International Headquarters & Laboratory
Phone 630 505 0160

WWW.WQA.ORG
A not-for-profit organization

RESIDENTIAL WATER REUSE FACT SHEET

Residential water reuse is a topic of increasing interest. With growing water shortages in the Southwestern United States and other areas, the ability to reuse water onsite as opposed to sending it all to a wastewater treatment facility becomes more and more appealing. Additionally, reuse of water is generally considered to be a part of sustainable resource management practice, so it is increasingly being utilized or considered in areas that do not necessarily suffer from water shortages.

Considerations with water reuse include the source of the water to be reused (gray water vs. black water), the configuration of the plumbing system within the facility, the type and quality of treatment of the reused water, and the ultimate purpose of the reuse.

In general, reuse focuses on irrigation and other non-potable applications, as opposed to treating wastewater to the point of being considered potable. The treatment requirements are lower for applications where there is little risk of human exposure, such as subsurface irrigation. As exposure risk increases so does the level of treatment required, with the most stringent requirements in place for indoor reuse applications such as toilet flushing.

TECHNICAL PROCESS

Residential waste water is typically considered in two broad categories:

- Gray water is defined as wastewater 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.

- Black water is defined as wastewater containing fecal matter and urine. It is also known as foul water, or sewage.

Quality of reuse water is typically specified using some or all of the following criteria, although other criteria are also used in some cases:

- Biochemical Oxygen Demand (BOD)
- Total Suspended Solids (TSS)
- Turbidity
- Fecal Coliform
- E. Coli
- Chlorine Residual

The level of contamination in graywater varies with the source of the water, water usage patterns, and water quality. Water collected from the clothes will be higher in particulate matter and detergents than water collected from the bathroom sinks. A longer shower will result in collected water with lower concentrations of detergents than a short shower will have. In a home with a water softener, less detergent is required for effective cleaning and the detergent concentrations will be lower than in a similar system with a hard water supply.

The technologies used to treat water for reuse vary widely depending on the source water, local regulations, and the intended end use. In the most simple of applications, water is simply diverted to storage tanks and then reused directly. A simple treatment system may include coarse filtration to remove particulate matter and chlorine tablets to prevent microbiological growth.

More sophisticated reuse systems are used in applications where human exposure is possible or likely, including applications of spray irrigation or indoor reuse such as flushing toilets. These systems need to remove potentially harmful constituents in the water as well as removing contaminants that may encourage microbial growth or cause odor issues. Technologies are combined in these systems with storage and pumping means to achieve the desired product water quality, and include:

Process	Technology
Primary particulate filtration	Bag filters or screens
Disinfection	Chlorination or UV
Fine filtration	Cartridge, media, or membrane filters;
Biological treatments	Immobilized bioreactors (membrane or media based, aeration tanks)

Water reuse systems should also consider the potential for over- or under-production. Where availability of water for the reuse application is critical, the system may need to include a connection to the traditional water supply to assure that water is available even when there is no reuse water. On the other hand, the system needs to be able to divert reuse water to drain when the system has reached its storage capacity or when the reuse water has been stored for longer than desired.

Two American National Standards have been developed regarding treatment systems for water reuse. These are NSF/ANSI 350 and NSF/ANSI 350-1, discussed below.

NSF/ANSI 350 Onsite Residential and Commercial Water Reuse Treatment Systems

This American National Standard was originally adopted in 2011. This standard includes methodology and requirements for testing reuse systems for efficacy. These reuse systems are small scale systems including filtration and other treatment technologies – the type of system that might be installed by a water treatment dealer.

NSF/ANSI 350 includes requirements for two categories of facilities – residential (up to 1,500 gallons per day), and commercial. It covers four different types of influent water – combined black and gray water; gray water only; bathing water only; and laundry water only.

The standard covers general non-potable reuse, including surface and subsurface irrigation, and toilet and urinal flushing.

It has two categories of rating that vary slightly in effluent water quality criteria: Class R for single family residential, and Class C for multi-family residential and commercial. These effluent quality criteria were developed considering the currently existing guidelines codes, and regulations, with the approach being to meet the majority of them, although not all of them. There are two separate requirements for effluent quality criteria for both Class R and Class C: one for the overall test average, and one that no individual sample can exceed.

There are three types of challenge water utilized in the standard, with each being a synthetic wastewater created in the laboratory. The three synthetic challenge waters have different compositions intended to mimic either typical bathing water, laundry water, or combined gray water. The type of challenge water used for testing depends on the intended application of the reuse system.

The test protocol covers a 26 week period involving typical daily loading, as well as various stress type events such as power failures and vacations. These stress events are designed to mimic typical events within a building that could influence the efficiency of a treatment system, but they are not designed to cover extreme stress events deviating from the manufacturer's use instructions, such as overdosing of corrosive treatment chemicals.

NSF/ANSI 350-1 Onsite Residential and Commercial Graywater Treatment Systems for Subsurface Discharge

This American National Standard was also originally adopted in 2011. It is similar to NSF/ANSI 350, and was developed with a similar approach, but includes a more limited scope in terms of gray water only with reuse for subsurface discharge only.

