WHY THINK ABOUT

# THE BOILER HOUSE?

Whether for hot water supply, steam generation, or heating, or any combination of these, significant quantities of water may be used in a boiler house. The 'value' of this water is often underestimated: it is frequently pre-treated before entering the boiler (softened or demineralised), has conditioning chemicals added, and is heated. Each step significantly adds to the value of the water.

The 'value' of treated water, steam and condensate can be compared with the costs of potable water.

| | |
|---|---|
| **Potable Water** | = £0.38 - 1.26/m$^3$ |
| **Demineralised or softened water** | = £2 - 3/m$^3$ |
| **Steam** | = £10 - 12/tonne |
| **Condensate** | = £3 - 4/m$^3$ |

Over-use or loss of any of this water can have significant cost implications. Costs are also incurred when water is discharged to the sewer, typically between £0.43 - 1.62/m$^3$.

## Where is water used?

The amount of water boilers use to produce steam and hot water depends on their size and operation. They require make-up water to compensate for the use (or loss) of steam or hot water, uncollected condensate or replacement blowdown water.

## Boiler feed water pre-treatment

In the majority of boiler installations some form of water pre-treatment is required before the water can be used. This frequently means demineralisation or softening using ion exchange beds. These beds require regeneration, typically using hydrochloric acid/caustic soda for demineralisation plants and salt solution for softening plants, followed by a short period of operation to stabilise the beds. These processes use water and reagents, and create effluent. Ideally, the frequency of regeneration of the beds should be controlled to the minimum necessary and should be based on conductivity breakthrough or volume treated rather than on a 'once per day' or similar time-dependent basis.

**Suggested action:**
**Check if the regeneration cycles could be reduced.**

WHY THINK ABOUT

# THE BOILER HOUSE?

## Boiler blowdown

Whatever the type of water fed to a boiler it is almost inevitable that periodic dumps of water from the boiler will be required to prevent the total dissolved solids (TDS) from building up within the boiler water. There are many ways of controlling boiler blowdown, for instance manually, by timer or based on conductivity (usually linked to TDS).

Automatic boiler blowdown control systems are available, usually set to operate at a conductivity which is equivalent to a TDS of around 3,000 - 3,500 mg/l. A typical treated water TDS is 275 mg/l. Assuming that the additional TDS burden from the returned condensate is small then the amount of boiler blowdown required can be estimated from the concentration factor, for example:

3,000/275 = 10.9

thus

blowdown = 1/10.9 = 9.2% of boiler feed water

**Suggested action:**
**Check if boiler blowdown amount or frequency can be reduced. Installing sub-meters on blowdown and make-up lines will help to monitor this.**

## Condensate recovery

Condensate forms as the steam begins to cool in the system resulting in the formation of hot water. This hot water has a value both in terms of water and energy. Condensate can be collected and returned to the boiler reducing the water and energy required to produce more steam. Other benefits of good condensate recovery include the reduction of raw water pre-treatment costs and reduced blow-down requirements (condensate typically has low dissolved solids).

Depending on the water quality, boiler blowdown may be used in other water consuming applications like irrigation.

**Suggested action:**
**See if it is possible to collect and re-use more condensate.**

## Steam losses and leaks

The cost of steam is often underestimated - For example, to produce steam (at 100°C) requires the energy equivalent of heating water to around 650°C, i.e. around 80% of the energy input to a steam boiler is for the latent heat of vaporisaton. Care should be taken when using steam and losses should be prevented.

**Suggested action:**
**Ensure good control and minimise steam use. Inspect the system for leaks. Repair or replace corroded or worn parts promptly.**

WHY THINK ABOUT
# THE CATERING DEPARTMENT?

Catering departments in hospitals can be areas of high water consumption, particularly in those where food is freshly prepared rather than cooked from chilled. Because of this it is worthwhile considering sub-metering the kitchen and possibly individual points of water use to monitor and track water consumption.

## Where is water used?

Water will generally be used in:

- Washing and preparing food
- Washing food preparation areas and equipment
- Food waste disposal channels
- Dishwashers/glass washers

## How can water use be reduced?

**Washing and preparing food**
Taps left running over sinks for rinsing food can often contribute to excessive water use. A large tap fully open, running continuously, can have a flow of around 40 litres per minute.

