

## **Ecological Sanitation and Wastewater Management Systems in North America and the Pacific Islands**

David Del Porto, Principal System Designer, Sustainable Strategies

P.O. Box 1330, Concord, Massachusetts, USA 01742  
(<http://www.ecological-engineering.com>)

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This paper focuses on composting toilets (also known as dry, waterless and biological toilets and non-liquid saturated systems) because, among wastewater treatment technologies, they are one of the most direct ways to avoid water pollution and conserve water and resources. Of course, most people in North America and the Pacific Islands who install composting toilets do so simply because they need to have a toilet system where a septic system cannot be installed.

### **Overview: North America**

Beginning in 1973, Swedish composting toilets were exported to the United States and later to Canada. The market was primarily driven by the economics of installing composting toilets to provide inexpensive indoor sanitation for holiday cottages and some remote full-time residences. However in 1980, the composting toilet industry was set back when a study by the United States Environmental Protection Agency found several of these systems, as well as those built by homeowners, to be functioning poorly. Within a few years, many systems were improved, and more Swedish, American and Canadian manufacturers entered the market.

Today, mostly due to the passing of restrictive environmental regulations, separated black- and gray-water systems are found in up-market homes, businesses, public parks, and schools. Increasingly, new laws regulating nutrient pollution are now broadening the market for these systems in North America. Their prices stay somewhat high due to the relatively limited market and the high cost of performance testing for manufactured systems. As a result, site-built systems are gaining more popularity, and at least one state may establish regulatory performance standards for these designs.

### **Overview: The Pacific Islands**

In Australia and New Zealand, introduction of these systems followed much the same pattern as that of North America, starting in the 1970s. About four types of site-built systems have been adopted in rural areas in subtropical parts of Australia, some with municipal approval.

A few formal ecological sanitation introduction programs have been conducted in the Pacific islands, with varying success. In 1992, Greenpeace International sponsored a clean development initiative for the Federated States of Micronesia, a nation of small islands in the Western Pacific. For this, Sustainable Strategies, an ecological engineering firm, designed a new zero-discharge system (to manage excreta and washwater) to replace failing pour-flush toilets, latrines and flush toilets with on-site nonpolluting wastewater systems, three types of composting toilet and graywater systems. Since then, these systems have been replicated in Palau, Kosrae, Yap, Chuuk, Pohnpei, Independent Samoa, and Fiji for use in homes (extended family compounds), parks, and public-use areas. In 1997, the South Pacific Commission funded an ecological sanitation education workshop in conjunction with the Fiji School of Medicine; this program is now conducted by the Center for Ecological Pollution Prevention. Other Pacific Island initiatives include an AusAID project in Kiribati and Tonga and a small FSP project in Kiribati. Now, tourism resorts in the Pacific are adopting these systems, as they find that ecological sanitation is less expensive than conventional wastewater treatment systems and, due to the specification of flowering plants in some systems, they provide an attractive way to prevent pollution of the shoreline areas that draw visitors.

### **Reasons for Acceptance**

Long used by developing countries, North American parks, off-the-grid homeowners, and cottage owners around the world, composting toilet systems are now making their way into mainstream year-round homes, for many reasons:

- ¥ Flush toilets are increasingly used with composting systems, making these systems more socially acceptable.
- ¥ More graywater (washwater) systems are emerging and getting approved.
- ¥ Increasingly, service contracts are available for maintaining composting toilet systems.
- ¥ Water shortages threaten at least one-third of the world. Some estimates place it at one-half.
- ¥ Many states are tightening on-site wastewater system standards, so that many of the United States, millions of septic systems are now considered inadequate, and therefore in noncompliance. As a result, many property owners are seeking ways to supplement their septic systems so they can avoid installing new ones. Diverting excrement and flush water from the flow removes more than 90 percent of the pollution, leaving only graywater to manage.
- ¥ Population densities are increasing in cities and coastal areas, intensifying the challenge of managing human waste.
- ¥ More people are converting vacation homes into year-round residences. These homes are often in remote and environmentally sensitive natural areas, such as seacoasts, lakes and mountains, with limited capacity for wastewater disposal.
- ¥ Individuals and institutions are increasingly interested in sustainable technologies, as the public's awareness of sustainability issues grows.
- ¥ A sewer-less society? According to the United States Environmental Protection Agency and the United States Census Bureau, on-site systems are increasingly chosen over

central sewer systems by property owners and municipalities because they cost less than a central sewer system. (USEPA, "Response to Congress on Use of Decentralized Wastewater Treatment Systems")

- ¥ Public health specialists at development agencies worldwide are promoting effective and ecological on-site waste treatment systems that save water and help prevent the spread of disease.

At the same time, the acceptance of composting toilet systems as a technology has grown tremendously. They are far more efficient, refined and proven. Every year, more states change laws and regulations to permit them. Even researchers at Harvard University have decided that this is the technology of the future, and have developed a high-tech prototype "Smart" composting toilet with solid-state sensors and microchips that control the process.

### **Need for Education**

Composting toilet systems are in place, have improved and are increasingly used worldwide. However, until recently, there has been a dearth of information about how to choose a system and how to maintain it. Meanwhile, regulations that pertain to these systems change monthly, as regulators learn more about separated blackwater and graywater systems. Also, decision makers have simply been unaware of the breadth of the wastewater problem, as much of the information about the relationship of nutrients and pathogens in excrement to disease and dying waters is buried in scholarly papers in scientific journals.

