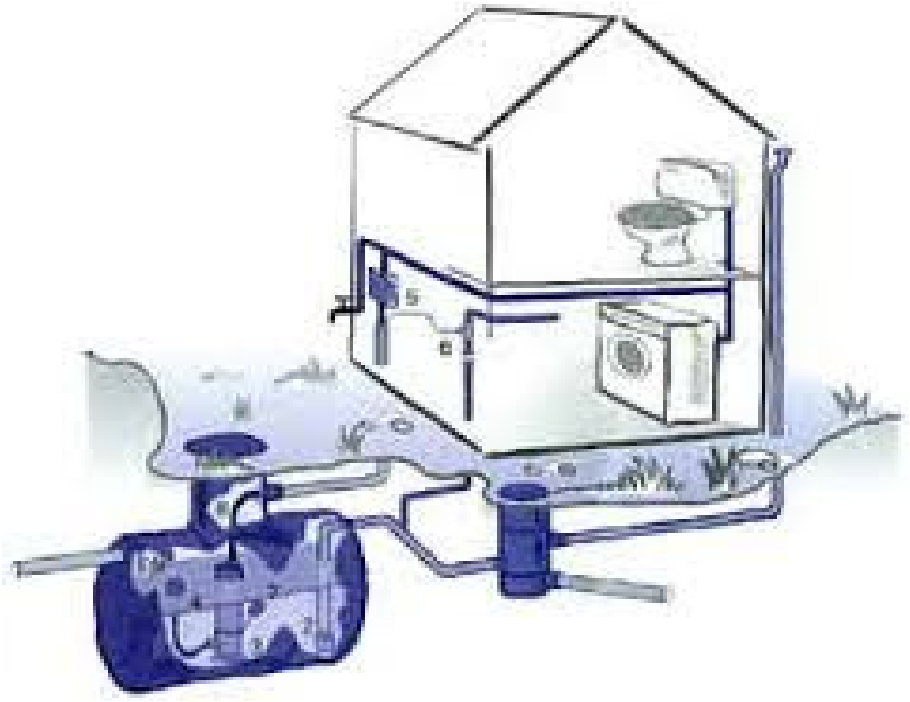
GREYWATER TREATMENT
&
REUSE



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INTRODUCTION

Grey water can be defined as any domestic wastewater produced, excluding sewage. The main difference between grey water and sewage (or black water) is the organic loading. Sewage has a much larger organic loading compared to grey water. Greywater is water that has been used for washing dishes, laundering clothes, or bathing. Essentially, any water, other than toilet wastes, draining from a household is greywater. Although this used water may contain grease, food particles, hair, and any number of other impurities, it may still be suitable for reuse. Reusing greywater serves two purposes: it reduces the amount of freshwater needed to supply a household, and reduces the amount of waste water entering sewer or septic systems.

Some people also categorise kitchen wastewater as black water because it has quite a high organic loading relative to other sources of wastewater such as bath water.

With proper treatment grey water can be put to good use. These uses include water for laundry and toilet flushing, and also irrigation of plants. Treated grey water can be used to irrigate both food and non-food producing plants. The nutrients in the grey water (such as phosphorus and nitrogen) provide an excellent food source for these plants.

1. "granting the variance will result in public health and environmental protection equal to or greater than the minimum protection provided by the varianced requirement"
2. "the proposed liquid waste system will, by itself or in combination with other liquid waste systems, neither cause a hazard to public health nor degrade any body of water"

Table

Water Source	Characteristics
Automatic Clothes Washer	Bleach, Foam, High pH,Hot water, Nitrate, Oil and Phosphate, Salinity, Soaps, Sodium, Suspended solids, and Turbidity
Automatic Dish Washer	Bacteria, Foam, Food particles,Bacteria, Foam, Food particles,Oil and grease, Organic matter,Oxygen demand, Salinity, Soaps,Suspended solids, and Turbidity, Suspended solids, and Turbidity
Bath tub and shower	Bacteria, Hair, Hot water, Odor,Oil and grease, Oxygen demand, Soaps, Suspended solids, and Suspended solids, and Turbidity
Evaporative Cooler	Salinity
Sinks, including kitchen	Bacteria, Food particles, Hot water,Odor, Oil and grease, Organic matter, Oxygen demand, Soaps, Suspended Oxygen demand, Soaps, Suspended
Sinks, including kitchen	Bacteria, Food particles, Hot water, Odor, Oil and grease, Organic matter,solids, and Turbidity solids, and Turbidity
Swimming Pool	Chlorine, and Salinity

UNTREATED GREYWATER

Untreated greywater should not be kept for longer than one day, but adding two tablespoons of chlorine bleach per gallon of water will extend storage time somewhat. Try to use greywater the day it is collected or the high bacteria count will cause objectionable odours.