**Suggested actions to consider include:**

- **Increase staff awareness, including the management team, about the value of water and the need to turn off taps.**
- **If possible, fit spray heads or flow restrictors to taps used for rinsing to reduce the maximum flow.**
- **Install taps which automatically shut-off when nobody is near the sink, for example foot-operated taps.**
- **Review the management of frozen food to avoid running water being used as a means of defrosting.**
- **Automatic potato peelers often require a water supply to flush out potato peelings. Set the flow to the minimum necessary for satisfactory operation. A flow restriction device can ensure that this flow is not exceeded.**

WHY THINK ABOUT
# THE CATERING DEPARTMENT?

### Washing food preparation areas and equipment
In some larger kitchens, washdown of equipment and floors is undertaken using a hose. If this is the practice, a low-flow high pressure hose should be used. If only a 'conventional' hose is available, try a 15mm (1/2") rather than a 25mm (1") diameter hose. In either case fit the hose with a pistol-grip nozzle so that when it is put down it automatically shuts off.

### Food waste disposal channels
In larger kitchens, food waste from returned plates and dishes is often scraped into a channel through which there is a constant flow of water to take the waste to a macerator before disposing to a sewer.

Depending upon the operation, actions that can be taken to reduce water use include:

- Ensure the water flows along the channel only when the channel is in use.
- Only use disposal channels when necessary and keep the number of channels to the minimum required.
- Evaluate alternative methods of collecting food waste, for example scraping into bins or into a mesh basket in a sink, to reduce or eliminate the need for a channel.
- Install passive infra-red control sensors (PIR) to automatically control the flow of water in the channel.

### Dishwashers, glasswashers and kitchen appliances
Dishwashers (batch or tunnel) and glasswashers should always be operated with full loads for maximum water and energy efficiency.

When opportunities arise to replace equipment, consider water and energy efficient models. Try and balance out the initial cost of the unit and the running costs arising from water and energy use.

Many of the above suggestions simply require a change in working practice rather than any financial outlay for equipment. Regular staff training can help achieve more efficient water use whilst maintaining hygienic and effective catering practices.

WHY LOOK AT
# LEAKAGE?

**Is your hospital losing water? Leakage can be the single largest cause of water consumption in a hospital making its detection vital. Above ground leaks are usually self-evident – but leaks below ground can go undetected for years.**

A recent survey of three hospitals showed that 15-30% of annual water use was due to leakage. A small pinhole leak can lose around 6 litres/hour ($53m^3$/year) with a more significant hole losing around 400-800 litres/hour (3,500-7,000$m^3$/ year). With water costs alone at £0.38-1.26/$m^3$ even a small leak can cost very large sums of money.

## Detecting leakage

A simple rule of thumb is that if the base flow of water (for instance at night) is significantly greater than 10% of the peak flow this may indicate a leak. The following steps will also help identify if you have a leak:

- If there are periods when your site should not be using water, perhaps late at night, have a look at the incoming water meter – it should not be going round.
- Check the volumes of water supplied to the site. Use your water bill to get this information. Do they equal or approach the volumes used? Volumes used may be obtained from installed sub-meters, plate rating of equipment or empirical calculations (see Useful Water Consumption Data sheet). If you cannot account for all incoming water – why not?
- Compare water use for the same period in previous years. If the use is very different and there is no valid reason it may be because of a leak.

**Suggestion:**
**Routinely compare current and historical water consumption – if there is a marked difference, find out why.**

## If you think you have a leak what should you do?

Repair it! If the leak is underground water companies have specialist equipment for locating the leak and can offer practical advice on leakage monitoring and detection – this is often free.

One hospital saved over £100,000 a year by locating and repairing two major leaks.

WHY BOTHER
# MONITORING WATER USE?

