryness and carbon of the cover materials. When urine is removed from the toilet contents, it can create a dry organic mass that can be deficient in moisture and

nitrogen and therefore can retard the important thermophilic phase of the compost.

In addition, paper products are encouraged to be added to the toilet contents, such as toilet paper, toilet paper center cardboard rolls, etc. There is no reason to separate these into a trash bin when using a humanure toilet. Feminine hygiene products can also be added to human toilets, although the plastic components of these products will have to be manually removed from the finished compost as they do not decompose.

Humanure toilets can be designed for household use indoors, for single person or family use, or for group use where many people gather, such as at refugee camps, villages, schools, orphanages, etc. They can also be used as backup or emergency toilets when flush toilets are not available due to electricity outages or disaster scenarios, for example.

Figure 1 illustrates a 20-liter capacity humanure toilet in Haiti. Under the toilet seat is the toilet receptacle where urine and feces are collected and covered with amyris sawdust, sugar cane bagasse, or another locally available plant cellulose material. The cover material, when the texture and moisture content are correct and when it is used in adequate quantities, completely blocks odors and flies. When full, the toilet receptacle is removed from the toilet and set aside with a lid, to be collected and composted at a separate location.



Figure 1: Typical 20 liter capacity humanure toilet in Haiti.

Figure 2 shows another 20-liter Haitian humanure toilet. The dark container to the left contains the carbon-based cover material that prevents odors and flies.



Figure 2: Toilet contents are covered inside this receptacle with sawdust and/or bagasse. The 20-liter receptacle simply lifts out when full.

Figure 3 shows another humanure toilet with the toilet receptacle completely exposed and ready for removal.



Figure 3: The toilet receptacle is easily removable.

**Component #2 - The Cover Material** -- Carbon-based cover materials are required for the humanure toilet system to function successfully. These materials cover the contents inside the toilets as well as the contents of the compost piles. Enough cover material of the correct consistency and moisture content is needed to totally and effectively eliminate odor and flies. The correct amount of cover material can be gauged by simply smelling the toilets or the compost piles. If there is an offensive odor, more cover materials, finer cover materials, or cover material with more moisture content must be used. Likewise, if flies can be seen accessing the contents of the toilet or the compost pile.

The cover materials must originate from "carbon based" plant cellulose material in order to promote thermophilic composting. One of the most widely used cover materials, for example, is sawdust from trees. Others include peat moss and rice hulls. Sugar cane bagasse, left over

from the crushing and processing of sugar canes, is widely available in Haiti and useful for compost sanitation systems. Sawdust from the manufacturing of amyris oil is also being used there. Cover materials can be any somewhat dry plant material ground into the correct consistency, such as from coco coir, paper products, cardboard, even junk mail.

Availability of appropriate cover material is essential to the successful operation of a humanure toilet system. The cover material must not be too coarse. Wood chunks, for example, are inappropriate -- even wood shavings are not ideal for use inside the toilets as they are airy and can allow odor to escape. Wood shavings can inhibit thermophilic composting due to the inaccessibility of the carbon to the compost microorganisms because the wood particles are too large, although wood shavings can be used successfully in larger compost piles. Wood ashes should never be used as a cover material, nor should lime (ground agricultural limestone). These mineral materials inhibit microbial activity, whereas compost sanitation is designed to increase microbial activity, not to inhibit it.

When the cover material is from an appropriate source and of appropriate consistency for use in the toilet, the toilet contents can be covered such that no odor whatsoever escapes from the toilet. This enables the toilet to be located indoors. However, if appropriate cover materials are not available or are not utilized, the toilet can emit unpleasant odors. Therefore, it is imperative to understand that the humanure toilet system is not appropriate for all people in all places and situations, any more than a flush toilet is. In woodland areas, tropical areas or any location where sawdust and/or other similar plant materials are available, the toilet works very well. In areas where agricultural byproducts may be collected and stockpiled for use, such a sanitation system can also work very well. The byproducts could include such things as grain chaff, pine needles, coffee grounds, distillery byproducts, cleanings from woolen mills, paper products ground to the right consistency, etc.

