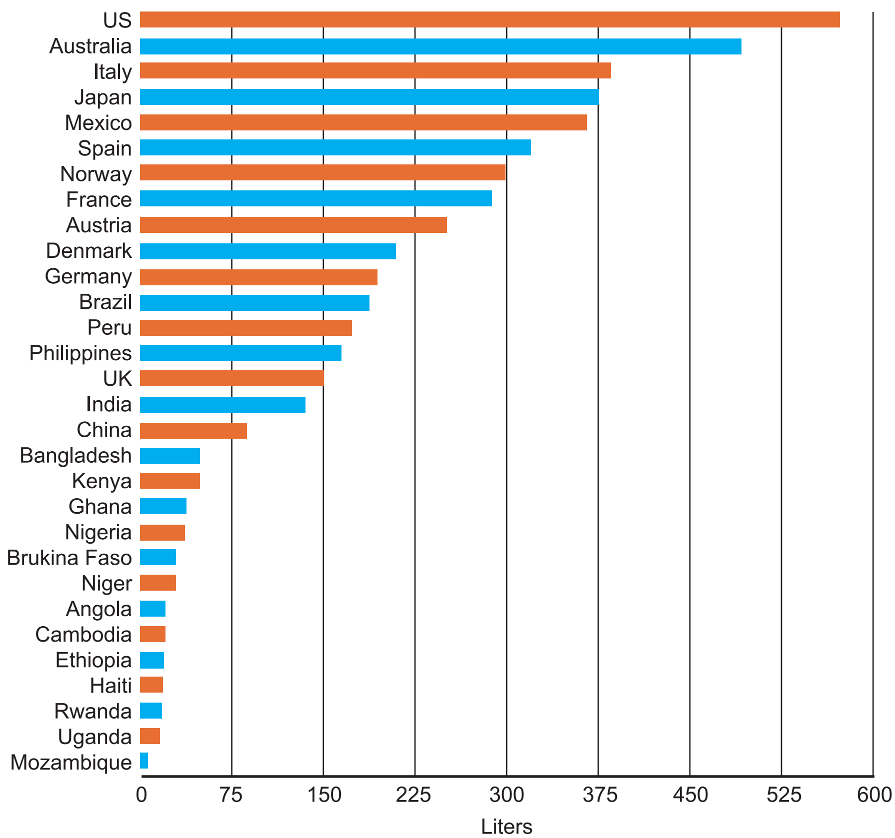
Home Treatment and Reuse of Residential Wastewater

By Tom Bruursema

We flush our toilets, water our lawns, wash our cars, all with water that is of sufficient quality to drink. Does that practice make sense? If you have abundant potable water at very low expense, perhaps so. Fewer and fewer people find themselves with such an option. The result is a growing interest in more practical and sustainable alternatives.

If we look to countries and regions outside the US, we find that the water usage practices of the US are not the norm. Figure 1 highlights our unusually high rate of water usage per day in comparison to other countries.

Figure 1. Average water use per person per day



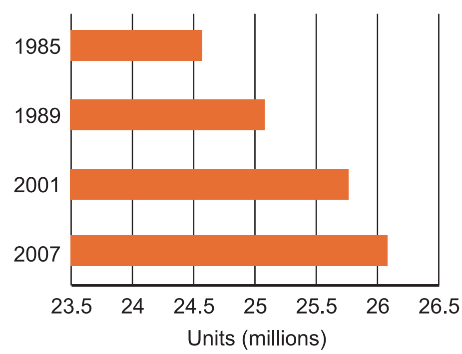
Options such as water conserving fixtures and appliances have helped to reduce water consumption. Another consideration that doesn't necessarily reduce the daily consumption of water but makes more practical use of water already available in the home, is the reuse of treated residential wastewater. Today, approximately 20 percent of US housing units are served by on-site, residential treatment systems, with a growing number of them utilizing more advanced treatment systems (see Figure 2).

Advanced, residential wastewater treatment systems have been on the market for several decades. Beginning in the 1960s, NSF developed test methods and established proper test facilities that enabled third-party evaluation of on-site, residential wastewater treatment systems. The first NSF standard for such products was adopted in 1970 and to this day remains the principal standard for evaluating and approving residential wastewater treatment systems throughout North America.

The effluent quality criteria in the NSF standards are consistent with that of the US EPA requirements for secondary effluent discharged from municipal treatment facilities. Many systems, however, demonstrate their ability to far exceed even these treatment levels. The result has been water of such quality as to allow for certain levels of reuse, principally for lawn irrigation. Such reuse has been taking place for many years in various parts of the country, as allowed for in local regulatory codes. As our water supply becomes a more precious resource, more attention is being given to how the treated effluent from these same, or similar, technologies can be utilized in more extensive ways.

One area of increasing attention within the residential wastewater resource is the graywater portion. The commonly accepted definition of graywater is that portion of wastewater coming from water bearing fixtures, including laundry, such as clothes washers and laundry sinks, and bathing, such as bathtubs, showers, or sinks, but excluding toilets, urinals, bidets, kitchen sinks and dishwashers. In short, graywater is bathing and laundry water.

