Graywater Use Still a Gray Area

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As clean water resources become more scarce, the concept of separating graywater from a home's waste stream and using it to supplement the family's water demand grows increasingly popular. Graywater is generally defined as all wastewater generated from household activity except that produced from the toilet.

Reuse is an integral part of ecosystem management. Reuse and recycling efforts are looked upon with favor these days, and the concept of reusing graywater seems to hold much potential. However, due to the possibility of disease transmission, the actual process of permitting safe, low-maintenance systems can be quite complex.

In arid parts of the U.S., the practice of using graywater for irrigation has a long history. To be sure, more than a few pioneer women's chores included marching out into the yard to dump their dishpans of water on some struggling little rosebush. This was graywater use at its most basic. And while graywater use is common in rural areas and has been practiced by many people in urban areas for years, it is technically illegal in many places in the U.S.

While the idea seems simple, the careless use of many gallons of untreated graywater could result in disaster. Before rallying around the idea that graywater recycling can solve all of our water shortage needs, it would be wise to investigate potential hazards associated with the practice, as well as reviewing some of the current permitted applications.

A significant portion of the nation's wastewater results from domestic activities; if deemed safe and practical, recycling graywater could be an integral part of a household's water conservation effort. The average amount of graywater produced is 40 gallons per day per person—an estimated 60 to 65 percent of a household's total water demand. If this amount of wastewater could be treated and applied to outdoor use, that would be a meaningful reduction in demand. Reduction of water demands through conservation is probably the cheapest and most environmentally sound and effective way of extending water supplies.

Technology for reuse can be as simple as saving the rinse water from the clothes washer for immediate use as wash water for the next load, to rather complex treatment systems. Some use multiple cells containing water plants and sand filtration systems—from simple and low-cost to highly complex and expensive systems.

Most of the permitted systems send the effluent, after minimal treatment, to underground irrigation piping or leachfields designed to avoid runoff or ponding. Presumably, graywater is naturally purified by biological activity in the topsoil. Soil microorganisms break down the organic contaminants, and the treated water percolates to recharge the underlying groundwater.

There also are many commercial package plants that produce a filtered, disinfected product suitable for many uses (but not drinking). Unfortunately, most of these recycling systems are fairly expensive to purchase and operate (requiring electric motor-driven pumps). They should be installed by professional, licensed plumbing contractors and only with the approval of local health departments.

In all instances, blackwater (wastewater generated by the toilet) must be disposed of through a separate treatment system, and the graywater system must be plumbed so it can be diverted to the sewer system when necessary.

What is in graywater?

Defined by the California Graywater Standards, graywater is untreated household wastewater that has not come into contact with toilet waste. Specifically, graywater includes water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. Wastewater from kitchen sinks, dishwashers, or laundry water from soiled diapers are typically heavily contaminated. It is usually recommended that they not be included in a recycling system but rather sent to the septic system for treatment.

Since concerns about public health are the biggest obstacles in accepting graywater use, its physical analysis is crucial. The quality of graywater can help define the appropriate guidelines needed to reduce health risks from exposure.

Studies indicate that turbidity (which shields microorganisms from disinfectant action) and microbial contamination (bacteria, protozoa, viruses, etc.) will be the greatest concern. Analysis shows that untreated graywater contains levels of biological oxygen demand and suspended solids as high as 149 and 162 milligrams per liter, respectively. Household characteristics, such as the number and age of children, and personal habits and lifestyles, affect graywater quality; levels of ammonia, nitrogen, and total and fecal coliforms are consistently higher in households where young children reside. High phosphate and sodium levels result from the use of laundry detergent.

Microorganisms and turbidity found in graywater have been shown to be at much higher levels than many states allow for surface disposal. For the practical application of a graywater system, treatment prior to use would be advisable.

Advantages

Some advantages of graywater systems include the following:

- less energy and chemical use,
- recovery of otherwise lost nutrients beneficial for plant growth,
- increased life and improved performance of the existing treatment system by reducing the hydraulic load, and
- lower water bills.