**The only reliable way of managing water is through monitoring. Monitoring water use can show how much water is supplied, where and when water is used and how water use varies. It will help identify where water may be saved and where it is being lost.**

## How do I start monitoring water use?

To start monitoring water use is very simple – take your water consumption figure from your water bill and plot a graph of consumption against time. This will show trends and any departure from normal water use patterns – a graph showing ever-increasing consumption is likely to be because of a leak. In the real example below can you spot when the leak started? Because the site did not monitor water consumption it was only in mid-2000 that it was thought that water consumption was 'higher than it was last year'.

## Once you've started what then?

Using a site plan identify all areas and facilities on site where water is used. If there are any areas, for example the boiler houses, or items of equipment such as sterilizers equipped with sub-meters, gather this information. Ideally, all buildings or departments/areas should be equipped with sub-meters so that water use can be monitored area by area, rather than the site as a whole. This will help identify where most water is being used and help target water saving efforts.

## Simple questions during a water monitoring initiative:

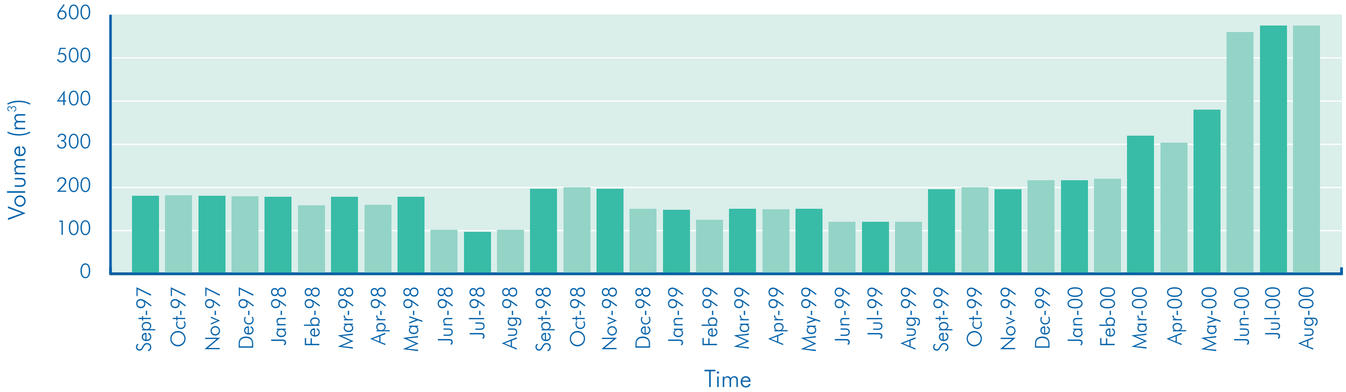
**1.** How much water do we consume?

**2.** Have we a graph of water use?

**3.** Where do we use our water?

**4.** Do the numbers add up?

**Example: Water use by month Sept-97-Aug-00**




UK water industry working with NHS Estates and Watermark

# WHY LOOK AT
# 'DOMESTIC' WATER USE?

The use of water for 'domestic' purposes (toilets, washing, bathing) will account for a large proportion of the total water consumption at your hospital, typically more than half. From a recent survey of hospitals it was found that worthwhile savings can be made without detriment to patient care, control of infection, hygiene or cleanliness standards and with minimal expenditure by simple modifications to toilets, urinals, sinks, showers and baths. Before taking any action you should consult the Control of Infection Team who will help ensure that what is proposed will meet the care needs of different patient groups.

## Where to start

- Make staff and patients more aware of their responsibility to use water wisely
- Identify which areas of excess water usage can quickly and easily be tackled
- Identify the low cost/high gain options and do those first.
- Monitor the effects of installing water saving devices/strategies. Compare previous bills from the same period of the year.

## Which areas should we tackle first?

The table below will help identify where excessive water use is likely to occur and what benefits are likely.

**Typical water usage, water reduction measure and benefits**

| Water Usage | Typical %age Hospital Use | Typical reason for Excessive Water Use | Action to Reduce Water Use | Typical Cost | Typical payback |
|---|---|---|---|---|---|
| Toilets - WCs | 24% | Large volume cisterns (9-14 litres) | Cistern dams | Low | Short |
| Toilets - Urinals | 5% | Flushing occurring even when not used | Flush only when used (plus hygiene flush) | Medium | Short |
| Taps | 13% | Dripping/ Running taps and high flow | Tap Restrictors, Percussion taps | Medium | Medium |
| Baths | 11% | Bath v shower = 3:1 water use | Increase ratio Showers: Baths | High | Medium |

Source: Audit Commission NHS Occasional Papers No 5 May 1993.