Figure 2. Total housing units in the US served by septic systems



Source: *USEPA Septic Systems Fact Sheet, EPA# 832-F-08-057*, Oct. 2008

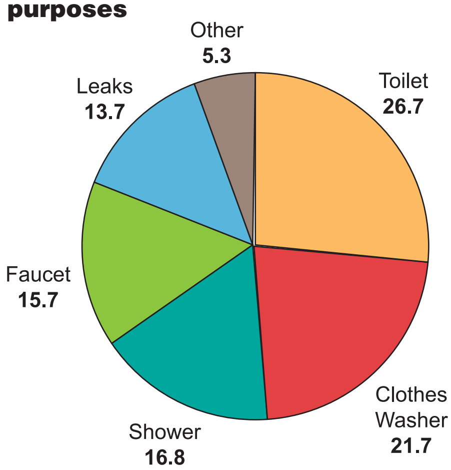
According to research funded by AWWA and AWWARF (Mayer, P.W., W.B. De Oreco, *et al.*, 1999. *Residential End Uses of Water*), laundry and bathing water equate to 40 percent or more of all the water used in a residence, amounting to more than 30 gallons/person/day (see Figure 3).

The contaminant concentration of the graywater waste stream is less than when combined with the other waste stream sources, helping to minimize the total treatment demand for producing water of reuse quality.

While a portion of the population may have the option to treat and reuse all of the residential wastewater through on-site, complete advanced treatment systems, every existing residence has the potential to be fitted with a graywater treatment system. Similar in some ways to a drinking water treatment technology, the system is installed within the graywater supply line in the home, and the flow of treated effluent delivered to its proper end use. A major difference in this case is the non-potable nature of the graywater, both before and after treatment, leading to a different plumbing arrangement. Code bodies have already identified and worked to address this issue.

Currently, deciding upon reuse quality for acceptable reuse applications at the residential level is left to local and state regulations, and not federal. This has created a range of varying criteria and product approval requirements. The result has been a push for national standards for treatment quality and for treatment product evaluation.

Figure 3. Relative percent of per capita water used for indoor purposes



Source: American Water Works Association Research Foundation, *Residential End Uses of Water*, 1999

Everyone agrees that treated graywater is not suitable for consumption. However, that leaves a significant number of other uses that comprise the majority of our water usage. The most obvious, agreed-upon use for treated graywater is in toilet flushing, which comprises more than one-fourth of water used in the home, and lawn irrigation, which some estimate to comprise up to 70 percent of water consumption during summer months.

Beginning in early 2008, the NSF Joint Committee on Wastewater Treatment Units formed a task group to develop standards for on-site treatment equipment used in reuse applications. The task group includes representatives from drinking water and wastewater equipment manufacturers, plumbing product manufacturers, federal, state and local public health officials, consulting engineers, code bodies, academicians and others. The results of their efforts to date have led to the drafting of a new standard, *NSF 350 Onsite Residential and Commercial Reuse Treatment Systems*.

The purpose of *Standard 350* is to establish minimum materials, design and construction, and performance methods and criteria. It encompasses systems that treat all the wastewater flow, along with those that treat the graywater portion only. Further, within the graywater portion, systems can be evaluated for treating bathing water only, laundry water only, or both. Reuse applications of the treated effluent include indoor restricted urban water use, such as toilet and urinal flushing, and outdoor unrestricted urban water use, such as irrigation.

Current elements of *Standard 350* include the following:

- Requirements for water tightness, noise, access ports, failure sensing and signaling equipment, and flow design
- Effluent quality performance testing for a minimum of six months
- Graywater treatment systems subjected to a synthetic wastewater challenge including a variety of common household personal-care and cleaning products. Both the ingredients and the final characteristics are specified in the standard, and differ by bathing water only, laundry water only, or the combined challenge.
- Commercial systems will be subjected to an additional chemical cleaning challenge.

Existing drinking water and wastewater treatment equipment can be utilized to meet the need for graywater treatment. Systems are already beginning to come onto the market and have been available in other foreign markets for some time. As in any market, the key is demand for the technology at an affordable cost. As the market develops, having product standards that enable acceptance and approval will be critical. NSF standards will help to address that need; completion of the standard is expected in the coming months. Creating the value and incentive among homeowners is likely to take more time for widespread use, but the need is clearly growing. Most agree it is not a matter of *if* the market will develop, but *when*.

About the author

Tom Bruursema, General Manager of Drinking Water and Wastewater Treatment Units, NSF International, has served in a number of technical and administrative positions for the organization over a 25-year period. He has primary responsibility for all NSF residential drinking water and wastewater treatment unit testing, auditing, monitoring, verification and certification services and associated NSF/ANSI standards. Bruursema holds a BS Degree in medical technology and an MS Degree in general biology from Eastern University Michigan. He is a former Board Member of National Onsite Wastewater Recycling Association (NOWRA), Controlled Environment Testing Association, and an Honorary Member of WQA. Bruursema serves as Chair of the WQA International Standards and Regulations Task Force and is a member of the European Committee for Standardization relating to water conditioning equipment inside buildings. He may be contacted at bruursema@nsf.org or (734) 769-5575.

Figure 4. Summary of draft *NSF Standard 350* effluent criteria for individual classifications

	Class R (Single-family residential)		Class C (Multi-family residential and commercial	
Measure	Test average	Single sample maximum	Test average	Single sample maximum
$CBOD_5$ (mg/L)	10	25	10	25
TSS (mg/L)	10	30	10	30
Turbidity (NTU)	5	10	2	5
E. coli[2] (MPN/100 mL)	14	240	2.2	200
pH (SU)	6.5 - 8.5	NA[1]	6.5 - 8.5	NA[1]
Storage vessel disinfection (mg/L)	≥ 0.5 - ≤ 2.5	NA[1]	≥ 0.5 - ≤ 2.5	NA[1]
Color	MO[3]	MO[3]	MO[3]	MO[3]
Odor	Non-offensive	NA[1]	Non-offensive	NA[1]
Oily film and foam	Non-detectable	Non-detectable	Non-detectable	Non-detectable
Energy consumption	MO[3]	MO[3]	MO[3]	MO[3]

[1] NA: not applicable. [2] Calculated as geometric mean. [3] MO: Measured only and reported.