Disadvantages

Some disadvantages of graywater systems include the following:

- potential for spreading disease through human contact if not properly handled or treated,
- damage to the soil caused by long-term use (potential for salt buildup in certain soils, etc.), and
- the rapid increase of microorganisms in graywater under typical storage conditions. (Graywater undergoes significant change when stored even for short periods of time.)

When a communicable disease, for example, hepatitis, flu, or measles, is diagnosed within the family, graywater irrigation should be discontinued by diverting it into the blackwater system until the affected person has completely recovered. This diversion capability is always recommended in case of system failure.

General considerations

When designing a household water conservation system, water-efficient plumbing fixtures are recommended. Examples of these are low-flow shower heads, faucet flow restrictors, and low-flow toilets. Depending on the state, these water-saving devices may be mandatory.

Graywater systems are easiest to install in new construction. Residences already constructed on concrete slabs or crawlspaces are difficult to retrofit for a separate graywater system.

To further reduce water demand, it is recommended that the homeowner consider reducing turf areas (lawn grasses typically are especially high water-demand plants) and replacing turf with native plants more tolerant of dry conditions. A special horticultural consideration is that graywater typically has an alkaline pH and therefore should be not used on acid-loving plants.

Putting it into practice

Recycling graywater is a very controversial subject due to the associated threat to public health. And although no national regulation exists governing its use, several states have begun to put together regulations that will allow its use in very restricted circumstances.
The more proactive states are, not surprisingly, the ones where a shortage of freshwater is of greatest concern. California, Arizona, and New Mexico are the most involved in legislating safe graywater use.

The possibility of system failure causing a public health threat, liability and maintenance issues, and potential negative environmental effects are central concerns in considering approval of innovative systems.

New Mexico

According to Brian Schall, environmental specialist with the state's liquid waste program, the current New Mexico liquid waste regulations do not differentiate between gray- and blackwater systems. A graywater system may be installed; however, it must meet all requirements of the regulations that apply to a blackwater system, including a properly sized septic tank and absorption field, and must meet all setback requirements.
"At present, there are very few legal graywater systems," Schall admits. "Once people find out they need to install essentially two separate systems, they feel a graywater system is not cost effective. The cost is comparable to two separate systems, and most homeowners simply can't see that the advantages are worth it."
New Mexico is presently revising its liquid waste regulations by including a section specifically on graywater systems. A separate treatment unit will be required (e.g., a septic tank) and the effluent may be discharged subsurface or above ground with disinfection, utilizing bubblers, trickle irrigation systems, or low-level, low-pressure spray. The revised regulations will prohibit using graywater for irrigating food crops that are consumed raw or that come in contact with the effluent. "The systems

must be permanent; that is, no garden hoses moved from location to location." said Schall. "Most people have the misconception that graywater is benign—just soapy water. However, there are still health risks associated with it. Graywater will test positive for fecal coliform; as such, it must be handled safely."

Arizona

In 1998, the Water Conservation Alliance of Southern Arizona began an in-depth study of residential graywater use in the greater Tucson area to add to the understanding of the issues surrounding the safe and effective use of household graywater. The study was supported by the Arizona Department of Water Resources, the Arizona Department of Environmental Quality, and the Pima County Department of Environmental Quality.

Published in 1999 as "Evaluating Residential Graywater Systems: The Good, the Bad, and the Healthy," the study's results revealed that unpermitted graywater use is occurring, with the most common use being the irrigation of shade or ornamental trees. Dispersal mechanisms were mostly simple garden hoses or buckets used to apply the graywater to the surface. Little or no pretreatment was being done before disposal.

