Conserving Water Supplies

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Recent droughts and rising costs have raised public awareness of the scarcity of clean water and of its economic value. It is a myth that, because rainfall is high in Britain, there are plentiful water resources. Britain is developing a climate of greater extremes. The wisdom of using high quality drinking water to irrigate land and to flush toilets is under debate. This leaflet summarises the design issues for saving water.

Water usage

Water consumption has increased by 70% per person in the last 30 years and is predicted to rise by 1.25% per annum over the next 30 years at present rates. Migration of populations into cities, mainly in the warmer, drier parts of the country, means that water is required at a distance to where it arises. The average energy production costs of UK mains water are 0.54 kWh/m^3. It is clear that our demands on water resources are unsustainable.

Lowering demand - painlessly

Reduction in water demand in a building can be achieved for very little extra cost by using good initial design principles. This is especially true for hot water pipework. It is essential that hot water reaches an outlet quickly to ensure that water is not left running. 'Dead legs' are not only wasteful of water but can also be a 'legionellae' risk. Energy efficient combination boilers have the disadvantage that it takes a while to heat water leading to warm-up water wastage. This can be solved by the use of small, integral thermal stores.

WC's are responsible for 30% of water usage. Currently the law allows a maximum flush volume of 6 litres. Exemplary WC's use 3 litres flushes and dual-flush cisterns use up to 2/3rds and full-flush quantities of 4 and 6 litres. These items do however have an added capital cost. There are a range of cheap retro-fit devices to reduce the amount of water volume in a cistern but these are often unsuccessful in old 9-litre flush toilets because the toilet bowl is not designed to empty its contents with lower water volumes. This can lead to repeated flushes which ultimately uses more rather than less water. The 7.5-litre flush toilets however work well with retro-fit devices.

In public buildings, urinals are large water guzzlers with a maximum urinal cistern fill flow rate of 7.5 litres per hour. Various devices are available that ensure flushing only occurs after use. The greatest reductions in water usage both for toilets and urinals are with entirely waterless facilities. The dry or compost toilet is covered in another Fulcrum leaflet. The dry toilet may have user acceptability issues but the waterless urinal has been shown to be perfectly acceptable. Indeed preferable because there is no build-up of lime scale. However, the oil-barrier, required to prevent odours, needs regular topping-up and maintenance.

Ensuring that baths, sinks and wash hand basins are not oversized is good practise. Beyond this, fitting regulated aerators for mains pressure outlets ensure that the user has the perception of a good water flow whilst using minimal quantities. There are a range of retro-fit devices that reduce tap flow rate - this can be as high as 20 litres / min and the flow restrictor devices cuts this to about 5 litres / min. Fitting waterbrakes, electronic sensing taps, self closing valves or spring taps ensures that water does not continue flowing when the user has left the wash room.

Minimising water flow for showers is more complex than for other appliances. It is important to maintain function per litre of water used. People generally equate more flow with a better shower up to a limit. Showers can benefit from ergonomic controls, minimising dead legs in pipe work and flow regulation to limit maximum flows and to help stabilise temperature. In the higher price brackets it is beneficial to specify mains pressure atomising showerheads which can give a very vigorous shower with very little water.

White goods, dishwashers and washing machines are now rated according to energy and water efficiency thus simplifying the choice of suitable appliances.

A combination of these low water use appliances can reduce water usage by between 50% (if waterless toilets and urinals are used) and 20%. Payback depends on water costs and quality of specification. In general with careful specification payback periods of under 8 years can be achieved. The Environment Agency in conjunction with 'Elemental Solutions' have produced a series of detailed leaflets on water conservation in buildings entitled, 'Conserving water in buildings'. (ISBN 1-85-705641-8)

Further reductions in water usage can be achieved by re-using water.-Greywater, otherwise known as green water.

Greenwater- what is it?

Greenwater or greywater is a term given to water that has been used once for bathing or washing, is then stored/treated and re-used in a range of situations not involving direct human contact, such as toilet flushing, car washing and irrigation. Car washing and irrigation are activities frowned upon during periods of drought and toilet flushing is responsible for 30% of total domestic water usage. Re-use of water for these activities have obvious water saving benefits.

