

Installing the EcoWaters Net-Drum Composting Toilet System



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Ecowaters Projects



**Ecological Wastewater
Transformation System**

Second Edition, 2005

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Check Your Plumbing and Environmental Health Codes

Before installing your Composting Toilet, consult your local plumbing and environmental health codes to determine if any particular guidelines are applicable. The information contained herein is for informational purposes only and might not conform to your local laws. Ecowaters Projects shall not be liable for your use of this information.

Check your state's requirements for graywater irrigation and the 1994 Uniform Plumbing Code, Appendix G. Your local library will have a copy of the Uniform Plumbing Code (UPC) published by the International Association of Plumbing and Mechanical Officials (IAPMO), 2001 Walnut Drive South, Walnut, CA 91789 (Phone: 1 917 989 2825). This excellent reference book is a wealth of valuable information, specifications, and drawings for effective and safe plumbing practices.

If in doubt, have your plan checked by a licensed plumbing installer. You might also consider having a licensed installer or plumber install your Composting Toilet System.

But first, read the entire guide to decide whether that is your preference.

For information about permission to reprint excerpts from this book, write to:

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Sales of this guide help support Ecowaters Projects, which conducts tours and workshops and publishes plans and publications to inform the public about ecological approaches to managing and using wastewater.

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The EcoWaters Net-Drum Composting Toilet System

Note: These plans are general design description of an ecological wastewater system. It is up to the user to adapt them to specific design flows and capacities. Site-built systems typically do not get local approvals (but there are exceptions, especially in Washington state). For permits, one usually must submit engineered system drawings. Remember that all composting systems work best when they are warm. Locate your composting containers near a source of heat, such as a hot water heater or an incandescent light bulb.

For in-depth installation and maintenance information, see *The Composting Toilet System Book*, available from Ecowaters.



This design was first developed by the ecological engineering firm, Sustainable Strategies, for ecotourism facilities. The engineered design plans were then donated to the Center for Ecological Pollution Prevention. Please do not make copies of these plans without permission from Ecowaters Projects (a.k.a. CEPP).

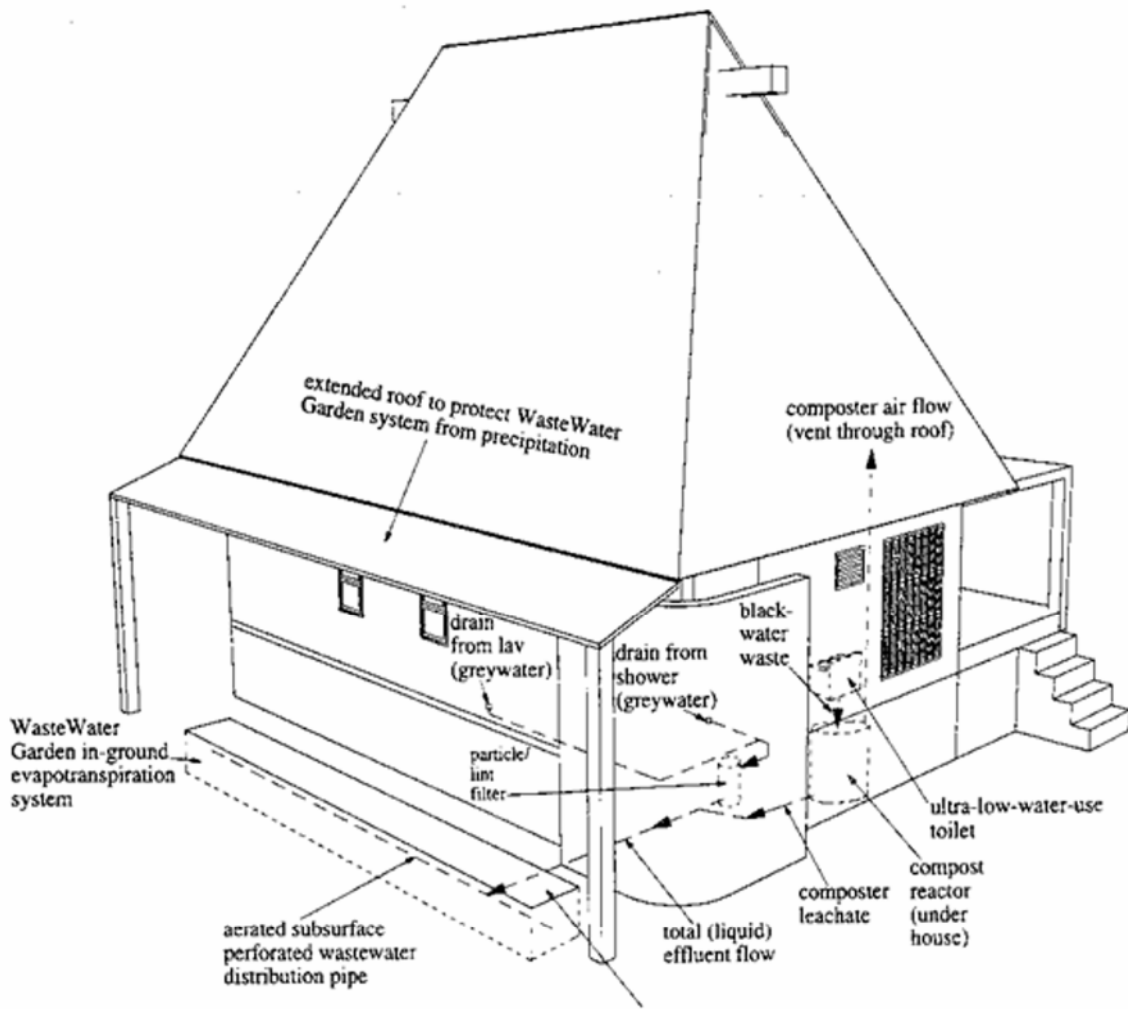
Ecowaters is continually updating plans—both text and design details—for this design and the EcoWaters Net-Batch Twin-Bin Composting Toilet System. For updates, write to the address below. Ecowaters appreciates receiving photos of completed composting toilet systems and may feature them, with permission, in newsletters and future editions of *The Composting Toilet System Book*.

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Wastewater Garden surface planted with attractive, high water use, plants to utilize pollutant/nutrients in the wastewater.

Sustainable Strategies
Ecological Wastewater Transformation System
Lalati Resort Beqa, Fiji
Perspective – Not to scale

Composting Toilets and Graywater Gardens at a Fijian Eco-Resort

Richard and Linda Kwasny operate Lalati, an upscale eco-resort on the Fijian island, Bega, a spot popular with divers.

The pair contracted engineering firm Sustainable Strategies to design and engineer site-built composting toilets (ship-ping manufactured systems from North America to Fiji was too expensive) and graywater systems, which were installed in 1999.

Each Fijian-style thatch bungalow, called a bure, features a SeaLand micro-flush toilet that flushes to a composter underneath, made of a rollaway trash container fitted with a hanging net (to assist aeration), a vent/exhaust chimney, a viewing porthole, an air-intake, and a leachate outflow line. Leachate from the composter and graywater from a sink and shower flow to a Washwater Garden located on the side of the bure and covered with a transparent Lexan roof overhang to keep out rain. These gardens are planted with broad-leafed thirsty plants.

Guests are supplied with locally made natural coconut soap and a biodegradable shampoo, although Linda Kwasny continues to use Dial antibacterial soap, and is monitoring the effects of that on her Washwater Garden. For laundry, they use a citrus oil-based detergent.

She reports, in the beginning, we had a problem eliminating the odor in the composter. We definitely had to play around with the composting additive, and now think we've got it right. Our additive currently is a daily dose of about two cups of woodchips, popcorn, sugar, and a good deal of peat moss. It took about two months for the composting to really start working well. [It may have occurred faster if composting microbes were added. – Ed.] We added worms to all of the composters and that has probably helped. They first changed a composter after six months in use by a house inhabited by male staff members. There is no smell, so we must be doing something right, Linda says. When a composter is full, it is disconnected from the toilet, exhaust, and leachate pipes, and taken to a sunny spot covered with transparent Lexan (to keep out rain). The openings are securely covered with two thicknesses of insect screening. After a minimum of six months of processing, the composters can be emptied.