Like NSF/ANSI 350, NSF/ANSI 350-1 includes requirements for both residential and commercial facilities. It also covers four types of influent water - combined black and gray water; gray water only; bathing water only; and laundry water only.

However, it covers only subsurface irrigation reuse, and has only one specification for effluent quality. The effluent water quality criteria, challenge water, and test protocol are similar to those in NSF/ANSI 350.

REGULATIONS

Regulations for reuse fall in two broad categories: Plumbing codes and regulations. It is important to note that in most areas permits are required for water reuse systems.

Plumbing codes:

Both the Uniform Plumbing Code (UPC) and the International Plumbing Code (IPC) have adopted reference to *NSF/ANSI 350 Onsite Residential and Commercial Water Reuse Treatment Systems*.

U.S. State Regulations:

The State of Washington has adopted *NSF/ANSI 350-1 Onsite Residential and Commercial Graywater Treatment Systems for Subsurface Discharge*.

Numerous other U.S. states have adopted or proposed various requirements for the quality of treated reuse water being reused for various purposes. These states include Arizona, California, Florida, Georgia, Hawaii, Illinois, Massachusetts, New Jersey, Oregon, Texas, Washington, and Wisconsin. These requirements vary in scope, and may cover areas such as subsurface irrigation, surface irrigation, toilet / urinal flushing, laundry uses, and car washing.

Other North American Guidelines and Regulations:

US EPA has published guidelines for reuse of wastewater, although these are guidelines only and are not enforceable. These guidelines cover subsurface irrigation, surface irrigation, toilet / urinal flushing, and car washing. They require a BOD of ≤ 10 mg/L and a turbidity of ≤ 2 NTU. They also address microbiological water quality of <1 fecal coliform CFU / 100 mL median for the last seven days, with no single sample to exceed 14 fecal coliform CFU / 100 mL. Additionally, a ≥ 1 mg/L 30 minute chlorine residual is required.

WHO has developed recommended permit limits for reuse, addressing surface irrigation and toilet / urinal flushing. The permit limits include two separate categories for surface irrigation – the first being fruit trees, ornamentals, and fodder crops; and the second being vegetables likely to be eaten uncooked. The first category of surface irrigation requires a lower quality of reuse water, with BOD ≤ 240 mg/L, TSS ≤ 140 mg/L, and fecal coliform ≤ 1000 CFU / 100 mL. The second category of surface irrigation for vegetables likely to be eaten uncooked requires a higher quality of reuse water, with BOD ≤ 20 mg/L, Total Suspended Solids (TSS) ≤ 20 mg/L, and fecal coliform ≤ 200 CFU / 100 mL. The requirement for toilet / urinal flushing is BOD ≤ 10 mg/L, Total Suspended Solids (TSS) ≤ 10 mg/L, and fecal coliform ≤ 10 CFU / 100 mL.

Canada has developed guidelines for household reclaimed water for toilet / urinal flushing. They require a BOD and TSS of ≤ 10 mg/L median and ≤ 20 mg/L maximum, and a turbidity of ≤ 2 NTU median and ≤ 5 NTU maximum, as an alternative to monitoring TSS. They also address microbiological water quality regarding thermotolerant coliform with 90% of samples < 10 CFU / 100 mL with a maximum of < 30 CFU / 100 mL. Additionally, a free chlorine residual of ≥ 0.5 mg/L is required at the point where the treated effluent leaves the reservoir or storage.

Some Canadian provinces have also adopted water reuse water quality criteria, including Alberta, Manitoba, Prince Edward Island, and Saskatchewan.

REFERENCES/SOURCES

NSF/ANSI 350: For Water Reuse Treatment Systems.
http://www.nsf.org/newsroom_pdf/ww_nsf_ansi350_qa_insert.pdf

The New NSF 350 and 350-1. Plumbing Systems and Design (2011).
http://www.nsf.org/newsroom_pdf/SU_PSD_Magazine_Article_LT_EN_350_351_LSU-2722-0911.pdf

ACKNOWLEDGEMENT

WQA wishes to express sincere appreciation for the unselfish contributions of the members of WQA who contributed their time and expertise toward the completion of this bulletin.

Arvind Patil, Ph.D., CWS-I	Richard Andrew
Gary Hatch, Ph.D.	Shannon Murphy
Charles Michaud, CWS-VI	Steve VerStrat
Mark Brotman, CWS-VI	Pauli Undesser, M.S., CWS-VI
P. Regunathan, Ph.D.	Kimberly Redden, CWS-VI
Rebecca Tallon, P.E.	

The Water Quality Association publishes this Technical Application Bulletin as a service to its members and the interested public. Information contained herein is based upon the most recent public data known as of the publication date, which is printed at the bottom of the last page, and of course, cannot take into account relevant data published thereafter. The Water Quality Association makes no recommendations for the selection of a treatment system, and expressly disclaims any responsibility for the results of the use of any treatment method or device to reduce or remove a particular contaminant.

This reference document is published by:

Water Quality Association®

National Headquarters & Laboratory

4151 Naperville Road • Lisle, Illinois 60532
Tel: 630 505 0160 • Fax: 630 505 9637