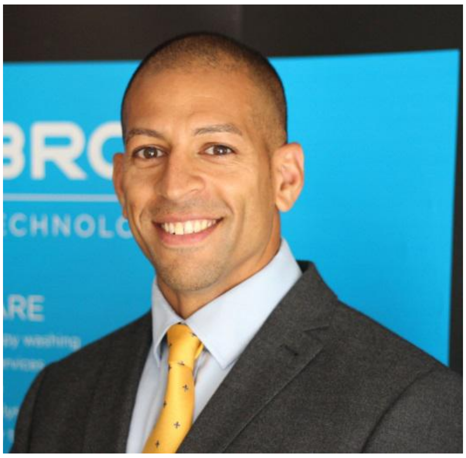
Water Efficiency – The Next Big Target

Mark Hadaway considers alternatives to expensive municipal water supplies



Against a backdrop of rising mains water supply costs and climate change causing stress to water resources, building services engineers are under pressure to reduce water consumption and associated costs. There is plenty of guidance available on water reduction, such as BREEAM Wat 01 and European Commission (DG-ENV) Study on Water Performance of Buildings, but how can you reduce costs further once consumption has been minimised?

The quantity of water used per capita in buildings depends, of course, on the type of building and what is going on inside. Benchmark studies suggest about 50 L/day for commercial offices, 120 L/day for residential buildings and more than 500 L/day for acute hospitals. The one common point is that no more than 10% of water consumed is used for drinking or food preparation. Most (about 50%) is used for toilet flushing and most of the rest for washing and laundry. In the majority of buildings, all of this water is taken from the mains drinking water supply. Wastewater from toilet flushing ("black water"), together with wastes from kitchen, laundry and washing ("grey water") is discharged to sewer. Both water supply and sewerage are charges paid by the building's occupants.

Drinking water quality is essential to public health, as is appropriate treatment and disposal of black water, so it's best for building services engineers not to get involved; leave it to the experts. Having said that, it leaves non-potable water services and waste grey water up for consideration. Non-potable supplies can be taken from any convenient source – private boreholes and rainwater harvesting are the commonest – but these will need treatment to adjust the quality to meet the requirements for use. Even allowing for treatment, the cost of this water will be an order of magnitude lower than that of mains water. But there is never something for nothing. Running potable and non-potable water systems means duplicate, and strictly segregated plumbing systems; easy to install in a new build but often prohibitively expensive as a retrofit.

Rainwater harvesting is a free source of water; but only when it rains. Climate change has changed the pattern of rainfall resulting in short, high intensity incidents. This means that the design of rainfall capture and storage systems have to be carefully considered to optimise performance. Rainwater is assumed to be of high purity but that depends on where it has fallen and with what it has been in contact. If it falls on roofs it will, inevitably, dissolve avian faecal matter including a variety of coliform bacteria. Runoff from hardstandings collects hydrocarbons and silt particles, not to mention salt from winter de-icing activities. There are, currently, no standards on harvested rainwater quality, but consideration of the application will influence the choice of treatment. In commercial buildings, it can be argued, it is the appearance – colour and clarity – of the water that is most important, and a simple filtration package will usually suffice. However, in a situation like a hospital, where immuno-suppressed patients could be exposed to aerosols generated by toilet flushing, microbiological quality will be of paramount importance. In this case, a validated disinfection system will need to be included in the treatment process.

Aside from rainwater, natural waters are an obvious alternative source to mains, subject to the availability of abstraction licences, which are becoming more difficult to obtain. Groundwaters from wells and boreholes are the preferred option because, having been filtered through underground rock strata, they generally require very little treatment. Where treatment is required, the processes used are relatively low in cost and are simple to operate. Iron and manganese, two common problem contaminants which cause discolouration of the water, are easily removed by aeration and/or pressure filtration using a variety of special catalytic filter media. Hardness salts of calcium and magnesium, common in chalk borehole waters, deposit scale on heat exchange surfaces in boilers, calorifiers and cooling systems and can cause pipework blockage. Scale deposits reduce the efficiency of heat transfer which means increased fuel costs and associated carbon footprint. However, hardness is easily removed by ion exchange softening. Framlingham College in Suffolk is an independent school fortunate enough to have a private borehole. “The borehole is 30m deep”, says Maintenance Manager, Allan Card, “The water is pumped through an iron removal filter to a reservoir and is then pumped into the college building via a softener to supply hot water down services. The treatment system is serviced twice a year and the borehole pump every three years.” Neither water filters nor softeners remove microbiological contaminants from water, so disinfection by UV irradiation or chemical dosing, which is less easy to control, will be needed to ensure safety in cold down services, if a *Legionella* assessment identifies a risk.

Microbiological contamination is also an issue in cooling towers no matter where the make-up water comes from so, whether the make-up is mains water, borehole or rain water, the circulating water will need to dosed with biocide and corrosion or scale inhibiting chemicals – a job for the specialist chemical supplier. Cooling towers evaporate water vapour, leaving behind a more concentrated circulating water. The chemistry will dictate the maximum allowable concentration factor that will prevent scaling and this, in turn, will set the required blowdown. Softening or reverse osmosis treatment to reduce the Total Dissolved Solids (TDS) of the make-up water results in a higher concentration factor and a lower blowdown, so the economic calculations are easy to do.

The chemistry of steam boilers is much the same as that of evaporative cooling towers, although there are no microbiological issues. Reverse osmosis or ion exchange deionisation of the make-up water once again minimises blowdown which, in the case of steam boilers, contains a good deal of heat (fuel) as well as expensive conditioning chemicals. Again the economic calculations are easy. Purified water is also needed in humidification systems, whether they are spray or steam type. Reverse osmosis, which produces bacteria-free low TDS water, is the preferred technology in this application.

Grey water recycling for flushing toilets has been much discussed but, so far, not widely implemented. The perceived problems of duplicate plumbing systems certainly contributes to this situation, but so, too, does a lack of treated water quality standards. The current generation of packaged Membrane BioReactors (MBRs) can produce a high quality treated effluent suitable for most domestic uses. It can also be fed directly into a reverse osmosis plant to produce treated permeate far better the required by the Water Quality Regulations. And remember that every litre of grey water recycled is a litre that doesn’t contribute to sewerage costs.

Incorporating alternative water supplies, and appropriate treatment technology, at the design stage of new building doesn’t have to be expensive. With a little help from a specialist water treatment company, it’s possible to accrue long term savings by reducing the costs of drinking water supply and sewerage.

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