Larger Washwater Gardens use up graywater from two clothes washing machines and the kitchen sinks. We planted the Washwater Gardens with different varieties of gingers and lots of canna lilies, which really love it there, says Linda. The gardens have flooded on occasion with heavy rains; we alleviated that by building rock berms to divert the water. In time, they will be just integral part of the surrounding gardens as the gardens spread, the plants all seem to be thriving well in the gardens.

Lalati has won an award for this system from the World Health Organization (WHO) for best ecotourism practices. Inspired by the success of Lalati's composting toilet and graywater system, WHO plans to introduce a composting toilet installation plan to Fiji as a method of reducing fecal conform levels in the water, which have been traced to septic systems.

Ultimately, that is perhaps the best that ecotourism facilities can do: not only lower their impact and highlight local aspects, but model lower-impact technologies appropriate for both developed and developing countries.

The EcoWaters Net-Drum Composting Toilet System



A Typical guest house (Left) at Lalatl, a eco-resort in Fiji. Each guest house features a roll-away composter (top right), a micro-flush toilet (above) and a Washwater Garden for graywater (top left). (Photos: Linda Kwasny)

EcoWaters Net-Drum Batching Composting Toilet System

This system relies on batching of the material: You're using one container until it fills up, then using another, while the other digests. This allows the composting process to stay aerobic and occur without interruption of fresh inputs. It also allows you to take containers to places where they will process faster and ultimately can be used.

Tips for Planning a Batch System

Figure out how many containers you will need. A 55-gallon drum has 7.352 cubic feet of volume, 6.5 after you put in a net or grate to separate leachate and enhance aeration of the material. A conservative formula is: One person will fill one 55-gallon drum with a grate and a leachate drain in about 200 days at 65°F compost temperature (unless you are adding gallons of additive every week)—more days at higher temperatures.

If you are not using wheeled containers or adding casters to your drums, figure out a method to move your containers. If you use a two-wheeled hand truck, do not fill the containers high, to avoid spills when they are later moved. Remember that even well-drained composters get heavy—as much as 300 pounds, and 470 pounds if the leachate was not drained.

Establish a warm storage/processing area for the full composters if you are not keeping them next to the active composter and using the same exhaust pipe. Ideally, this is a warm, ventilated room, perhaps near your water heater or clothes dryer. A minimum of one year of processing at 65°F should do it—longer if it is cooler, less time if it is warmer. Install a flexible duct from each composter to the active composter's exhaust opening, or fit the drums with screened or perforated lids, and vent the room. Note, though, that they might not need as much active aeration during curing as they need during the initial active aerobic microbial digestion. Consider, too, placing them in a vented outbuilding with solar windows.

Each drum requires a leachate drain with a valve that can be closed when you need to switch containers (unless you use a fixed leachate system). The leachate drain fitting on the drum must be higher than its destination, so it can drain by gravity. Otherwise you will have to pump it. Use at least a two-inch pipe for this if you are installing a micro-flush toilet.

As with all composters, remember to inoculate each container with compost starter, such as warm sifted compost from your compost pile or purchased bio-activator. Or leave a little material, fluffed up, from the previous batch.

Consider providing an inspection hatch or Plexiglas window at the top of the container.

System Concept

Pollution from sewage is one of the most urgent environmental in developing countries—as well as more and more in industrialized nations. Many critical environmental and public health problems resulting from the disposal of human excrement have been identified, including algae blooms and eutrophication in streams and lakes, contaminated drinking water wells and outbreaks of gastrointestinal disease and cholera. The causes of this pollution include septic systems, sewage treatment plants as well as the complete lack of sanitation facilities in some places.

Conventional on-site sewage treatment options such as septic systems are often a threat to ground and coastal waters. These technologies essentially place harmful pathogens and nutrients from human wastes directly over the water table. Although in certain soils and under the right conditions, some treatment can take place, nitrogen and other pollutants still generally remain in a form which presents potential health and environmental hazards.

In addition, the use of water to flush away human excrement wastes valuable and limited fresh water resources.

Only technologies which use up all the waste-water assure the protection of drinking water resources, bathing and swimming areas and sensitive environments such as coral reefs. The best solution to any problem is not to create the problem in the first place. Avoiding or preventing pollution problems is always less expensive than attempting to control the problem through treatment. The answer: Use it, don't dispose it.

The Sustainable Strategies Ecologically Engineered System

The recycled 55-gallon polyethylene Drum Composter¹ has been designed to prevent pollution problems by employing batch composting combined with an innovative Wastewater Garden™. Human excrement composters have been in use around the world for many years, particularly in Scandinavia, where they are used by hundreds of thousands of people.

Batch Composting Is Best

There are two basic types of composters: continuous and batch. Continuous composters process all the matter in one container, continuously, adding fresh excrement to the top, and removing processed matter from the bottom. A batch system has many individual composters and allows each batch to compost without being recontaminated by fresh excrement.

The best composting is accomplished in isolated batches. It's common sense. Like composting your leaves and vegetable matter, segregating the batches yields far more complete composting of each batch, because you're not mixing fresh material with older, more advanced compost. Complete composting needs time to ecologically cascade all the by-products of the many different organisms in the composting food web until all the organic matter is finally transformed into safe, stable humus. Now it is ready to be recycled as nutrients to green plants, which completes the great ecological cycle. Adding fresh material to processed material causes trouble. This is especially true with human and animal excreta, due to the high concentrations of bacteria, viruses, parasites, and unoxidized nutrients, such as urea in raw excrement. In continuous composters, urine or flush-water can mobilize dissolved fresh excreta, and drain it by gravity through cracks, fissures, and saturated compost into the finished humus-collecting area.

By segregating the batches, the risk of having living disease organisms in the finished product is dramatically reduced.

Introduction to the Recycled 55-Gallon Polyethylene Drum Composter

The recycled 55-gallon polyethylene Drum Composter is an ecologically engineered system designed to provide sanitation without harming the environment. Polyethylene is a plastic that can be recycled indefinitely by melting the scrap or broken pieces and molding the hot liquid into new products. Further, polyethylene has no chlorine in the plastic as other plastics do, so that if it is burned, no chlorinated compounds such as Dioxin or Hydrochloric acid are formed which are human and environmental toxins. The system is completely contained in a drum so that there is no discharge of pollutants into underground or surface water. And, because little water is used for flushing, the system does not waste valuable fresh water supplies.

Instead of simply disposing of wastes as most toilets do, the Drum Composter recycles them just they way nature does. The living machines of microscopic organisms, under proper conditions, turn compostable waste into the resource of a rich, fertile soil conditioner.

The Drum Composter uses the same process as occurs in nature when a stick, leaf or any animal waste falls to the ground. Tiny organisms that live in the soil, often helped by insects, digest these organic materials and turn them into soil for new plants to grow in. In a Drum Composter, heat from the sun is used to help speed up this process and to evaporate some of the liquid portion of the

¹ Designed by David Del Porto and staff engineers.

wastes. Because of the way the toilet is designed, there are no unpleasant odors and there is no danger of transmitting diseases through contact with the waste. After a year or more of composting, the small amount of odorless material that is left over, called humus, can be removed from the Drum Composter and used as fertilizer around the roots of plants.

When the simple maintenance procedures described in the manual are followed, the Drum Composter will be pleasant and odor-free, and will protect the environment and the health of people in the community.

What is Composting

Composting is the natural process through which plant material is decomposed by microorganisms and returned to the soil. Many different kinds of bacteria, fungi, and other tiny organisms that live in the soil consume organic materials and convert them into carbon dioxide gas, water vapor and a small amount of compost, also called humus. The humus is a valuable soil conditioner, improving the soil's ability to hold water, adding nutrients, and helping to maintain a healthy population of beneficial soil organisms that actually protect plants from soil-borne diseases. The amount of humus remaining after composting is less than a quarter of the amount of waste material which there was at the beginning of the process. In addition, the composting process kills most human and plant pathogens which may be contained in the wastes.

Safety Precautions

While the drum composter provides safe treatment of sewage, proper safety precautions should always be followed whenever handling toilet wastes, finished compost, wastewater, the Wastewater Garden sand bed, or Wastewater Garden plant roots. Always wear gloves and avoid touching eyes, nose, mouth or others until washing thoroughly with soap and water.