Cover materials are required for the compost bins as well as for the toilets. The compost bin cover materials can be coarser than the toilet cover materials. They can include grasses, hay, straw, pine needles, weeds, leaves, sugar cane bagasse or many other organic plant materials that are odor-free and do not attract flies. Such cover materials allow for the collection of large quantities of toilet materials in above-ground compost bins without creating unpleasant odors or attracting flies. They also contribute to the aerobic thermophilic microbial reaction by creating tiny interstitial air spaces in the compost piles.

If appropriate cover materials are not available, a compost sanitation system is not recommended. If the cover materials are available in limited quantities, humanure toilets can be successfully used in limited numbers.

The carbon-based cover materials balance the moisture and nitrogen in human excrement. This creates a desired "carbon to nitrogen ratio" that encourages reproduction of heat-producing microorganisms. By using enough cover material of the correct consistency to prevent odors from escaping the humanure toilet system, the correct balance of carbon to nitrogen can be achieved so long as urine is included. In addition, most food scraps and other organic materials available from human activity can be added to the humanure compost bins to achieve high-quality compost.

**Component #3 - The Compost Bins** -- All toilet materials that are collected must be composted above ground in an aerobic, thermophilic manner in order to achieve maximum sanitation. This requires the depositing of the materials into a compost bin. The purpose of

the bin is to allow the piling of the collected material in such a manner that it is not accessible to children, animals, vermin, or insect vectors.

The bins are constructed with a "biological sponge" as the base layer. The sponge consists of plant materials such as straw, hay, weeds, grasses, etc., piled approximately ½ meter deep in the bottom of the bin for the purpose of absorbing excess liquids that may collect when the pile is being constructed. Cover materials should also be applied to the inside walls of the compost bins when the toilet material is added in order to provide an organic layer between the toilet material and the inside walls of the bins.

The bins can be located on bare soil with the base shaped into a slightly concave configuration, allowing for the pooling of any excess liquid into the center of the bin, thereby preventing leaching out the bottom should unexpected heavy rains drench an uncovered bin, for example. Bins can also be constructed on concrete or other hard surfaces, although a soil base encourages beneficial soil organisms, including earth worms, to migrate into the compost pile, and the soil will absorb moisture whereas concrete will not. Sufficient material must be used in the biological sponge to absorb excess liquids. Once the thermophilic phase begins, liquid is rapidly absorbed by the extremely robust biological activity, hence the need for urine and possibly for rain water or graywater to moisten the compost mass.

The compost bin walls may be constructed of wood boards, masonry materials such as bricks, blocks or concrete; straw or hay bales (which can be reused as cover material after their function as side walls is completed); bamboo; poles or logs; wood shipping pallets turned on their sides, etc.

Proper management of the compost pile is very important, therefore experience and education are strongly recommended. Composting is as much an art as it is a science. The top of the compost pile must be kept covered at all times with clean cover materials of sufficient quantity such that all unpleasant odors are eliminated. Also, the cover material must be appropriate in consistency so that flies cannot access the contents of the pile. Straw, grasses, leaves or hay scattered loosely, but adequately, over the compost pile, for example, work well for this purpose. Very coarse materials such as pond reeds, for example, will not. The compost pile cover materials also absorb rain water, thereby preventing leaching.

Compost operations can be executed in two basic manners: "batch" compost or "continuous" compost. Batch compost occurs when an entire compost bin is filled in a short period of time – perhaps in a few days or in a week or two. Continuous compost is when a compost bin is added to continuously for a long period of time such as a year. In either case, after the bin is filled, the compost should be covered with additional cover material and left undisturbed for approximately a year.