The report included results from a year-long, 10-house study of the quality of the graywater and the soil irrigated with graywater. Fecal coliforms were detected in most samples at above-normal levels. Levels of fecal coliforms in graywater-irrigated soil were higher during the warmest summer months and were higher in houses with children younger than 12. Analysis indicated that irrigation with graywater does introduce E. coli into the soil that would not otherwise be present. No protozoan parasites were found. From their results, the authors recommend that residents consider the makeup of their household and the methods of irrigation (e.g., avoiding irrigation of entire lawns) before deciding how to recycle their graywater.

Michele Robertson, water permits section manager with the Arizona Department of Environmental Quality, said, "We knew the 'wild-cat' [unpermitted] systems were out there, but we were not sure what effect they were having as a public health risk. This study showed that there appear to be no long-term health risks when using untreated graywater for irrigation.

"We are looking at the reuse of graywater from the aspect of conservation of water. Our existing regulations are rather antiquated [requiring rigorous analysis of effluent], and as a result, there are very few permitted systems. We are currently cleaning up the wording on a proposed new regulation for Type 1 reclaimed water general permitting that will hopefully make it easier for homeowners to be in compliance."

Desert House, a residential water and energy efficiency demonstration project, located at the Center for Desert Living in the Phoenix Desert Botanical Garden, has been using graywater for landscape irrigation since 1996. The system uses the water retained from showers, baths, sinks, and washing machines, resulting in annual water savings of 11,370 gallons.

Desert House has recently finished a 2-year study on the effect of graywater irrigation on the landscape plants around the residence. The system is a drip system, buried a few inches underground. The study revealed no accumulated effect on the plants or the surrounding soil besides a slight increase in boron, probably from soap. And although they were elevated, the boron levels detected were still below the acceptable levels. The residents of Desert House use common soap products but divert the graywater stream to the blackwater system when they use products containing bleach.

California

A brief summary of Appendix G of the California Administrative Code reflects that state's caution by mandating that all systems must be subsurface. It does not allow connection with a potable water system and describes specific allowable lot and soil conditions. It sets procedures for estimating a home's graywater discharge volume and for determining the irrigation capacity of the soil. It requires soil percolation tests and/or soil analyses as the basis for determining the amount of required disposal area.

Subsurface drip irrigation, mini-leachfields, or other equivalent irrigation methods can be permitted. All caution must be taken to prevent the ponding of graywater on the land surface. Due to the health threat from contacting this contaminated water, residents are prohibited from applying graywater above the land surface or discharging it directly into storm sewers or any body of water.

Rick Merrifield, supervising environmental health specialist with the Santa Barbara County Public Health Department, pointed out that, "Because of the cost of the system required to be in place before using graywater, there are very few permitted systems in existence. There isn't much incentive for a homeowner to install a graywater system due to the work and expense involved and the limited irrigation value of a system that meets the requirements."

Is there a future for graywater use?

In spite of the reservations against graywater use, there is definitely a momentum pushing technology development forward. Said Clement Solomon, a program coordinator with the National Onsite Demonstration Program, "Up to this time, we have concentrated on the combined waste stream—always assuming that a separate graywater stream would have to be treated the same as a blackwater one. Now we are starting to understand that this may not be so and that graywater is a bit more benign than previously thought. Especially in the arid regions of the United States, it is time to re-consider some of the previously established concepts about graywater use."

For More Information

Call or write Thom Hulen, Desert House Coordinator at (480) 481-8164 or Desert Botanical Garden for more information about these projects. In addition, the National Small Flows Clearinghouse (NSFC) offers information about graywater including the resources listed below.

NSFC Resources

Graywater Technology Package is an information package compiled in response to questions the NSFC received on its toll-free assistance hotline. The package contains articles divided into four sections: general information, design/performance, case studies, and hazardous/concerns. The price of this 50-page package is $7.95. Additional shipping charges apply. Request Item #WWBKGN82.

Graywater Systems from the State Regulations—September 1997: This 48-page NSFC booklet is a compilation of onsite regulations from states that have rules governing the design and construction of graywater systems. This 48-page booklet sells for $7.60. Additional shipping charges apply. Request Item #WWBLRG24.

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