How the Drum Composter Works

Process Description

In the Drum Composter, human waste and other organic material (toilet paper, dried crumbled leaves, shredded leaves or popped pop corn, or small wood chips) are deposited into the Drum Composter where the solid portions are decomposed by aerobic (air-breathing) bacteria and some of the liquids are evaporated while the rest is used to irrigate plants in the adjacent Wastewater Garden. The solids land on a woven plant-fiber mat which sits on a net hanging in Drum Composter separating them from the liquids which go to the bottom and are allowed to drain out into the garden.

The large ventilation pipe acts like a chimney, drawing air into the Drum Composter from the fly-screen covered air intake pipe at the base of the Wastewater Garden. Air is also drawn down into the Drum Composter through the toilet valve when it is open (it should be closed when not in use to prevent odors in the room). Any odors generated by the process are therefore drawn out through the ventilation pipe over the roof, along with carbon dioxide gas and water vapor released by the bacteria as they digest the waste.

Operating Conditions

The Drum Composter will function best if certain operating conditions are maintained. Just as we do our best work when we are well fed and comfortable, the aerobic bacteria in the Drum Composter work best when they live in their favorite temperature and climate, have enough air to breathe and the right kind of food to eat. The toilet is designed to take care of most of this by itself, but some care is needed to maintain the proper operating conditions, as explained in the maintenance section of this manual.

There are four basic conditions which need to be maintained to ensure proper operation of the toilet:

Food for the composting organisms (Carbon and Nitrogen)

Food for the microorganisms which carry out the composting process comes primarily from the waste which is deposited into the toilet. But just like people need a balanced diet; these composting organisms need the right balance of carbon and nitrogen to their food supply (the raw materials you deposit down the toilet). Carbon is their source of energy, and nitrogen is used with other nutrients as they reproduce to form new cells. Too little nitrogen and the waste will decompose very slowly. Too little carbon and unpleasant odors from ammonia may be produced. Ideally, they need a ratio of about 30 parts carbon to 1 part nitrogen.

The human waste which is deposited in the toilet has plenty of nitrogen, but usually not enough carbon to keep the process working at its best. As explained further in the maintenance section, small amounts of organic material containing high levels of carbon, such as dried plant leaves, small wood chips, or finely shredded leaves or popped pop corn must be added periodically. Toilet paper is also a source of carbon, and is fine to put in the toilet.

Air

Composting is accomplished by aerobic bacteria, which need air to breathe. The ventilation system in the Drum Composter is specially designed to promote the growth of these air-breathing bacteria by drawing plenty of air across the digesting wastes. Nothing should be done which blocks either the air intake or the exhaust vent. To make the composting process work best, the materials being composted should have a loose texture to allow air to circulate freely within the pile. If the waste material becomes matted down or forms too solid a mass, the air will not circulate and the aerobic bacteria will die. The periodic addition of bulking material such as wood chips or shredded leaves or popped pop corn as described above helps to create the right texture in the waste pile.

Moisture

The microbes in the Drum Composter also need the right amount of moisture to thrive. Too much water will drown them, and create conditions for the growth of odor-producing anaerobic bacteria (this kind of bacteria does not breathe air and can live underwater). Too little water will dry them out and slow down the composting process. The ideal amount of moisture in the pile of composting waste is like that of a well-wrung out sponge.

Most of the time the moisture content of the waste pile in the Drum will be just right. The Drum Composter is designed to keep the aerobic bacteria from drowning by separating the solid portion of the wastes from the liquid by catching them in the net suspended in the Drum Compost. However, during very hot and dry periods, or if the toilet is not used very often, the waste pile may dry out, and some water may have to be added through the toilet.

Temperature

The organisms at work in the Drum Composter prefer a range of temperature between 68° and 140°F (20° - 60°C). Fortunately, the average temperature in the 80s over much of the Pacific region is ideal for promoting the composting process. As the bacteria get working, they generate their own heat in the waste pile, just as we do when we're working hard. This pushes the temperature into their preferred range. The Drum Composter uses the sun's heat to push the temperature up still further, which greatly speeds up the composting process. To keep the solar system working properly, it is important not to allow trees or other buildings to block the sun from shining on the area containing the Drum Composter.

The Destruction of Pathogens

Most disease causing bacteria, viruses and other harmful pathogens will be killed by the composting process in the Drum Composter. A combination of several factors aids the destruction of pathogens. In order of importance in the Drum Composter, they are as follows:

Time

The amount of time allowed for the wastes to digest is perhaps the biggest factor in killing pathogens². Most simply do not live very long when outside of the host conditions they prefer. The Drum Composter has been designed so that with the projected regular use by 2 adults, each Drum Composter is allowed to sit unused for 6-12 months after it is filled while another empty one is filling. This amount of time in combination with the conditions of the Drum Composter (low pH, predation by aerobic microbes and antibiotics produced by certain fungi) will eliminate almost all pathogens.

Air

Most human pathogens are not air-breathing, and prefer to be in the body of an animal or under water. The aerobic conditions maintained in the Drum Composter are a shock to these organisms and is enough to very quickly kill many of them.

Heat

The high temperature which can be achieved in the full Drum Composter when placed in a sunny solar area, is responsible for killing many pathogens. Studies have found that waste-pile temperatures of 140°F (60°C) for 36 hours were responsible for widespread elimination of harmful fecal bacteria and parasites.

Caution: While the combination of factors described above should eliminate the presence of any harmful pathogens under proper operating conditions, there is still the chance that some may have survived if all operating conditions were not properly maintained. Therefore, proper safety precautions should be taken whenever finished compost from the Drum Composter is handled. Wear gloves when handling finished compost and wash thoroughly with soap and water afterwards.

Use of Finished Compost

Each Drum Composter will take approximately 6-12 months to fill with the normal use predicted for the Bure's in Fiji and will sit unused for another 6-12 months while soother; one is being filled- At this point, when it is time to remove the finished compost, it will not look or smell at all like the original waste material which went in. Instead, it will be fairly dry with the look and smell of very rich garden soil. This humus is an excellent soil conditioner which will bring many benefits to any garden.

The finished compost can be removed from the Drum Composter and mixed into the soil of a garden or other planted area. (Note: do not put the finished compost into the Wastewater Garden because it is specially designed to have a bed of sand instead of soil.)

Because there is a slight chance that the compost will still be contaminated with disease-causing organisms, it should be buried in a shallow hole or trenched around the roots of trees and other plants. Also, do not use the compost around taro, sweet potato or other plants whose roots are eaten. Instead, use the compost around flowers, bananas and other non-root crops. Always wear gloves when handling the compost and wash thoroughly with soap and water afterwards.

Operation and Maintenance Procedures

It is very important that individuals be assigned responsibility for regular maintenance of both the Drum Composter and the Wastewater Garden to ensure that these procedures are followed. These systems will not function properly if the maintenance procedures described below are not followed, potentially resulting in foul odors and unsanitary conditions.

² Pathogens are human disease-causing living organisms such as bacteria, virus, parasites

Start-up

During construction, a fishing net attached by bent steel hooks was inserted into each Drum Composter so that the net hangs down as shown (see construction plans for details) and a square woven natural-fiber mat, approximately 4 ft. x 4 ft. was placed in the net to catch the solid materials deposited into the toilet so that they are separated from the liquid portion of the wastes. The following initial start-up procedure should be used the first time each Drum Composter is started:

1. Soak about 4 quarts of finely shredded leaves in fresh water and place them on top of the mat before the cover is fastened to the drum. Using a stick to poke the leaves, look down and rake the leaves into a fairly even layer over the surface of the mat. If necessary, add more leaves or popped pop corn so that most of the bottom of the mat is covered. Don't worry if a few leaves fall to the bottom of the Drum Composter.
2. Drop one quart (1 liter) of rich soil from a productive garden into the net so that it falls on top of the leaves. Inspect with flashlight and spread it fairly evenly. This soil contains the aerobic bacteria and other tiny organisms that will compost the wastes. It should not come from a garden where pesticides have been used because these chemicals may have killed the naturally occurring solid organisms. The attached drawing shows the net with mat.
3. This Drum Composter is now ready to use. Transport it from the storage and composter maintenance area to the building where it will be used. Connect the toilet discharge pipe, the exhaust pipe and the drain to the Wastewater Garden. After it has been filled with wastes (in approximately 6-12 months), close it off and follow steps 1 and 2 on a second Drum Composter.