### ***How Thermophilic Composting Works***

Thermophilic composting is the aerobic decomposition of organic matter that includes a hot stage dominated by heat-producing bacteria. The hot stage may last days, weeks or months, depending on factors such as the organic ingredients, the size of the compost mass, ambient temperatures, geographical location and/or time of year, and moisture content, among others. Thermophilic temperatures are generally in the range of 45 degrees C or hotter.

Much scientific research has been conducted regarding the efficacy of the thermophilic

compost environment in destroying human pathogens such as viruses, protozoa, intestinal worms, and bacteria. Research has shown that human pathogens find thermophilic compost hostile and that they will rapidly die off in such an environment. When Westerberg and Wiley composted sewage sludge which had been inoculated with polio virus, Salmonella, roundworm eggs, and Candida albicans, they found that a compost temperature of 47-55C (116-130F) maintained for three days killed all of these pathogens.<sup>ii</sup> Finished compost that has been subjected to adequate and well-managed thermophilic conditions typically contains “no detectable pathogens,” regardless of the initial pathogen load. When human excrement can be rendered hygienically safe through the elimination of pathogenic organisms, the true essence of sanitation can be achieved. Refer to Table 1 for a partial list of pathogen thermal death points.

<u>Pathogen</u>	<u>Soil Application</u>	<u>Unheated Anaerobic Digestion</u>	<u>Composting Toilet (Three mo. min. retention time)</u>	<u>Thermophilic Composting</u>
Enteric viruses	May survive 5 mo	Over 3 mo.	Probably elim.	Killed rapidly at 60C
Salmonellae	3 mo. to 1 yr.	Several wks.	Few may surv.	Dead in 20 hrs. at 60C
Shigellae	Up to 3 mo.	A few days	Prob. elim.	Killed in 1 hr. at 55C or in 10 days at 40C
E. coli	Several mo.	Several wks.	Prob. elim.	Killed rapidly above 60C
Cholera vibrio	1 wk. or less	1 or 2 wks.	Prob. elim.	Killed rapidly above 55C
Leptospire	Up to 15 days	2 days or less	Eliminated	Killed in 10 min. at 55C
Entamoeba histolytica cysts	1 wk. or less	3 wks or less	Eliminated	Killed in 5 min. at 50C or 1 day at 40° C
Hookworm eggs	20 weeks	Will survive	May survive	Killed in 5 min. at 50C or 1 hr. at 45C
Roundworm (Ascaris) eggs	Several yrs.	Many mo.	Survive well	Killed in 2 hrs. at 55C, 20 hrs. at 50C, 200 hrs. at 45°C
Schistosome eggs	One mo.	One mo.	Eliminated	Killed in 1 hr. at 50°C
Taenia eggs	Over 1 year	A few mo.	May survive	Killed in 10 min. at 59°C, over 4 hrs. at 45°C

Source: Feachem et al., 1980

Compost piles will undergo several stages of decomposition in addition to the initial thermophilic stage. After the hot phase has ended, the organic material will continue the process of biological degradation and transformation into humus aided by non-thermophilic microorganisms, macroorganisms such as earthworms and other insects, and fungi. These additional stages allow for the further decomposition of the organic material to produce a final product that is plant-friendly and agriculturally beneficial. The composting process incorporates both the element of temperature and the element of time. Combined, they produce an end product that is safe, sanitary, pleasant smelling, stable, can be stored indefinitely and can be used for growing human food.

More information about this system is available on the internet via The Humanure Handbook, 3<sup>rd</sup> edition, which can be read or downloaded in English and several other languages, including Finnish, free at HumanureHandbook.com. The same website has a number of

instructional video clips showing humanure composting toilets and bins in use, both at a single family scale, at larger scales, and in Haiti. Video clips also show humanure toilet receptacles being emptied into a compost bin, humanure compost being used for gardening and for planting trials, etc. There is also a message board open to the public where people from around the world can discuss issues and exchange information regarding humanure toilet systems. The site also has instructions on building a personal humanure toilet.