Now, composting toilet technology and its regulatory and market climates are changing. The challenge of designing composting toilets is providing adequate control of the composting process: temperature, moisture, exhaust, perhaps mixing, etc. at affordable prices. These costs are coming down. At the same time, the availability of service contracts makes this more of a user-friendly technology.

### **Municipal and State Financing**

In the future, it is likely that owner/operators will not maintain their own composting toilet systems unless they elect to do so. The United States Environmental Protection Agency and regulators worldwide are recommending the formation of on-site management districts in response to poorly maintained or inadequate conventional on-site systems. These would involve a central organization that manages a district's on-site systems, so no matter what system one has, an agency would be accountable for its performance. This also would allow on-site systems to receive the federal funds and financing that were once provided only for central wastewater treatment plants.

### **The Shift to EcoSan Progresses!**

Thanks to these developments, composting toilets, long considered appropriate only for remote applications may soon be widely viewed as a conventional wastewater treatment technology with obvious advantages for the present and the future.

## **Why Haven't We Changed Sooner?**

Progress in innovation and the use of alternative technologies for wastewater treatment has been slow. Factors include:

### **Out of Sight...**

Our wastewater has been out of sight and often out of mind. As long as the public health bureaucracy said that what we were doing was good enough, there was little impetus for change. Now, high costs and health concerns are bringing wastewater back to the public's consciousness.

### **Prescriptive versus Performance Standards**

Septic systems have been the only on-site wastewater systems regulators would permit—the easiest approach from a regulatory standpoint. (Recycling wastewater, in fact, has been illegal in most states.) Now, regulations are increasingly establishing treatment performance standards. Technologies that can meet those standards will be permitted.

### **Toilet Zoning**

In many states, if a property's soils are not right for a septic system, you cannot legally build on it, unless there is sewer access. Although the intent of this is to protect the environment, some town planners use such regulations as surrogate zoning bylaws to control growth. Now, with the advent of zero-discharge wastewater technologies, community planners see this control removed, and they fear that development will run unchecked. One answer is national land-use planning—not forbidding nonpolluting wastewater treatment methods.

### **Cheap Drinking Water**

Until now, drinking water was inexpensive. Since our water sources were perceived to be relatively free of contaminants, the only costs for supplying water were for transmitting it and filtering it. But now, the new Federal Safe Drinking Water Act's more rigorous standards for water cleanliness require most communities to disinfect water. Chlorine has been the disinfectant of choice, because it is cheap. However, chlorine causes its own problems: Its byproducts, such as dioxin, and trihalomethanes, such as chloroform, are known carcinogens. Also, some organisms, such as cryptosporidium, are resistant to it, which has resulted in massive outbreaks of illness, including fatal instances in Cleveland and Detroit. These concerns are prompting some water treatment plants to switch to ozone and ultraviolet disinfection, and that is raising the price of water.

### **A Powerful Wastewater Industry**

Since the 1972 passage of the U.S Federal Clean Water Act, a very powerful construction, engineering, manufacturing and government bureaucracy complex perpetuates the centralized collection and treatment model.

## **The Future for Ecological Sanitation in North America**

As costs continue to rise for cleaning up water, wastewater and water pollution and as this pollution affects more of us more directly, the sound eco-nomics of ecological wastewater solutions will make them viable and mainstream choices.É

In many parts of the world, acute water shortages call for the most strategic and efficient use of water, making waterless and low-water toilet systems a viable, if not overdue, solution.

Increasingly, composting toilet systems will evolve into microbial reactors that control all of the composting process variables automatically. They will be a more transparent technology requiring relatively little responsibility from their owner-operators. Periodically, the systems will deposit packets of high-powered designer composting microbes into the composter. In the future, we may refer to composting toilets as Óunsaturated aerobic systems,Ó a broader term that better describes this approach to waste management.

### **Cost Reduction**

Mass production and increased demand will bring down the cost of manufactured systems. At the same time, composters may be built right into building foundations in new construction. Self-contained composting toilets will become more aesthetically acceptable to more people. As in a garbage compactor, the compost/end-product will be removed fully packaged in biodegradable bags that one either throws away or uses on a yard as soil conditioner. A municipal service person will come around every few months to check systems and perhaps take full composters to a central composting facility.

### **Washwater Reuse**

Washwater will no longer be considered wastewater, because it is too valuable a commodity. It will be recycled for irrigation, often on rooftops of high-rise buildings and hanging gardens of vertical walls, as well as in landscapes.

Micro-flush toilets will advance, and will likely be used with all types of systems.

### **Ecological Water Design in Architecture**

Ecologically integrated homes, with passive solar features, composting rooms and removal doors, and graywater-irrigated landscapes, will be the normÑand will look completely conventional.

### **Change Is Happening Now**

Some key changes are occurring now. In rural and suburban communities, management districts are being formed for financing the construction, installation and management of on-site wastewater treatment systems. The goal is to extend the management and financing

mechanisms for central systems to on-site systems, which are far more feasible and economical for many communities.

Today, many on-site wastewater systems are shared by small clusters of homes. Construction, operation and maintenance are managed through modified condominium agreements, an arrangement well suited to managing ecological wastewater systems. It is quite possible that, in the future, our central wastewater collection system will be used for commercial and industrial use only.

Some suggest this is harkening back to the past, when wastewater was recycled (but without processing). A more accurate view is that it is a timely converging of common sense, economics, resource management know-how, and improved technology.

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