Alternating the Drum Composters

The system features as many Drum Composters as may be required by the loading from the building, thus providing maximum flexibility under diverse loading conditions. First one is used until it is filled, closed off, and then another one is used while the material in the first one finishes composting. By the time the second is full; the material in the first one may have been fully transformed into humus, and is removed so that the first Drum Composter can again be used while the second one is closed off. When the first one is filled again, the finished compost in the other one is removed and so on back and forth. Under the expected regular use by 2 adults, it will take at least 6-12 months to fill each Drum Composter. This means that it could be a year or more before the finished compost is removed from the first Drum Composter. And then compost will be removed every 6-12 months after that. If however, high use fills the drum composter before the second is ready, build a third drum composter and put it into service.

Daily Maintenance

While the composting process in the Drum Composter will mostly take care of itself, some care and maintenance is required to make sure that proper operating conditions are maintained. Remember. **ODORS WILL MAKE YOUR GUESTS UNHAPPY** so take all necessary precautions to insure that the guests never smell bad odors. Check all the connections for odor tightness. **NEVER** open the cover or perform any maintenance on the Drum Composter when there are guests in residence. Cover open drums immediately and transport them to the compost maintenance and storage area.

Keep toilet seat closed

The toilet must be kept closed when not in use. This will ensure proper functioning of the ventilation system, keep out insects, and also prevent the possibility of an up-draft forming which could pull odors from the Drum Composter up into the toilet room.

Addition of bulking material

Periodically add a small handful of dry organic bulking material such as finely shredded leaves, popped pop corn, or small wood chips. These should be added to the Drum Composter by dropping

them down through the toilet. A container of bulking material should be kept in the composter storage and maintenance area for this purpose.

The person responsible for regular maintenance should add a few handfuls of hulking material every day or two in case not everyone remembers to do so after each use.

The most important factors of good composting is keeping the compost light and aerated, not compact. That means no matter what organic matter you add to the system, ensuring proper aeration is critical to successful processing.

Biological decomposition requires moisture, oxygen and balanced nutrition, just as humans do. The enzymes that the aerobic bacteria produce to break down larger organic molecules into simple oxidized molecules that can be utilized by plants for growth prefer simple sugars, starches, and complex carbohydrates to woody cellulose and lignin found in tree products. We emphasize “prefer” because toilet paper, peat moss, and wood shavings will break down; it will take longer and could fill the toilet faster with uncomposted additives.

Add spoiled vegetable foods or leftovers from the house rather than purchasing special materials. The size is important so shred or chop additives into ¼ -inch pieces. Leaves could mat down causing loss of air space, so be cautious.

Do not add animal, poultry, fish products or oils of any kind. Plant-originated materials only! These materials are not helpful.

A small handful of additive per person per day is a good rule of thumb. A little more or less will not be a problem.

However- adding a lot of additional matter to the toilet can reduce its capacity to process excrement and will shorten the retention time in the composting process. This means emptying it more often.

Control fruit flies with a fine mist of soap and water (two tablespoons per gallon of water) sprayed directly on insects as much as possible. Diatomaceous earth (a natural mineral) works very well—dust it onto the surface of the compost.

The following is a list of materials in order of ease of digestion by the resident microbes:

1. Sugars

Fructose is a fruit sugar, so add spoiled or dried apples, melons, bananas, coconut meat, pears, raisins, figs, etc. Rinds generally break down more slowly than the pulp so shred them well. Avoid citrus peels (orange, grapefruit lemons) as they impede the breakdown process.

2. Starches Potatoes (peels, too), yams, taro, pumpkin and squash.

Corn is both a sugar and a starch, so add dried or spoiled corn kernels and stale popped corn, as they aerate and provide nutrients for the microbes. Corn cobs must be well shredded. All vegetables and stalks work well too, as do pelletized or loose horse and cattle animal feeds.

3. Complex carbohydrates

Cereals (including all breakfast cereals), grains (wheat, oats, rice, alfalfa), pastas, bread and biscuits (crumbs and slices) crackers, burned and stale popcorn, etc.

4. Cellulose

Wood shavings, fine shredded bark, and leaves or small chips (not red cedar, eucalyptus wood or birch or pine bark or other woods that inhibit biological decomposition) and no sawdust, as it is too fine and will compact like flat unshredded leaves.

Toilet paper (preferably white with no perfume) finely chopped newsprint (no colors or glossy paper), plain brown corrugated, dry wood pulp from a paper mill, wood pellets for stoves, etc. Finely chopped straw, hay, alfalfa, pea straw, kenaf etc.

5. 0.Minerals

Minerals will not break down, but they can help aerate the compost. However, minerals, such as horticultural grade perlite and vermiculite, work well as balking or aerating agents.

Normal cleaning

The toilet and the area around it can be cleaned periodically with a sponge or scrubbing brush, water and some mild soap. Soaps made from natural ingredients like coconut oil are best. Chemical soaps, detergents, bleach, and other poisons should never be used when cleaning the toilet seat or dumped into the Drum Composter. This will kill the organisms which carry out the process, causing the Drum Composter to stop working.

If this occurs, remove the Drum Composter to the Composter storage and maintenance area and restart the composting process by adding new garden soil as in step 2 of the start-up procedures. After several days or weeks, the waste should begin to compost again.

Small amounts of water poured through the toilet seat into the Drum Composter will not hurt the process as they will drain into the Wastewater Garden, although care should be taken not to pour too much at once. Small amounts of disinfectants can be wiped on the toilet seat but take care not to let any seep down into the Drum Composter.

Periodic Maintenance Inspecting the Drum Composter

Inspect the Drum Composter at least every week or two. If the waste material appears to be very dry, sprinkle a liter of water down through the toilet so that the pile looks moist. Using a stick, knock down and level any piles of waste that have formed to provide more room in the Drum Composter. When the net is filled with waste and the pile gets close to the cover, the Drum Composter is full.

Inspecting insect screens

Periodically check the insect screens on the air intake and on top of the ventilation pipe and make repairs as necessary to keep flying insects out of the Drum Composter. Also check to make sure that they have not become clogged with dirt or other materials which could block air flow. Use a dry brush to clean the screens at least once a year to keep them from getting clogged.

Inspecting the exhaust pipe, air intake and Drum Composter leachate drain pipe

Periodically check the top of the air intake and exhaust vent pipe to make sure that there are no obstructions blocking the airflow. If either of these pipes is made up of several connected pieces, check the connections to make sure that there are no leaks. Repair with silicone, leak-proof tape, or other caulking compound. Give special attention to the leachate drain from Drum Composter to the Wastewater Garden. Arrange pipe and connecting hose so that no liquid stands in the line.

Changing Drum Composters

When the Drum Composter currently in use becomes full, it must be closed off and another one installed in its place for use. A few days non-use is helpful here.

1. Disconnect all connections and cap them to prevent odor from escaping from the one in use and with the special 2 wheel hand truck, strap the drum to the truck, and transport it to the composter storage and maintenance area.
2. If using S hooks to hold the net, they may have to be removed from the top of the container to permit the use of a cover or lid.

3. Install the empty Drum Composter to the toilet, exhaust/vent pipe, and Wastewater Garden.
4. 0. Check all connections for water and odor-tight integrity and the Drum Composter is ready to use.

Emptying finished compost and restarting Drum Composter

When both Drum Composters are full, the material in the Drum Composter which was filled first is ready to be removed — as long as the Drum Composter was not used for at least 6-12 months.