### ***The Amurt School -- Port au Prince, Haiti***

Amurt, a “green” school, consists of 11 pavilions and 22 classrooms, 8 composting toilets, 8 rainwater catchment systems, a reservoir, a composting site, a tree nursery, a permaculture demonstration site and organic garden. Two Agronomists and three technicians provide classes and demonstrations of urban permaculture, with a particular focus on the 820 children attending the preschool and after school programs, their parents, and the women’s and youth groups. Here, students utilize two toilet stalls, each with four toilets (Figure 4).



Figure 4: A toilet stall at the Amurt school, located next to the compost bins.

The private toilet stalls access the receptacles through chutes through the floor (Figure 5). The receptacles, located underneath the stalls, each have a capacity of approximately 60 liters (Figure 6).



Figure 5: This lady keeps the toilets clean at the Amurt School.



Figure 6: 60 liter receptacles slide out from underneath the toilet stalls.

They can easily be replaced with empty receptacles when full. Sugar cane bagasse and amyris wood sawdust are utilized as cover materials. The system produces approximately eight 60-liter containers of toilet material every three days. This volume fills a compost bin measuring 1.5 meters wide, two meters long and one meter high, every three months (Figure 7).



Figure 7: Each bin holds approximately 3 months' worth of toilet material.

Food scraps are added to the compost bin twice a day. Temperatures in the nearly full active compost bin were measuring approximately 60C (Figure 8). A bin that had been aging for six months was still reading 55C.

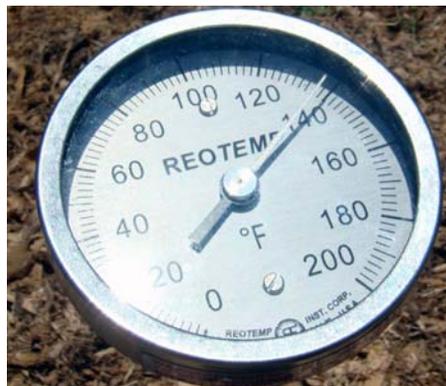


Figure 8: Temperatures recorded in Haiti's humanure compost piles ranged from approximately 46C to over 70C. This is approximately 60C. Fluctuations vary according to size of pile, age and contents.

The compost bins are adjacent to the toilet stalls. This allows the toilet contents to be conveniently composted without the need to transport the toilet material. The system is devoid of unpleasant odor. Flies are not a problem. A hand washing station is located next to the toilet stall (Figure 9).



Figure 9: Hand washing stations are an important part of compost sanitation systems.

The self-managed compost system has a dedicated crew of three persons: one woman who cleans the compost receptacles and two men who manage the composting (Figure 10). They are paid by the school.



Figure 10: Two men manage the compost sanitation system at the Amurt School. The nearer bin has reached maturity and is being used in the gardens. The far bin has been aging for 6 months and is still over approximately 55C. It will require months more to reach maturity and cool down.

When toilet receptacles are full, they are deposited into the compost bin. First, the cover material is raked back, and then a depression is dug into the top of the compost pile. The toilet material is added into the depression (Figure 11).



Figure 11: The compost pile is opened and fresh toilet material is added into the pile.

The toilet receptacle is rinsed with water (Figure 12) and the water is dumped into the compost pile (Figure 13). The cover material is then raked back over the fresh deposit and new cover material is added (Figure 14).



Figure 12: The toilet receptacles are rinsed after emptying.



Figure 13: The rinse water is dumped into the compost pile.



Figure 14: The fresh material is covered over and buried under bagasse.

The compost must undergo a prolonged aging period of approximately a year after it is collected. Otherwise, the compost will be immature and phytotoxic (it will kill plants). Maturity is reached when the compost pile cools down and the internal temperature is approximately the same as ambient temperatures. At this point, the compost is suitable for growing food. There is no waste in this system. Instead, where other sanitation systems produce sewage and pollution, compost sanitation produces fertile soil and food for humanity (Figure 15).



Figure 15: Mature compost is an excellent soil additive for gardens.

