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## 19. Wastewater use

The use of wastewater for a variety of purposes is gaining increased popularity as a means of preserving scarce freshwater resources. Wastewater and greywater use is increasingly considered a method combining water and nutrient recycling, increased household food security and improved nutrition for poor households. Economic and environmental pressures, and the conservation ethic, have led to widespread and growing applications for recycling of wastewater, including irrigation of food and non-food crops, green spaces, recovering arid land, fire systems, industrial cooling or industrial processing, sanitation and even as indirect and possibly direct sources of drinking-water. The beneficial use of wastewater also helps to decrease the impact on the environment of disposal of sewage or industrial effluent. The end use of wastewater determines the required quality of the water and management procedures required to ensure safety. WHO and several countries have developed guidelines and standards for the safe use of wastewater in agriculture and other settings (WHO 2006a).

### 19.1 Use of greywater

There has been considerable focus on the use of greywater. The *2000 Uniform Plumbing Code illustrated training manual* published by the International Association of Plumbing and Mechanical Officials defines greywater as “untreated household wastewater which has not come into contact with toilet waste. Greywater includes used water from bathtubs, showers, bathroom wash basins, and water from clothes washing machines and laundry tubs. It shall not include wastewater from kitchen sinks or dishwashers” (IAPMO 2000). Even though greywater does not include wastewater, pathogens may still be present from different sources (e.g. babies’ nappies or diapers). However, pathogen concentrations are generally much lower than in wastewater. Greywater can be used in domestic installations, for water closet flushing and for garden watering. Depending on the use, greywater may require some treatment (e.g. disinfection) or management steps prior to application to ensure safety. For example, greywater used for garden irrigation should not be distributed by aerial spraying, as there is high risk of spreading airborne infectious particles (see section 14.5). But if the greywater is applied below the soil surface for landscape irrigation, little or no treatment may be necessary. WHO has recently completed Guidelines for the Safe Use of Wastewater, Excreta and Greywater, which provide more

information on risk management associated with the use of these substances (WHO 2006a). Table 19.1 summarizes the suitability of different grades of water for use in different applications.

TABLE 19.1 SUITABILITY FOR USE OF DIFFERENT GRADES OF WATER

Water grade	Definition and reuse applications
Greywater	Water from a potable source that has already been used for bathing, washing, laundry or washing dishes
Wastewater	Combined domestic effluent that contains sewage
Reclaimed water	Water that has been treated so that its quality is suitable for particular specified purposes, e.g. irrigation, toilet flushing, etc.
Green water	Reclaimed water that has been treated to a relatively high standard, suitable for general use as a non-potable source in parallel with the potable source. It may be identified through inclusion of a green dye and supplied through a dedicated pipework system
Drinking-water	Very high-quality water assured to be suitable for drinking by humans

## 19.2 Use of wastewater

Greywater does not include the wastewater from toilets, urinals or bidets. The discharges from these fixtures are classified as wastewater (sometimes referred to as black water), because they contain high levels of pathogenic organisms and solids. Such discharges should undergo specialized treatment prior to any secondary use. The installation and operation of wastewater use systems must be strictly controlled. Safe wastewater use systems require subsoil discharge in order to limit the amount of exposure to humans and animals, so minimizing any possibility of transmission of infections by viruses, bacteria or parasites. However, precautions should be taken to avoid the contamination of ground-water resources used for drinking-water.

In larger urban sewerage systems, the effluent from at least secondary treated community sewage treatment plants can be reclaimed by filtration, disinfection and other more advanced treatments (e.g. membranes) and sold for industrial processes or cooling, or used for irrigation of community sports grounds and gardens, or even for indirect potable reuse. Industrial and mine processing sites may set up internal recycling of cooling and process water to reduce their reliance on community supplies. A comprehensive overview of management measures for the reuse of wastewater in agriculture and aquaculture is presented in the WHO guidelines (WHO 2006a).