1. Identify the Composter storage and maintenance area. Make sure that it is well away and downwind from any public area. The composter storage and maintenance area should be sheltered from the weather, but exposed to direct sunlight to solar-heat the composting drums.
2. Connect Drum Composters to a screened vent and drain system ensuring adequate aeration for good composting and to allow the leachate to drain to a sheltered Wastewater Garden.
3. After 6-12 months of segregated composting. Disconnect the vent and drain, open the cover and inspect the now mature finished compost.
4. Identify the S-shaped hooks below the cover on the top of the Drum Composter.
5. Remove the net containing finished compost from the Drum Composter by removing it from the hooks. Remember to wear gloves when handling the net and compost. Empty the compost from the net into a pile or bin for storage where children will not have access to it until applied to garden soil.
6. Shovel out any dried compost from the floor of the Drum Composter and add to the storage pile.
7. Check the wastewater drainage area. Located in the base of the Drum Composter Remove any solid material or sludge in or around the drain so that wastewater will flow freely into the garden for treatment. Push a stiff wire such as a coat hanger into the 2 in. drain pipe leading to the garden to make sure it is unobstructed.
8. Inspect the net and hooks, and make any repairs as necessary. Re-seal the point where the hooks attach to the drum to assure odor-tight integrity. Thoroughly clean the drum by washing it with deodorizing pine oil cleaner.
9. To reduce the amount of liquid going into the Wastewater Garden, attach non-biodegradable polyester or nylon fabric strips from old clothing to hang down below the net. These strips act as wicks to draw up liquids into the airflow and aid in evaporation.
10. Place a new mat, woven from palm fronds or other plant material, approximately 4 ft. x 4 ft., into the center of the net.
11. Cover the mat with a layer of wet, finely shredded leaves or popped pop corn.
12. Place one quart (1 liter) of rich soil from a productive garden on top of the leaves and spread evenly. As with the initial start up, the soil should come from a garden area where no pesticides have been used to ensure that it contains the aerobic microorganisms which will compost the waste.
13. Replace the net, with mat, wet leaves or popped pop corn and soil back into the Drum Composter by inserting the S-shaped, polyester resin-coated, steel hooks so that they fit into slots cut into the drum opening at the top. Be sure that the mat on the net is hanging in a position to catch the solids as they fall from the toilet Make sure that the wicks (fabric strips) are hanging down to the floor of the Drum Composter.
14. Inspect the Drum Composter with the start-up mixture in the net. Make sure it is clean and odor-fight Bring it to the location where it will be connected.

15. 0. Check the drums that are composting from time to time mix the contents with a dull paddle to aerate the processing matter. They should be left in an area that is sunny so that they can be solar heated to speed-up the process. Make sure they are getting sufficient air.

Insect control

The air intake, the exhaust stack, and breezers in the Wastewater Garden have all been screened to prevent the entry of flying insects, which can spread disease-causing organisms if they come into contact with fresh wastes. In addition, the high temperatures in a properly operating Drum Composter will discourage the survival of most flying insects. However, it is important to take certain precautions to keep pests out of the Drum Composter:

1. Inspect and maintain insect screening.
2. Keep the toilet room door closed to prevent insects from entering.
3. 0. Keep the toilet valve or seat closed when not in use to help ensure that any insects which do get into the toilet will not fly down into the Drum Composter.

If flying insects do become a problem, a small amount of non-toxic insecticidal soap or a short-lived organic pesticide containing pyrethrins can be used without harming the composting organisms. A five second burst of spray in the toilet room and in the air intake can be repeated each day until the problem goes away.

Worms and other non-flying insects in the Drum Composter are not a concern, and in fact help speed up the composting process by increasing the flow of air through the waste. They will disappear before the finished humus is removed (6-12 months) from the Drum Composter.

Emptying undigested waste

The Drum Composter has been designed to fully contain wastes and prevent contact with them until they have been transformed into harmless compost. It is hard to imagine why waste would be removed prior to complete-However, if it should ever be necessary to remove waste from one of the Drum Composters before it is completely composted, great care should be taken to avoid direct contact. The waste can continue composting out-side of the Drum Composter, but it should be mixed with leaves and piled in an area where people and animals will not come in contact with it until composting is complete. Wear gloves while handling waste and be sure to wash self and clothes afterward.

Problem Solving

Problem: There is an odor of fresh wastes in or around the unit

Some odor may be present in vent system of the Drum Composter for the first week or two after a Drum Composter has been started-up before the composting process begins. After this there may be a slight musty-sweet odor occasionally if the wind blows air from the exhaust pipe down toward the ground, but there should not generally be any objectionable odors.

A foul odor may indicate that air from the Drum Composter is venting into the toilet through the toilet opening or perhaps a leak in the ventilation system. Changes in wind and weather may sometimes bring odors down from the top of exhaust pipe above the roof, but it may be difficult to tell where the odor is coming from.

One source of the problem could be that the toilet has begun to act as a chimney, drawing air from the Drum Composter up into the toilet room. Normally, air should flow down through the toilet seat into the Drum Composter. You can check this by holding a lit cigarette over the toilet and seeing which way the smoke blows. If air is coming up from the Drum Composter into the room from the toilet seat, do the following.

- Make sure that the toilet valve and seat are closed when not in use.

- Make sure that the toilet room door remains shut and that there are no windows or large openings in the walls or ceiling. The only openings along the wall should be small and near the bottom. Make repairs as necessary.
- Check the top of the exhaust pipe to make sure that it has not become obstructed. It may be that the rain cover has slipped down to cover the opening or that the insect screen has become clogged. The insect screen should be around the fitting of the rain cover as shown on the plans so it will not restrict air flow.
- Check the air intake pipe to make sure that it is not obstructed and has no leaks.
- Make sure that trees and vegetation are not blocking sun from shining for most of the day on the rear of the building. Heat from the sun helps to keep the air flowing properly through the system.

If the cigarette smoke test shows that the air is flowing properly down into the toilet, the odor may be coming from a crack in the floor or one of the walls of the Drum Composter. Check for leaks and cracks and repair as necessary. If odors outside cannot be remedied, the installation of an odor filter may be necessary.

Problem: There is a strong odor of sewage, rotten eggs, or ammonia.

These strong odors indicate that the Drum Composter may have become anaerobic or that the microorganisms do not have the right balance of food.

Try increasing the amount of bulking material (such as finely shredded leaves or popped pop corn) which is dropped into the Drum Composter through the toilet. If this does not help after a week, try adding a pint of cold ashes from burning wood.

Make sure that the net has not been damaged, allowing all wastes to fall down to the bottom of the Drum Composter. Stop using that Drum Composter if this has occurred. If the other Drum Composter has not been used for at least a year, you may remove the finished compost and begin to use it, and the contents from the Drum Composter with the damaged net can be removed and the net repaired after the other one has been filled, just as would occur in the normal rotation.

Undrained liquid could be standing in the bottom of the Drum Composter and may decompose without air and generate bad odors. This can be remedied by pouring liquid plastic or cement mortar into the bottom of the drum. Only add enough mortar to fill the space between the bottom and the bottom of the drain spigot. **DON'T BLOCK THE DRAIN OPENING OR NO LIQUID WILL DRAIN OUT!** When hardened, this will prevent standing leachate in the drum.

If odors outside cannot be remedied, the installation of an odor filter may be necessary

Problem: The Drum Composter does not seem to be filling up with waste material, even after years of use.

This is not a problem at all. It means that the wastes are being decomposed faster than they are being added. Although this means that no compost can be harvested, it means that the process is working very well. As long as there are no other problems and the Drum Composter does not get full, you should keep using it.

Problem: Periodic inspection of the Drum Composter reveals that the woven mat is not properly positioned, allowing solids to fall through to the bottom.

A small amount of solid wastes slipping through the net to the bottom of the Drum Composter is to be expected and is not a problem. If all or most of the solids are not being caught by the mat in the net, try to place a new mat or a thick sheet of plastic directly under the toilet seat to channel the waste into the middle of the net. Drop it down through the cover and move as necessary using a flashlight and a long stick.

Contacting Sustainable Strategies

Sustainable Strategies, the designing ecological engineering firm, will assist with any questions or problems regarding the Recycled polyethylene Drum Composter.

Do's and Don'ts

Do:

- Keep the toilet seat down when not in use and keep the waste valve to the toilet closed at all times when not being used.
- Put toilet paper or leaves down the toilet.
- Put a handful of organic bulking material such as finely shredded leaves or popped pop corn down the toilet periodically.
- Use a mild soap in the wash basin, shower and when cleaning the toilet seat area.
- Bury finished compost in a shallow hole or trench around the roots of plants.

Don't:

- Throw cigarettes, matches, or burning material into the toilet.
- Use harsh detergents, chlorine bleach or toxic chemicals in the wash basin, shower, or pour them down the toilet.
- Pour lots of water down the toilet.
- Switch Drum Composters until one is full.
- Remove compost from a filled Drum Composter until it has been composting for 6-12 months or longer.