The compost sanitation system at Amurt is facilitated by educational efforts. Posters explaining the proper use of the toilets are posted in the toilet stalls (Figure 16). Community training seminars are provided by GiveLove.org (Figure 17).

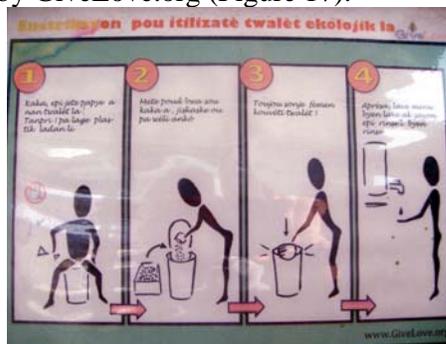


Figure 16: Posters describing the correct way to use the toilets are posted in every toilet stall.



Figure 17: Community training seminars that teach local residents about this type of sanitation system are provided by GiveLove.org.

### ***Other Haitian Examples***

Many Haitians do not have the luxury of compost sanitation systems and instead must use pit latrines. These are very odorous, fly infested, maggot-breeding holes in the ground which children can fall into. They're unpleasant to say the least, they pollute ground water, and the flies can spread disease. Figure 18 provides an example of a typical pit latrine in use at a Habitat for Humanity site in Leogane.

As an alternative to pit latrines, portable toilets are provided. However, these often fill up and remain unemptied. They then become very odorous and fly-infested and are shunned by the local population who would rather practice open defecation than walk into a portable toilet. Figure 19 shows such a toilet in Cite Soliel. Feces are scattered on the ground around the toilet because the children would not go inside due to odor.



Figure 18: A typical Haitian pit latrine in Leogane is filthy and unpleasant. The toilet smells bad, breeds flies and pollutes ground water.



Figure 19: A portable toilet in Cite Soliel next to a medical clinic fills up and remains unattended. It is so unpleasant that the local children defecate openly on the ground around the toilets rather than go inside.

### ***The Matt Gunn Orphanage Site***

The Matt Gunn orphanage in Leogane has a compost sanitation system very similar to the Amurt School. The stalls are located near the compost bins (Figure 20) and they're adorned with a painting of the "human nutrient cycle," while inside each stall is a poster describing how to use the toilet. There is a rain water catchment system on the toilet roof which provides water for washing toilet receptacles and for hand washing (Figure 21). Both 20 liter and 60 liter receptacles are used. The 20 liter toilets are meant for the smaller children while the 60 liter toilets are meant for the older children and adults. The toilet receptacles are located inside the toilet stalls and are removed from the inside by hand. The 20 liter receptacle lifts out while the 60 liter receptacle slides out. Figure 22 illustrates the 60 liter toilet and Figure 23 illustrates the 20 liter toilet.



Figure 20: The toilets at the Matt Gunn orphanage site are located adjacent to the compost bins. There is no odor and no flies. A bagasse pile nearby provides the cover materials.



Figure 21: The Matt Gunn site toilet stall is painted with a picture of the “human nutrient cycle” as well as a “GiveLove ecological sanitation” emblem. GiveLove.org provided the setup and training for this self-managed compost sanitation system at the orphanage.



Figure 22: The Matt Gunn toilets utilize both 20 liter and 60 liter toilet receptacles. This photo shows a 60 liter toilet. The receptacle simply slides out the front of the toilet when full, and then a lid is placed on the toilet until it is emptied.



Figure 23: Twenty liter receptacles provide smaller toilets for young children. The dark bucket to the left is full of bagasse cover material. After using the toilet, the children cover the contents with the bagasse. This compost sanitation system is self-managed by orphanage personnel.

