BRE

Newsletter

The news from BRE's Water Centre

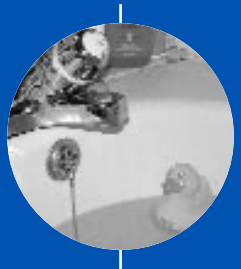
Issue 4

Contact us at BRE's Water Centre

Martin Shouler
Tel: 01923 664459
E-mail: shoulerm@bre.co.uk
John Griggs
Tel: 01923 664543
E-mail: griggsj@bre.co.uk

Water Centre
Fax: 01923 664088

Water Centre website:
www.bre.co.uk



Welcome

Welcome to the fourth BRE Water Centre newsletter. This edition looks at:

- ***Energy use and CO_2 emissions in the Water Industry***
- ***Forensic Engineering***
- ***Wastewater Engineering Standards***
- ***Scalding – risks and potential solutions***
- ***Market Transformation Programme***

Energy use and CO_2 emissions in the Water Industry

The Watermark Project, run by OGCbuying.solutions was established in 2000 to provide benchmarks for various building categories within the public sector and enhance people's knowledge of water conservation. As part of the project, Watermark contracted BRE to carry out a comprehensive study of the effects of energy use and CO_2 emissions within the water industry.

Since privatisation in 1989, there are 10 Water Service Companies in the UK (who supply water and treat wastewater), and 20 Water Supply companies. Together these companies supply a total of 18,000,000,000 litres (or 18,000 Megalitres) per day. The water supply industry, at a national level, is an industry which consumes a considerable amount of energy (6,000 GWh annually) in providing water supply and sewage services to its customers. The water industry's energy consumption contributed about 2.7 million tonnes of carbon dioxide (0.5% of the UK total emissions) in 1998/99. A suitable and reliable method for assessing CO_2 and other greenhouse gas emissions has not yet been developed. Operators do not record their energy use in a standard way and confidence in the data is moderate.

Factors that affect energy use

Each water supply company will have a different population to service and this will affect the amount of energy required to supply water and treat wastewater. In addition, the mix of energy sources available will determine the amount of CO_2 emissions.

Water has to be treated and stored before it is distributed to the consumer. Once water has been supplied to a consumer and used for domestic, commercial or industrial purposes, a large proportion of the water supplied (up to 90%) will be returned to water companies as wastewater. This wastewater needs to be transported and treated so that it can be safely returned to the environment.

The following are factors that affect energy requirements and CO_2 emissions:

- Geographical region and topography
- Depth of boreholes (pumping head)
- Supply pressure
- Leakage rate
- Age of network (pipe friction)
- Age and type of pumps
- Size of region
- Quality of water
- Industrial/ domestic mix (wastewater quality)
- Renewables (hydroelectric, biogas, windpower)

There are a number of stages in abstracting and delivering water to the consumer and the subsequent treatment of wastewater requires the use of energy. A very large proportion of energy used in the water industry is consumed by the requirement of energy for pumping. The uses of energy in water companies for the main stages in supplying drinking water and processing wastewater are listed in Table 1.

Our thanks to the Watermark Project for allowing us to use this extract. For more information on the Watermark Project see ***www.watermark.gov.uk***

Table 1 – Uses of energy in water companies

Stages in treatment	Energy using equipment
1 Abstracting water from boreholes or rivers	Pumps
2 Filtering, disinfecting and water treatment	Monitors, dosing machines and analytical equipment
3 Transfer to storage reservoirs	Pumps
4 Supply to domestic and commercial consumers	Pumps and monitoring equipment
5 Return of wastewater to treatment works	Pumps
6 Cleaning wastewater	Aerators, pumps, actuator valves, level controllers, mixers, monitoring equipment
7 Return the treated water to the environment or reuse the water	Pumps

Energy use and CO_2 emissions in water supply and wastewater processing

The energy office of the DTI confirmed the national average CO_2 emitted per unit of electricity in 1999 was 0.435 kg/kWh. This is the national average for energy produced by a mixture of nuclear fission, fossil fuels, and renewable sources. The form of electricity production affects the amount of CO_2 produced per kWh. The national average of energy use and CO_2 emissions in 1998/99 for the supply of water and the treatment of wastewater were:

- 468 kWh per megalitre of water supplied, producing 209 kg of CO_2
- 437 kWh per megalitre of wastewater treated, producing 195 kg of CO_2.

The above indicates an emission of 0.446 kg of CO_2 per kWh, compared with the average figure for 1999 stated by the Department of Trade and Industry of 0.435 kg of CO_2 per kWh.

The national average of energy produced by renewable sources (eg wind generators, biogas, hydroelectricity) in the UK for 1998/99 was 6.3%.

As more water and wastewater is treated, and to a higher standard, the amount of energy needed has increased. The increase in energy use will continue for some years to come as distribution and treatment systems are modernised and extended and more stringent standards have to be met.

CO_2 emissions resulting from different energy usage.

An average family of four uses approximately 200,000 litre of water per year. This requires 94 kWh to supply the water and 83 kWh to subsequently treat the wastewater. This will result in a release of 78 kg of CO_2 into the atmosphere according to the Water UK emission rate of 0.446 kg CO_2/kWh.

To process one megalitre of water and wastewater results in the release of 404 kg of CO_2. A typical car would produce 2.2 kg of CO_2 and travel approximately 10 km per litre of petrol. Hence a car could travel 1836 km for the amount of energy used to supply and subsequently treat one megalitre of water.