List of Materials

55-gallon polyethylene barrels with removable lids
30 in. x 24 in. mesh bags (these can also be made)
12 "S" hooks or 6 ft. to 8 ft. nylon cord per drum
3 UniSeal Grommets* (size depends on design)
Compostable lining
Vent T (a pipe T)
Flyscren
Flexible wire to attach flyscreen
PVC pipe with appropriate length and diameter according to design
True Union Ball valve
Exhaust Fan (optional)
Carbon filter (optional)

Tools

Drill
Appropriate sized drill bit (5/16 in.)
Appropriate sized hole-saws
Jigsaw/Sawzall (as needed)
Scissors or Knife

*You can make a system without this specialized part, simply substitute bulkhead fittings. However, the UniSeals offer many advantages.

Sources for Material

Cheap drums and other reusable containers

Reconditioned 30- and 55-gallon open-topped polyethylene drums with locking bands are available for \$8 to \$10 each. Check your telephone directory for reused containers dealers. Other sources include food production operations, such as juice vendors and distributors that repackage "wet" foods, such as juice concentrate and pickles. If that doesn't work, try:

Association of Container Reconditioners

800-533-3786

Its website lists sources in most states.

www.reconditioner.com

Fittings, containers, tanks, casters, accessories

Gloves, brushes, mixers, etc. and nearly every kind of plastic container suitable for composters.

United States Plastics

1390 Neubrecht Road

Lima, OH 45801-3193

www.usplastic.com

Rubbermaid/Consolidated Plastics Company

8181 Darrow Road

Twinsburg, OH 44087

800-362-1000

Quick-disconnect flexible couplings

UniSeal by AGS, Inc.

2530 County Road 775

Perrysville, OH 44864

419-938-7120

Ferco/Plumbqwik

300 s Dayton Street

Davison, MI 48423

800-521-1283

bulkhead fittings

Hayward

900 Fairmount Avenue

Elizabeth, NJ 07207

908-351-5400

Inspection hatches

Sold as removable deck plates

Viking Marine

1630 W. Cowles

Long Beach, CA 90813

888-268-3387

Fans

800-225-5994

www.grainger.com

About UniSeals

These plans are based on using UniSeal gaskets.

If you do not use UniSeals, change the sizes of the holes according to the outer diameter of the pipe you're using.

Using Your Uniseal Pipe Bushing/Grommet

The UniSeal allows you to perfect pipe seals fast and easily.

Available in sizes 3/8 to 6, the UniSeal is made of Alcryn, a synthetic rubber. It resists most foreign sub-stances, and has an extremely long life. A UniSeal bushing can be fitted to flat on concave PVC to PVC, and PVC to copper or steel.

It will fit pipes with ID 3/8 in. to 6 in. through any wall to 1/2 in.

UniSeals are used for leachate drain-lines and exhaust vent connections, as well as toilets for the Carousel, such as the SeaLand, or the Waterless Toilet from Norway. For pipe diameters other than 6 inches, an alternative coupling mechanism such as a bulkhead fitting must be installed.

Installing a UniSeal is simple:

1. With the chart below, determine the specifications and the ID of the pipe you are going to install.
2. Using a hole-saw or carefully using a jig saw, cut the appropriate size hole that matches the part number and pipe diameter that you have chosen.
3. Lubricate the UniSeal with a little soapy water.
4. Push in the UniSeal so that the large outer lip is on the outside (the UniSeal inscription will face out). Lubricate the pipe that you are inserting with soapy water and twist it into the UniSeal to a depth of about 3/4 in.—any longer and the pipe end could obstruct the turning of the internal Carousel.

You have now made a removable but air- and watertight connection to the Drum. If you must remove the pipe, simply twist it out.

Part No.	Pipe I.D.	Pipe O.D.	Hole-saw Size
U038	3/8 in.	0.675 in.	1 in.
U050	3/4	0.840	1.25
U075	3/4	1.050	1.25
U100	1	1.315	1.75
0125	1 1/4	1.660	2
U150	1 1/2	1.900	
U200		2.375	
U300	3		
U400			5
U400-35		4.35	5
U600	6	6.625	7

Choose a Toilet Stool



Dry Toilet

Use a 8 in. toilet chute pipe.

Above: SunMar Dry Toilet about \$240 from EcoTech and SunMar.

Clivus Multrum dry toilet stool from Clivus Multrum.

Also, make your own toilet stool.

EcoTech 8 black plastic bowl liner makes it easy.



SeaLand MicroFlush Toilet

Use a 3 in. toilet pipe.

Above: SeaLand Traveler one-pint flush, about \$300.

From EcoTech, SunMar or SeaLand Technology.

Drain extra liquid (leachate) to Wastewater Garden.



Urine-Diverting Toilet

Use a 6 in. toilet pipe.

Above: Ekologen urine-diverting toilet, about \$600 from EcoTech, Ecovita, and Ekologen.

Drain urine to Wastewater Garden



No Toilet Stool

Just cut your toilet opening into the top (be sure it's sturdy--considering using a wood top).

Just cut your toilet opening into the top (be sure it's sturdy--considering using a wood top)

Toilet Stool Considerations

First, decide on what kind toilet stool you'll use. The primary difference, with respect to these plans, is the size of the waste-inlet pipe that you will install.

- Dry toilet stool: Requires an 8 in. pipe between stool and barrel.
- Microflush toilet stool: Requires only a 3 in. pipe between toilet and barrel.
- Urine-diverting toilet stool: Depends on the model.

No toilet stool: This option is simply attaching the toilet seat to the top of the barrel and is not detailed in these plans. If you choose this method, there are some additional provisions you must consider. You must provide some additional support beneath the toilet seat such as a simple wooden frame. The size of the waste-inlet hole will be variable depending on the seat you will use. You will also need to create a plug for the waste-inlet hole for when it is not in use.

Venting

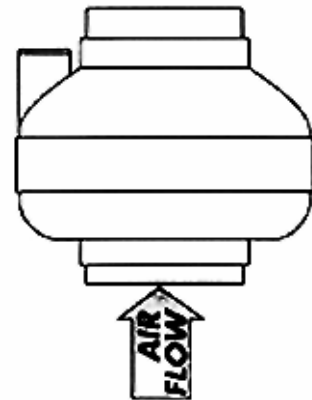
The top of the barrel will have a vent pipe installed to allow for air flow and encourage odor venting. You can use a fan to assist this process. The difference in design is, once again, the diameter of the pipe you will install.

No fan: Without a fan, you will use a 6 in. diameter vent pipe and paint the portion that exceeds the roofline with black paint to encourage heat-induced air flow. Use a 7 in. hole-saw to create this opening.

Fan: If using a fan, such as the Fantech FR100, you will use a 4 in. diameter vent pipe. Instructions for installing the fan will be included with the fan purchase. Use a 5 in. hole-saw to create this opening.

Vent Pipe Hole: Decide how close the vent-pipe hole may be made to the edge of the lid. Once the maximum distance is determined, use the 5- or 7 in. hole-saw to cut a circular hole at the appropriate location. Be sure the cut surface is completely smooth: remove all burrs. Insert the 4- or 6 in. UniSeal gasket into the hole.

To keep out insects and water, put a rain hat or pipe T on top of the vent shaft. The details of this installation are left to the architect or owner. Then enshroud the rain hat or T pipe with fly screen and secure with wire. If the toilet is located in a region of poor ventilation or odors become an issue, you may want to install a carbon filter at the top of your vent pipe. Contact EcoTech for more information.



A FanTech fan is a good choice for durability and suitability to damp conditions. Some builders also use computer fans, etc. These don't have as much power or durability, (so won't move air as well) but may be fine for your installation.

The Composter (Barrel or Other Container)

Net Support Loop-Holes: Using the appropriate drill bit drill a number of holes equidistantly apart, near the rim of the barrel. The number of holes to be drilled will depend upon the shape of your barrel. For a circular barrel, we recommend approximately 12 holes about 6 inches apart. A different shaped barrel may require more or less as needed. The diameter of the cord that will support the net will ultimately decide the size of the holes. Nylon laundry line, which is approximately 5/16 in. diameter, is a good example. Try a slightly smaller bit such as the 7/32 in. drill bit to use with the laundry line. It requires a bit of work to push the loop through, but it makes for a desirable, tight fit. The diameter of the holes should be no more than the diameter of your cord. Keep in mind that you want smaller holes to avoid odor leakage.