Observe these precautions when using untreated greywater:

- Greywater containing sodium, bleach or borax can damage plants. For this reason, water from automatic dishwashers should not be used for irrigation.
- Water used to wash cooking utensils in the sink may contain grease, fats and oils, and is not acceptable for greywater use.
- If you plan to use water from your washing machine, avoid liquid fabric softeners and detergents with softeners. Use a dryer fabric softener sheet instead.

TREATING GREYWATER

Investing time and equipment in a system designed to filter, store, and possibly disinfect greywater may make water reuse a more convenient practice. Some questions to answer before building a treatment system are:

- How much greywater will have to be treated? About 65% of domestic wastewater is greywater. Bathing and laundry can generate considerable quantities of greywater in a large household.
- What contaminants are present? Greywater from the bathroom will have different characteristics than that from the kitchen (see figure 1).
- What are the possible uses after treatment? The planned uses of greywater may call for more or less treatment. Some uses, such as outdoor irrigation, are seasonal; greywater is produced year round.
- What is the soil type and depth to water table at your site? A shallow water table underlying sandy soil could be in danger of contamination.

METHOD FOR GREY WATER REUSE

Re-using water does not diminish our quality of life; however it can provide benefits on many levels. Apply greywater directly to the soil, not through a sprinkler or any method that would allow contact with the above-ground portion of the plants .Root crops which are eaten uncooked should not be irrigated with greywater. Plants that thrive only in acid soil should not be watered with greywater, which is alkaline. Use greywater only on well-established plants, not seedlings or young plants. Disperse greywater over a large area, and rotate with fresh water to avoid build-up of sodium salts. Toilet flushing can use considerable amounts of greywater, as it normally accounts for up to 50% of indoor water use. Poor quality greywater is not a problem if it is used to flush toilets, because

the water goes into the sewer or septic system where it would have gone had it not been reused. Greywater should be pumped into the toilet bowl for flushing. **DO NOT** put greywater into the toilet tank. Greywater in the tank may not only cause the flushing mechanism to malfunction, but could be back siphoned into the fresh water supply if water pressure decreases suddenly. Lagoons or ponds containing greywater can grow algae to feed fish in a separate pond, or provide food for ducks and other waterfowl. Removal of the algae is necessary to keep the system aerobic and prevent foul odours. Ponds are often lined with concrete, stone, or plastic to prevent leakage. This method is a relatively inexpensive and easy way to recycle water, but requires some expertise to site and construct the lagoons. With an automatic clothes washer, the wash water from a lightly soiled load, or rinse water, can be saved to wash the next load. When reusing laundry water for irrigation, do not use liquid fabric softener or detergents including softener (use softener sheets in the dryer instead). Water should not be reused if the laundry includes diapers. Wash water containing gasoline, diesel, or similar pollutants, should not be used for purposes other than flushing.

Two major benefits of grey water use are:

1. Reducing the need for fresh water. Saving on fresh water use can significantly reduce household water bills, but also has a broader community benefit in reducing demands on public water supply.
2. Reducing the amount of wastewater entering sewers or on-site treatment systems. Again, this can benefit the individual household, but also the broader community.

These types of grey water systems rely on plants and natural microorganisms to treat the water to a very high standard so that it can be safely re-used. The main advantage with these types of systems is that they treat the grey water naturally, and also enhance the local environment because of the attractive plants used and the fauna attracted to them. There are other natural systems available to treat grey water. The type of system selected will depend on the specific application, and selection would be considered on a case by case basis.

Diversion devices simply carry grey water from your bathroom or washing machine directly to your **garden** or toilet, without treating it. Components may include:

Hose

Grey water is diverted from its source to the garden using a simple flexible hose.

Diverter valves

For around $30 you can install a switch that allows you to choose when the water flows to your garden and when it flows to the sewer.

Closed-loop system

This diverts grey water to your toilet rather than your garden, but isn't approved in some states.