### ***The Sopudep School in Port au Prince***

Sopudep School set up a similar compost sanitation system utilizing 20 liter receptacles with the help of GiveLove.org. It is also self-managed by school personnel trained by GiveLove. Their toilets serve 500 children at a time when school is in session. The toilet stall also has a painting of the human nutrient cycle on the outer wall for educational purposes (Figure 24). The compost bins are immediately adjacent to the toilet stall and the bagasse supply is also nearby. The bagasse is stored next to the toilets in wall-mounted dispensers (Figure 25). Rain water is collected and provided for hand washing (Figure 26).



Figure 24: The compost sanitation system at the Sopudep School in Port au Prince utilizes the same procedures as Amurt and Matt Gunn. The “human nutrient cycle” from the Humanure Handbook is painted on the toilet wall, translated into Creole.



Figure 25: Sopudep uses 20 liter receptacles that lift out of the toilet when full. The bagasse is dispensed from a wall-mounted bin.



Figure 26: Sopudep's toilet includes a hand washing station provided by rain water.

### ***Potential Problems with Compost Sanitation Systems***

Inadequate information, training, understanding and knowledge can make humanure sanitation systems problematic. This is compounded by fear of fecal material. People who are not comfortable with alternative sanitation and who do not have a solid understanding of compost should not be managing humanure toilet systems. There should be a dedicated compost crew who knows what they're doing when compost sanitation is undertaken.

Correct and adequate cover materials must be used. Some people simply expect toilets to smell bad and they cannot imagine that a toilet can be odor-free – a result easily obtained by humanure toilets when correct cover materials are used in adequate quantities. Cover materials that are too coarse may not mask odor adequately. This causes the user to deposit too much cover material into the toilet, causing the toilet to fill too quickly and throwing the carbon/nitrogen ratio off balance with too much carbon, thereby making thermophilic composting less likely. Large or even visible air spaces are not necessary in compost piles when the organic material is piled above ground.

The basic management procedure is simple enough: if bad odors are smelled or flies are visiting the toilet or the compost bins, then more cover material must be used. A conscientious compost sanitation manager will easily understand this and will be able to maintain an odor-free and sanitary system.

Also, all toilet wash water must go into the compost piles and never be dumped anywhere else. The system is to be kept “closed” in order to keep human excrement from polluting the environment.

It is important that humanure toilets be kept indoors in a heated area in cold climates; otherwise the contents of the receptacles can freeze and will not be able to be emptied. Frozen receptacles can also crack and leak

Compost bins can be located too far from the toilet area. This can make the job of emptying toilet receptacles costly, burdensome and unpleasant if the toilet receptacles must be moved

by hand. There is no reason to situate the compost bins far away. If they are adequately managed and covered, there is no odor. People who fear human excrement assume the compost bins will stink and will put them so far away from the toilet as to be impractical. This is a recipe for failure. The solution is to use enough cover material in the bins to prevent odors from escaping no matter where the bins are located.

## ***Conclusion***

Compost sanitation systems can provide safe and pleasant toilet alternatives in developing countries where electricity, water or money are in short supply, so long as carbon-based cover materials are available and compost sanitation personnel are trainable. Compost sanitation systems are already in use in schools and orphanages in Haiti where users are motivated by the desire to have pleasant toilets while preventing pollution and producing compost. The fact that compost sanitation systems are waste-free and instead produce compost suitable for growing human food should make this an attractive sanitation alternative anywhere in the world.

## ***About***

*Joseph Jenkins is best known for authoring the Humanure Handbook — A Guide to Composting Human Manure — first published in 1995 and now in its 3<sup>rd</sup> edition. The book has been sold worldwide and published in foreign editions on four continents. He has been a compost practitioner in the United States since 1975 and has grown his family's food with humanure compost for the past 33 years. His web site at [HumanureHandbook.com](http://www.HumanureHandbook.com) offers videos, instructions and the complete Humanure Handbook free of charge. Jenkins also provides humanure sanitation consulting services internationally. More information about the author can be found at <http://www.CompostSanitation.com>.*

*GiveLove.org was founded by Patricia Arquette and Rosetta Getty. Its project coordinator is Alisa Keeseey and its primary educator in Haiti is Jean Lucho.*

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