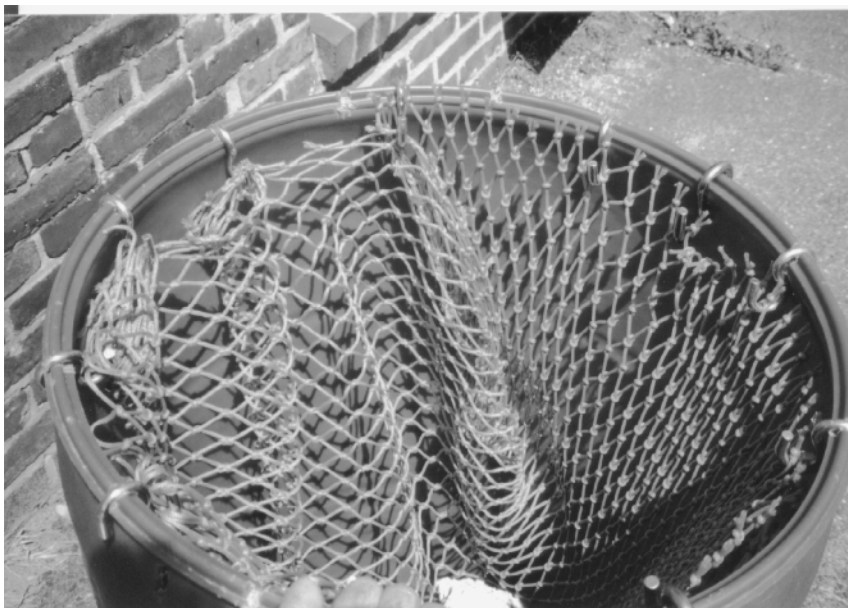
Hanging the net: Weave the cord through the upper portion of the net. Allow for some slack. Put the net inside the barrel and push the slack in the cord through the holes around the rim in such a way that it creates a loop on the outside, under the rim. Insert a straight, sturdy piece of material, such as a tent stake or even a nail, through the loop. When all loops are secured, the net should hang with about 6 in. of clearance from the bottom of the barrel. Finally, lay a compostable liner on the bottom of the hanging net, such as thin burlap, cheesecloth or single-ply, low wet-strength paper towel.

There is an alternative way to hang the net inside the drum. Use “S” hooks at the top of the net so the net hangs from the rim of the drum. Use 12 hooks per net. The hooks should be crimped so the hooks will not fall off the net.

Leachate Drain Hole: Drill a hole near the bottom of the barrel using the appropriate hole-saw (see below). The hole should be approximately 2 in. from the bottom as measured from the inside of the barrel. Ensure that the hole is smooth by removing all burrs. Insert the UniSeal gasket into the newly drilled hole.

The size of hole you create will depend on whether you have a dry toilet or a flush toilet.

Dry toilet: There will be less liquid in the system, so a smaller pipe, even a flexible one, may be used. Use a 1¾ in. hole-saw and a 1 in. UniSeal bushing.



Using hooks to secure the net.



Any flat-topped watertight container can be your composter.

Waste-Inlet Hole: If you're using a micro-flush toilet, use a 4 in. hole-saw to cut out the center of the lid. Remove all burrs and insert the 3 in. UniSeal gasket into the hole. If using a dry toilet, stencil an 8¾ in. diameter circle near to the center of the lid. Stencil a 6¾ in. hole for a urine diverting toilet. Use a drill to make a pilot hole within the bounds of the circle and then carefully cut the hole with a Jig Saw or Sawzall.

Attach the Lid: Presumably your barrel lid has a gasket to ensure an airtight seal. Regardless, we suggest you apply vegetable oil on the upper rim of the barrel to assist in the sealing. Apply the lid and secure it with 4 C-clamps spaced equidistantly apart. Use silicone caulk or other appropriate sealant to close any gaps in between the lid and barrel and around any holes drilled into the barrel. Let the sealant dry before putting composter into use.

Installing the Fan

If you use the FanTech fan

STEP 1.

When selecting fan mounting location, consider the following:

Fan location should allow sufficient access for service. You will want to insert a piece of exhaust pipe in place of the fan when you are servicing it or the power has been turned off.

The best location for the fan to be mounted is as close as possible and practical to the termination of the vent pipe. This minimizes the transmission of vibration sound back to the bathroom.

In order to prevent bathroom odors insure that no competing demands for air, such as open windows (only on the side of the building opposite the direction from which the wind blows), fireplaces, bathroom exhaust fans, are present. If necessary, cut 1 or 2 inches off the bottom of the bathroom door to supply air to the commode.

STEP 2.

Using the wood screws provided, attach the mounting bracket to a support beam at the selected location. We recommend vertical mounting to reduce condensation buildup, however if horizontal installation is necessary, either wrap insulation around the fan or drill a 1/4 in. hole in the bottom of the housing (along with an threaded insert and drain tubing) allowing condensation to drain.

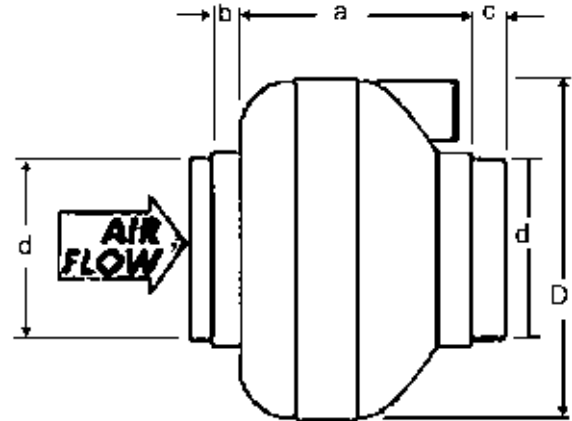
STEP 3.

Attach fan to the mounting bracket with the sheet metal screws provided. Be careful to ensure that direction of air flow is to the outdoors. The bracket is provided with rubber vibration isolation grommets to prevent the transmission of sound through the structure. Do not over tighten. Also, care should be taken not to strip the plastic housing. Although screws are self-tapping, we recommend that pilot holes (no larger than 3/32 in.) be drilled.

STEP 4.

Connect 4 in. ID vent pipe (PVC schedule 40 pipe recommended) to the inlet and outlet of the fan using the quick-disconnect rubber couplings provided. While the worm clamps should be snug, care should be taken not to over tighten (60 lbs. of torque max.).

NOTE. Steps 2 & 3 may be reversed.



Fan Dimensions

a = 5.25 b = 0.875 c = 0.875 d = 3.875: D = 9.5

The Electrical Connection

Installation work and electrical wiring must be done by qualified persons in accordance with all applicable codes and standards.

DO NOT CONNECT POWER SUPPLY until fan is completely installed. Make sure electrical service to the fan is locked in “OFF” position.

While we recommend that the fan be left running at all times, this unit is suitable for switched use. A number of users have found that it is advantageous to have a wall-mounted switch near the commode so that the fan can be shut off temporarily while the fan is being serviced. It is important to note, however, that the fan be turned on immediately following service. **NEVER** place a switch where it can be reached from a tub or shower.

STEP 1.

Remove the screws securing the terminal box cover plate located on the side of the fan. All fan motor connections are prewired to an electrical terminal strip. A 3/8 in. clamp connector is provided to secure the wiring through the knockout provided on the side of the terminal box.

STEP 2.

Bring incoming electrical service through the connector and the knockout. There are two open ports on the terminal strip. Using a small regular screwdriver, tighten the neutral (white) wire of the incoming supply under the open port labeled “N”. Tighten the line (black) wire of the incoming supply under the open port labeled “L”. Because the fan motor is isolated within a plastic housing, grounding is not necessary.

STEP 3.

Secure connections, clamp connector, and terminal box screws.