Surge tank

This stores the brunt of the outflow so your grey water won't flood the garden, or worse, the house. You need to remove sludge from the tank every six months or so, and it should also have an overflow device to divert excess water into the sewer.

Filters

These remove hair and other large particles from the water so they don't clog up your irrigation pipes. Filters need regular cleaning and need replacing every 6 to 12 months. The type of filter required for a greywater system depends largely upon the amount of greywater to be filtered and the type of contaminants present. A drain filter is an easy and inexpensive way to filter lint and hair Out of bath or laundry water. A simple cloth bag tied over the end of a hose or pipe may be sufficient for irrigating outdoors or similar applications.

Many types of commercial water filters are available. Most use an activated charcoal, cellulose, or ceramic cartridge that must be cleaned or replaced regularly. Before buying a filter, determine whether it is a gravity filter (for low volumes) or a pressure filter (for flow rates greater than 20 gallons per minute). Also consider the frequency, cost, and ease of maintenance.

Slow sand or multi-media filters are usually built by the homeowner. These gravity filters may be constructed in a 55-gallon drum or similar container that is of suitable size. Features that should be part of a filter include a perforated plate or some other device to distribute water evenly over the top, a concrete funnel in the bottom to help water drain to the perforated drain pipe, and a cover and vent to prevent odors. Fill the bottom of the filter with stones that are too large to enter the drain pipe.

Pump

This may be necessary to get water to all parts of your garden, especially if gravity's not on your side. You'll need a power source, which may mean getting an outdoor power point installed.

Tanks

In a settling tank, solids and large particles will settle to the bottom, while grease, oils, and small particles will float. The remaining liquid will be reused. A settling tank also allows hot water to cool before reuse. The tank should be large enough to hold twice the expected daily flow plus 40 percent, to allow for sludge accumulation and surge loading. One type of settling tank well-suited for greywater treatment is a septic tank. A septic tank is specifically designed to allow settling, but do not confuse the use of a septic tank to treat greywater with the conventional use of a septic tank. Greywater intended for reuse should NEVER be mixed with toilet wastes.

Greywater coming out of a septic tank contains little or no oxygen. Greywater from an aerobic tank will contain more oxygen, which is better for irrigation purposes. An electrical pump or aerator added to a septic tank can create an aerobic environment. Aerobic conditions allow some decomposition of wastes in the tank, and may help minimize sludge build up and blockages in the system. Both aerobic and septic tanks will need to be pumped out every three to five years.

Several types of tanks may be suitable for settling or storage of greywater. In addition to metal, polyethylene, fiberglass or wooden tanks that are commonly used, consider using plastic garbage cans, 55-gallon dims, portable swimming pools, or waterbed mattresses.

Grey water treatment systems

These systems collect and treat (and some disinfect) the water to various levels of purity and hygiene. Several stages are involved in the treatment of water:

- Filtration of solids (lint and hair).
- Removal of pathogens and unwanted chemicals (such as salts and nutrients) using either micro-organisms or chemical treatment.
- Disinfection by chlorination or UV light, though not all systems do this.

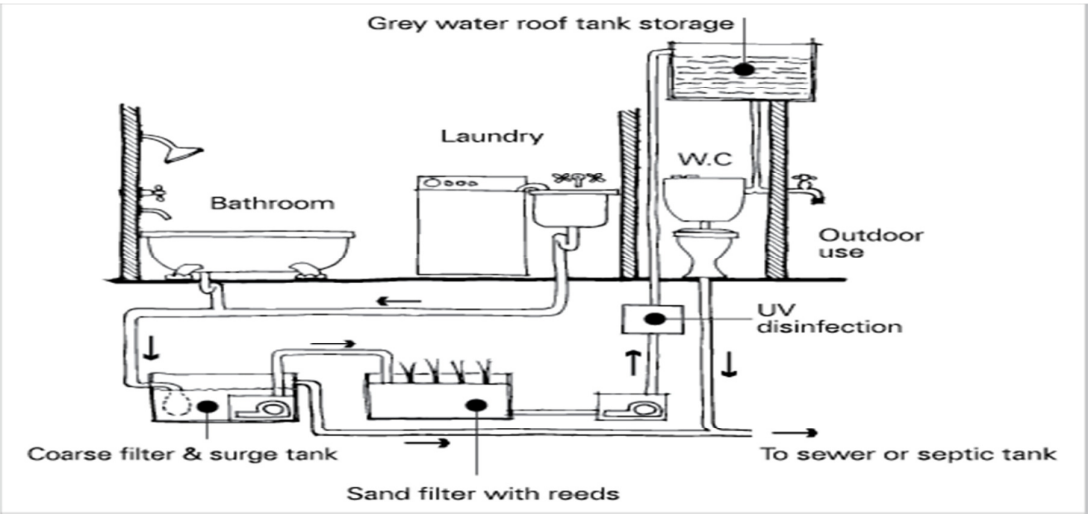
Treated water can be used in washing machines and toilets, as well as on the garden. If you don't have much garden to water, or if you don't need to water it in all seasons, this sort of system may be a more useful option as you can use the water elsewhere.