The degree of contamination of the water with food particles, fats, skin debris, human pathogens, detergents and soaps depends on its initial use. Water used in kitchens and by cleaning / maintenance staff is usually heavily contaminated wheras water used for hand washing and showering is lightly contaminated. Only lightly comtaminated water is suitable for the production of greenwater.

Legislation

Presently, there is no legislation or regulations governing water re-use. A 1998 risk assessment by Nigel Lightfoot, Group Director of the Public Health Laboratory North, concluded, *'Given the infection dose, the levels of contamination, the route of transmission and the level of immunity in the community, for clearly defined uses for recycled water, the risks of transmission from rainwater and greywater are very low.'* (Hazard does not equal risk'). After extensive consultation, BSRIA have produced 'Water Reclamation Guidance' (Technical note TN 6/2002 and TN 7/2002) with the purpose of highlighting specific areas of concern in order to maintain standards of design and construction of grey water systems.

Economic viability

In deciding whether it is economically viable to install the necessary dual pipework, storage tanks and treatment sites, it is initially important to estimate how much lightly contaminated water is produced and how much greenwater can be used. In a domestic setting, hand washing and showering uses approximately 28% of total water consumption. This quantity matches well with toilet flushing requirements. This varies with low water-use devices. In a school setting, only schools with active sports facilities are likely to generate the necessary quantities of greenwater.

For individual household, water recycling can save up to 30% of a water bill. For a 'typical' family of four, assuming 150 litres/person/day, in a water authority area charging £2.00 per cubic metre, the typical costs are:

Annual metered bill £440.00
30% saving from re-use £130.00
Estimated capital cost £1000.00

Payback with these figures is approximately 8 years. However, there are hidden costs. - The ongoing maintenance costs ie, regular filter cleaning and the use of space for water storage. For new build, costs of incorporating a dual drain and distribution system can be minimised and so capital costs may be reduced.

In sites that are not connected to main sewers, recycling greywater will significantly reduce the volume that is required to be treated via septic tanks or packaged sewage treatment plants. This can lead to substantial capital cost and ongoing energy savings.

Proprietary Systems

Suitable propriety systems for toilet flushing (with Institute of Plumbing accreditation) comprise of the following design parameters.

- Mains back-up provided
- Mechanism to bypass greywater supply if desired
- Safety mechanism to prevent storage beyond a few days
- Microbiological or biocidal treatment
- Water coloration to show that water is not potable
- Attachment to use water for irrigation or car washing
- One or more storage tanks
- Clear labelling of parts to avoid confusion with potable water pipes
- Unrestricted overflow
- Stable (low) storage temperature via ground contact
- Exclusion of light to limit algae growth in the presence of nutrient.

Storage and Treatment

Storage is necessary to equalise the peaks and troughs of greywater generation and to ensure a regulated flow. The water is warm and contains nutrients. It therefore provides the conditions to support bacterial growth and, as oxygen is depleted, the water will become odourous. The time that the water takes to become 'septic' depends on the origin of the greywater, the nature and dilution of its contaminants and how rapidly it is re-used. It is generally unwise to store untreated grey water for over 12 hours.

A number of proprietary systems use bromine (a chlorine substitute) as a disinfectant. It is debatable whether the environmental benefits of re-use outweigh the environmental problems created by the use of bromine. - although not as active as chlorine in ozone destruction or chloroform production when mixed with organic compounds, its effects are not negligible. It also increases the chemical load that has to be dealt with at the centralised sewage treatment works.

An alternative, under development, involves the removal of particulates by sedimentation or filtration and removal of organic and soap residues with micro-organisms attached to gravel or a material with a large surface area.

For toilet use, pathogens can be eliminated with ultra violet (UV) light treatment .The effectiveness of UV depends on the clarity of the water and contact time. This system requires monitoring and maintenance and as such is only economic on a large scale.

With large future construction projects, green-water masterplanning is essential. Buildings, although built to varying time programmes should not be considered in isolation. A school, for instance, needing large quantities of water for flushing can be linked to residential areas that produce large amounts of grey water. Communal autonomous facilities could link these different building types.Where dual plumbing is considered unfeasible, use for irrigation only is an option.

With limited finance, greenwater recycling is the least viable option for tackling depleting water supplies but is worthy of consideration for large-scale future projects. Greater water savings can be achieved for less capital outlay by installing water saving appliances and collecting and using rainwater (details in a separate Fulcrum leaflet).