# WHY LOOK AT
# 'DOMESTIC' WATER USE?

## Toilets

### WCS

The volume of water used for flushing can be minimised by:

- Adjusting the internal ball-cock to reduce filling volume to a minimum
- Fitment of a cistern volume adjuster such as cistern dams or cistern bags
- Replacement of the toilet, new units have a maximum flush of 6 litres.

### Urinals

The frequency of flushing urinals is normally determined by the slow flow of water into a cistern, typically 7.5 – 12 litres, which then repeatedly fills, flushes and fills again. Although dependent upon the setting of the needle valve, this flushing typically occurs once every 20 mins. Over a year, one single 7.5 litre cistern will consume over 197 $m^3$ of water, incurring both water and sewerage charges. By fitting a flush control, for example a passive infra-red detector, flushing is limited to a pre-set number of uses plus hygiene flushes. In many instances where use of the urinal is limited to only 8 or 12 hours a day, savings of 60%+ can be achieved, about 118$m^3$/year per cistern. With fitment costs typically £120 - £150 per unit payback is rapid.

### Taps

First of all check for dripping taps and replace the washer if necessary.

Tap regulators can be fitted to reduce the flow of water. In the case of hot water taps, energy savings will also result. Regulators can reduce the flow of water by up to 50%. For a tap with a flow of 12 litres per minute and an average use of 20 seconds per handwash, 100 times a day, around 400 litres of water will be used per day, equivalent to 146 m3/year. This use could be cut by a third with the use of a tap regulator without compromising health or hygiene. Self-closing or percussion taps can be used if there is a 'tap turning off' problem.

Creating staff awareness through appropriate training will be critical to successfully introducing changes.

### Baths

Use of a shower rather than a bath typically reduces water consumption by 60% - a bath typically uses 80 litres and a shower 30 litres. It is recommended that where showers are provided, high performance low-flow types are used and that to avoid water running to waste while the correct temperature is reached, and for safety, thermostatic controls are used. Apart from the water savings there are also significant energy savings as the majority of water saved will be hot or warm. However, the decision to change the ratio of showers to baths must also be based on appropriateness for the care needs of each patient group and ensuring that a choice continues to be offered to patients.

# WHY CONTROL **WATER PRESSURE?**

## Too much water pressure could contribute to excessive water consumption in hospitals.

There are three main effects of high pressure:

- Puts additional and unnecessary wear and tear on the distribution system
- Can cause or exacerbate leakage
- Causes a higher flow-rate of water through taps increasing wastage

Dealing with high pressure and the effects it has can save water and money.

## Why could there be a high pressure problem?

Most water mains are operated at about 2-4 bar to meet minimum pressure and flow requirements. There is currently no stipulated maximum mains pressure limit. In some areas, where a hospital is located in a valley and the storage reservoirs are on top of a hill, mains pressure can be higher than this.

High pressures may also occur in bottom floors of high-rise buildings where the water is supplied under gravity from a break tank in the roof void or where there are systems equipped with booster pumps, often installed to supply water to the top floors of a tall building.

## What sort of effect can this high pressure have?

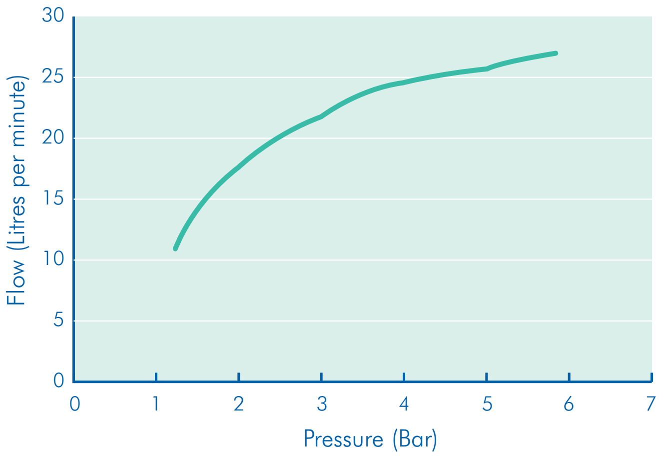
Let's take the simple example of an open tap operating on the top floor of a 7-storey building fed from a break tank on the roof. The flow through the tap on the top floor will be around 10 litres/min, which will be perfectly acceptable to the user. The same tap on the ground floor will be flowing at approximately 17 litres/min.