Disinfection

Two chemicals used to disinfect water are chlorine and iodine, with chlorine being more common. Not only is it readily available (as household liquid bleach or at swimming pool supply houses) and relatively inexpensive, but it is stable in storage and will, in time, vaporize from the water after disinfection. Organic material in greywater may combine with chlorine, and reduce the amount available for disinfection. For this reason, a filter or settling tank before the disinfection point may be advisable.

Iodine is less affected by organic material, persists longer, and may be more effective at the high pH of greywater. Iodine is also fast-acting, requiring no more than two minutes to kill most pathogens.

Several devices are available commercially that dispense appropriate amounts of iodine or chlorine (in solid or liquid form) to a water system. Check with swimming pool supply houses or water treatment companies.



SUMMARY TABLE

TABLE

Sr. No	Treatment	Variable
1	Aeration	Odor, Organic matter, Oxygen
2	Alum	Soaps, and Turbidity
3	Carbon filtration	Odor
4	Chlorination	Bacteria, and Odor
5	Crop filtration	Bacteria, Food particles, Suspended
6	Crop uptake	Nitrate, Phosphate, Soaps,
7	Dilution	Hot water, Nitrate, pH, Phosphate,
8	Filtration	Food particles, Oil and grease,
9	Flotation	Oil and grease
10	Hydrogen peroxide	Bacteria, and Odor
11	Lime	Bacteria, Odor, and Sodium
12	Settling	Foam, Food particles, Hot water,
13	Soil filtration	Bacteria, Bleach, Chlorine, Foam,
14	Soil uptake	Nitrate, Phosphate, Soaps, and Sodium
15	Storage	Foam, Food particles, Hot water, Organic

Option for You

If you have access to mains water, it's unlikely you'll want to bother with grey water recycling unless you really want to do your bit for the environment, or if you don't have a rainwater tank. But if you don't have access to mains water, or you produce a lot of grey water thanks to a large household, it could be worth investing in some sort of grey water recycling system.

The system that best suits will depend on your situation.

Big garden (fruit or ornamentals)

The cheapest and simplest solution is to get a diverter and send water to the lawn or garden through sub-surface irrigation pipes. However, a higher level of treatment will be safer and give you more options.

Vegetable gardening

If you want to water herbs and vegetables you'll need to get a higher level of water treatment. Untreated grey water should definitely not be used on food that will be eaten raw.

Small or no garden

If you produce a lot of grey water but don't have much garden, you could get a treatment system that allows the water to be used in your toilet and/or washing machine.

Drought-affected supply

If you live in a drought-affected part of the country and/or have to rely on rainwater for your household water supply, a grey water treatment system could help a lot. If plumbed into your toilet and washing machine, you'll save precious drinking water. It will also reduce the load on septic tanks or drought-stressed waterways. (You might also consider a waste water treatment system that handles black water as well as grey water.)

You want the whole green shebang

Installing a grey water treatment system will reduce how much water you use and reduce the amount of waste going into the sewerage system. While it won't necessarily save you much money, you'll get that warm fuzzy feeling knowing you're helping the environment.

CONCLUSION

Slow sand filters require regular cleaning and replacement of the top layer of media. Multi-media filters require less frequent cleaning, but all layers must be cleaned or replaced when maintenance is required. Routing greywater through a settling tank before filtering reduces contaminant load and can lengthen the interval between cleanings. reduce water bills. Use fewer water resources. Irrigate the garden during drought or water restrictions. Cut down the amount of pollution going into waterways. Help save money on new infrastructure for water supplies and wastewater treatment. Decrease demand on infrastructure for sewage transport, treatment and disposal, allowing it to work better and last longer.

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