The Fan

The Fantech FR 100 is a remote mounted inline centrifugal fan that features a plastic housing manufactured of GE Noryl plastic, allowing the fan to be mounted in wet and outdoor locations. The fan utilizes an external rotor motor with an totally enclosed design that allows the fan to operate in high moisture, lint and dust laden air. The motors are a permanent split capacitor type, with automatic reset thermal overload protection and sealed ball bearings. The fans are caulked at the motor screws, the wiring cables and along the seams of the fan to prevent moisture from entering the housing. The fan is prewired and supplied with a mounting bracket for easy installation (at the point as close to the termination of the 4 in. exhaust pipe as possible, e.g. under the roof of the building to minimize fan operating noise from being transmitted back through the duct work). This fan is UL recognized and ultraviolet light protected.

The clamps, band screw, and housing are made from series 300 stainless steel. They are corrosion resistant and rustproof and specially designed for greater sealing efficiency. The couplings flex with pipe and fan movement, maintaining integrity of seal.

Troubleshooting

If fan fails to operate, please check the following:

- Consult wiring diagram provided with the fan, to assure proper connection.
- Check motor lead wiring and incoming supply leads to assure definite contact.

MAINTENANCE

Because fan bearings are sealed and provided with an internal lubricating material, no additional lubrication is necessary. If fan is to be turned off and left inoperative for more than ten (10) days, we

The EcoWaters Net-Drum Composting Toilet System

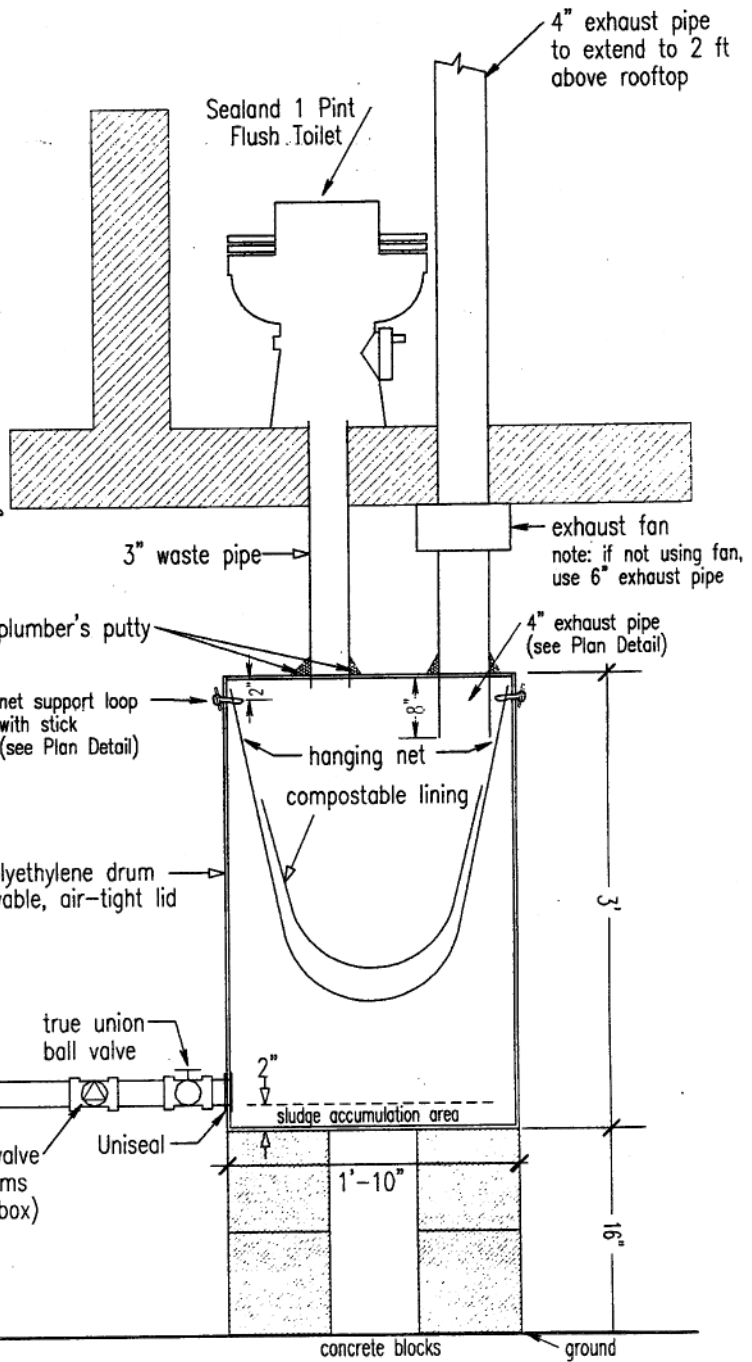
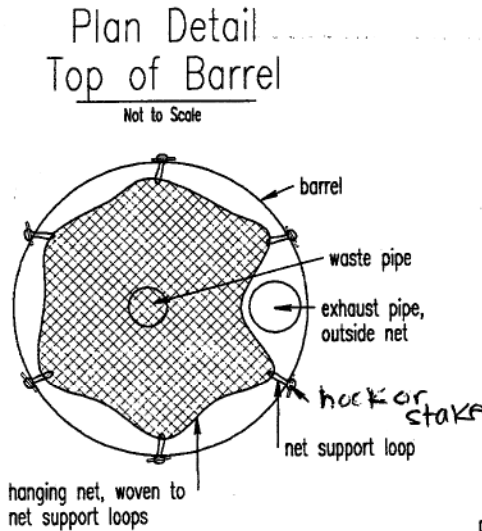
recommend that fan be removed from vent pipe and stored in a dry environment (and short section of vent pipe be installed in fan position in vent pipe).

Composting Toilet System

SUSTAINABLE STRATEGIES
 www.ecological-engineering.com
 50 Beharrell Street v (978) 369-9440
 Concord, MA 01742 f (978) 369-2484

Composting System Section

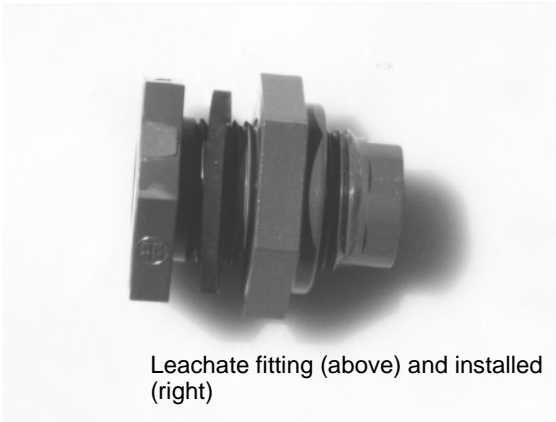
Not to Scale



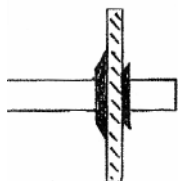
SEE INSTALLATION NOTES FOR IMPORTANT INFORMATION

The EcoWaters Net-Drum Composting Toilet System

55-gallon drum with hooks installed (below left). Preparing the net (below right).



Leachate fitting (above) and installed (right)



UniSeal Gasket

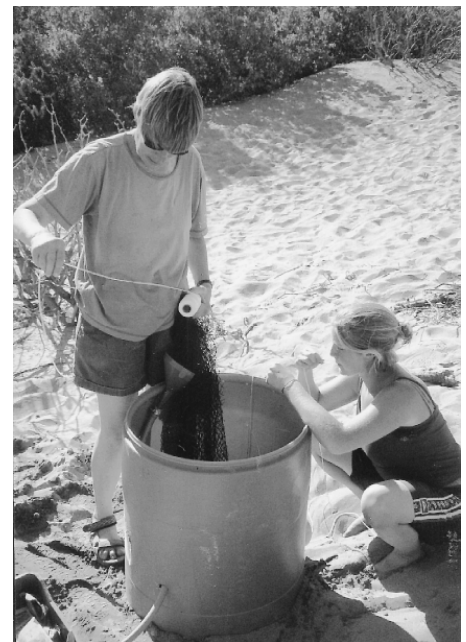
The EcoWaters Net-Drum Composting Toilet System



In Baja, we sewed the nets in by pulling loops through the holes and running a cord through the loops on the outside of the drum. A hoop was also added at the bottom to keep the net open. At the upper left of the drum is a funnel for urine diversion.



A urine-diverting toilet, such as the one shown here, can be used with the net-drum system. This one is imported from Mexico (contact Ecowaters Projects for ordering information).



Drilling holes to install the cord that suspends the net.