Assuming that the taps in this situation are used for handwashing (20 sec per person) by 500 people per day, the unnecessary water consumed is around 1,167 litres/day or 1.16$m^3$/d or over 426 $m^3$/year. Taking an average water and sewerage charge of 69p and 89p/$m^3$ respectively this represents a financial loss in water and sewerage charges of around £700/year for just this single over-use of water. It is worth noting that there would be additional energy costs incurred, as some of these taps would supply hot water.

# WHY CONTROL
# WATER PRESSURE?

The variation in flow as pressure varies through a standard open tap can be estimated from the graph:

**Effect of pressure on flow through an open (10mm) tap**




## What can be done to control pressure?

The pressure in the incoming main or the distribution system can be controlled using pressure-reducing valves (PRVs). These valves, which can be pre-set or adjustable, can typically accept delivery pressures of up to 25 bar and control these to a delivered pressure of 1.5-6 bar. They are available in a variety of sizes, and their application in potable water is commonplace.

## Where should they go and how much do they cost?

Typically, PRVs can be installed on incoming mains, if they are at too high a pressure. They are also commonly fitted on the supply to each floor off the downlegs of a gravity-fed distribution system or risers in a pumped system.

Costs are low – typically a 15mm adjustable PRV will cost about £20 and a 50mm around £200 plus fitting costs.

## What should I look out for?

Care needs to be taken to ensure that:

- The minimum required operating pressure is maintained for equipment
- Mixer taps or shower mixer units can function correctly at the new pressures (i.e. the thermostatic control will operate)

## Useful tips

1 bar = 14.5 psi

Approximate calculation to determine the new flow rate after a change in pressure:

New flow rate = Old flow rate x Square root of (New pressure/Old pressure)

# A USEFUL GUIDE TO
# WATER CONSUMPTION

## Water consumption data

### Total water use in hospitals expressed in m³ per m² of floor area per year

(1 m³ = 1000 litres).

| | |
|---|---|
| Small acute or long stay hospital without personal laundry | 1.17 |
| Small acute or long stay hospital with personal laundry | 1.56 |
| Large acute/teaching hospital | 1.66 |

Source: Watermark 2003

### Total water use in hospitals expressed as litres per patient bed-day

| Type of hospital | Litres per patient bed-day | | | |
|---|---|---|---|---|
| | very poor | poor | average | good |
| Acute >100 beds | 1138 | 711-1137 | 531-710 | <530 |
| Long stay >25000 patients days p.a | 690 | 412-689 | 331-411 | <330 |
| Long stay <25000 patients days p.a | 380 | 298-379 | 218-297 | <217 |

Source: Audit Commision NHS occasional papers No5 May 1993

### Water use expressed by activity or person

| Item | Average water use |
|---|---|
| Toilets | 6-9 litres/flush |
| Urinal (uncontrolled) | 500-900 litres/day |
| Urinal (controlled) | 120-200 litres/day |
| Sinks | 3-6 litres/event |
| Showers | 30-60 litres/event (higher for power showers) |
| Baths | 50-170 litres/event |
| Restaurants (on-site prepared) | 20 litres meal |
| Vehicle washing | 50-100 litres/vehicle (bucket)<br>400-900 litres/vehicle (hose) |
| Hose (_" or 15mm) | 8-10 litres/minute |
| **Person** | **Average water use** |
| Employee (full-time no canteen) | 25-50 litres/day/person |
| Employee (full-time with canteen) | 40-90 litres/day/person |
| Resident employee | 180 litres/day |
| Hospital patient (in-patient) | 450 litres/day |

NHS Estates

WATER UK

UK water industry working with NHS Estates and Watermark