## 19.3 Management of dual water systems

Community and large industrial water reuse systems require a separate water distribution system that runs parallel to the drinking-water distribution system. Extreme care is required to keep the two systems separate, to prevent cross-

connection and to prevent inadvertent use of non-potable water for food preparation or consumption by both humans and animals. Dual water systems of this type must be clearly identified with a system of colour coding, labels and tags that conform to a national standard. All non-potable water outlets must be clearly labelled, and should be physically separated from potable (drinking) water outlets. Where possible, non-potable water outlets should be locked off to prevent unauthorized use. In a domestic environment non-potable water is best restricted to uses such as water closet flushing or garden irrigation. A closed distribution system will prevent casual use of the water for other uses.

Another potential user of a dual water system is the firefighting service. However, water outlets such as hydrants used for firefighting may also be illegally used by the public for domestic purposes. Epidemics have been traced to the use of water from fire hydrants for domestic purposes in the poorer sections of cities where the fire service water is drawn from water supplies of unknown quality. Because unauthorized use cannot be prevented, fire hydrants in public places should be supplied with safe drinking-water when possible.

#### **19.4 Identification of potable and non potable-drinking-water systems**

The pipes in all buildings having drinking-water and non-drinking-water systems must be clearly identified. The following is a suggested system of colour codes and labels used to identify different grades of water:

- Drinking-water: green background with white lettering
- Non-drinking-water: yellow background with black lettering, with the words “Caution – non-potable water, do not drink” or “Non-drinking-water, do not drink”.
- Reclaimed water: purple or lilac (Pantone colour #512) background, imprinted in nominal 12.7 millimetre (0.5 inch) high, black, upper case letters with the words “Caution – reclaimed water, do not drink”.
- Each system shall be identified with a coloured band to designate the liquid being conveyed, and the direction of normal flow shall be clearly shown. The minimum size of the letters and length of the colour field shall conform to the recommendations in Table 19.2.
- A coloured identification band shall be indicated every 6 metres (20 feet) but at least once per room, and shall be visible from the floor level. Where vacuum breakers or presenters are installed with fixtures, identification of the discharge side may be omitted.
- Each outlet on the non-potable water line that could be used for special purposes shall be posted as follows: “Caution – non-potable water, do not drink”.

TABLE 19.2 MINIMUM LENGTH OF COLOUR FIELD AND SIZE OF LETTERS

Outside diameter of pipe or covering in inches (mm)	Minimum length of colour field in inches (mm)	Minimum size of letters in inches (mm)
0.5–1.25 (13–32)	8 (203)	0.5 (12.7)
1.5–2.0 (40–50)	8 (203)	0.75 (19.1)
2.5–6.0 (65–150)	12 (305)	1.25 (32.0)
8–10 (200–250)	24 (619)	2.25 (64.0)
> 10 (> 250)	32 (813)	3.5 (89.0)

Source: IAPMO 2003.

Additional information on grey water systems, reclaimed water systems, private sewage disposal systems, and drinking-water supply and distribution systems can be obtained from the following organizations:

World Plumbing Council (WPC)

KPMG Fides

14 Chemin De-Normandie

CH-1206

Geneva, Switzerland

[www.worldplumbing.org](http://www.worldplumbing.org)

International Association of Plumbing and Mechanical Officials (IAPMO)

5001 East Philadelphia Street

Ontario, CA 91761-2816 USA

[www.iapmo.org](http://www.iapmo.org)

Institute of Plumbing & Heating Engineering (IPHE)

64 Station Lane

Hornchurch, Essex

RM12 6NB

United Kingdom

<http://www.iphe.org.uk/>

World Health Organization

Water, Sanitation and Health Programme

20 Avenue Appia

1211 Genève 27

Switzerland

[http://www.who.int/water\\_sanitation\\_health/en/](http://www.who.int/water_sanitation_health/en/)