Update on Waste Water Engineering Standards

There have been many developments recently in European and British Standards. The European Standard (EN) for Air admittance valves (AAVs) has recently been published as BS EN 12380:2002. This Standard has been written over the last 10 years and was issued for public comment in 1997. At that time it was a two part Standard, the first part for design of the drainage system, the second part for evaluation of the valve. Following the first enquiry, most of the elements of the design part were incorporated into BS EN 12056-2 and 12056-5. The remainder has been honed, after a long period of test development, into the document that was issued for Formal Vote in the summer. The Standard was then ratified and sent for publication. In the near future BRE will issue some guidance to support it. BRE's sister organisation, BRE Certification, is currently setting up an approval scheme for AAVs.

A current controversial issue is the testing of wastewater treatment plants. Many continental countries favour laboratory testing, but the UK has traditionally used on-site testing. Although both routes can lead to CE marking the costs and reliability of the tests are being questioned. The UK has developed a new draft Standard for on-site testing that compliments the laboratory testing Standard. It was presented to the European Working Group in January 2003.

Forensic Engineering

The Water Centre regularly carries out forensic engineering into situations where there is dispute over responsibility or cause. Its findings are usually conclusive and final. Recent confidential investigations have been conducted on these topics.

- Rainwater system failure
- Gas fired heating boiler fire
- Plumbing related wooden floor failures
- Cuprosolvency and plumbosolvency
- Corrosion and leaks in commercial heating systems
- Installed WC flushing

A safe temperature for hot water?

There has been an on-going debate about the right temperature for hot water used in washing and showering. Martin Shouler describes current research into the incidence of scalding.

What is the best temperature for domestic hot water supplies? On the one hand, the need to avoid bacteriological risks (such as those associated with Legionella) indicates that water should be heated above 60°C. On the other, there is the need to prevent burning and scalding, which can easily occur at this temperature (see Table 2).

Assessing the risks

Research at the Building Research Establishment Ltd (BRE) is under way to assess the risks and determine the most appropriate method of producing safe hot water. The first step in this process is to identify the scale of the problem. The initial phase of the study, being carried out on behalf of the Department of Transport, Local Government and the Regions (DTLR), has therefore been looking into the incidence of scalding in England and Wales caused by water from hot water supply systems (including vented and unvented hot water storage systems, combis and instantaneous hot water generators).

Water that comes out of hot water taps can cause injuries, casualties that require a hospital visit, or even death.

Injuries and deaths in the home are recorded on two DTI databases: the Home Accident Surveillance System (HASS) and the Home Accident Deaths Database (HADD). Some mortality figures from the Office of National Statistics were also used in the study.

The relevant data was extracted covering three categories:

- incidents involving hot water from a tap
- those where the water was supplied from a fitted shower (those identified as involving a removable shower attachment are including in the tap category)
- unknown, which may include tap or shower-related incidents, but also includes water heated by other means such as kettles, microwaves and saucepans. There is too little information available through the source data to allow further distinctions to be made.

Table 2 – Effect of water temperature on human skin and Legionellla

Water temp		Time for first degree burn	Time for permanent second or third degree burns	Effect on Legionella
°C	°F			
20-50	68-122			Growth range
43.3	110	(Normal hot shower temp)	(Normal hot shower temp)	
46.7	116	(Pain threshold)		
46.7	116	35 minutes	45 minutes	
50	122	1 minute	5 minutes	Legionella can survive but not multiply
55	131	5 seconds	25 seconds	
60	140	2 seconds	5 seconds	
65	149	1 second	2 seconds	
66	150.8			
67.8	154	Instantaneous	1 second	
70-80	158-176			

Fatalities

During the period 1985-95, there were between 11 and 36 fatalities a year that were due to individuals scalding themselves with hot water from the domestic supply. Overall, there is an average of nearly 22 deaths a year due to water from the tap and a further four from hot water from unspecified heating methods.

Of the recorded cases virtually two-thirds (62%) were females and the average age of all the fatalities was over 65 (although there was a significant minority of cases – more than 10% – of children under 5). In more than 93% of cases, the scalding took place in the bath. Some 17% of fatalities took place in the communal homes, consistent with the much higher proportion of incidents among the elderly.

The vast majority of the fatalities associated with hot water occurred in the bathroom and not in the kitchen.

Casualties

With non-fatal incidents that required a hospital visit - casualties – once again the kitchen area was the venue for only a small proportion of injuries (5%) with the bathroom/toilet area accounting for more than 75%.

Whereas nearly 60% of deaths were in the 75+ age group, the picture for casualties shows almost a mirror image. Here, just over 60% of incidents involve children younger than five years old. Another difference is that nearly 10% of the scalding injuries occurred when using fitted showers.

There are two main ways to reduce scalding: the installation of thermostatic mixing valves and a reduction in the hot water storage temperature, together with an adequate water treatment system to control water quality.

Market Transformation Programme

DEFRA's Market Transformation Programme (MTP) encourages products which do less harm to the environment, using less energy, water and other resources. BRE is currently managing the water sector which includes household water using appliances

The Market Transformation Programme supports a structured public domain sector review process, conducted in partnership with business, consumers, experts and other bodies. It uses the Internet to encourage public awareness and scrutiny of current policy thinking, promoting openness, transparency and joined-up government.

MTP provides:

- a market transformation rationale and structured environment for identifying the key issues that determine resource efficiency, for constructing robust policy solutions and for monitoring the outcome
- a reference knowledge base of reliable information, current analysis and working assumptions
- up to date briefing notes on key issues and current developments and informed consensus on the potential for change, the policy options and the priority actions
- accessible, public information on policy direction and likely outcomes via **www.mtprog.com**
- support for specific policy initiatives and for wider policy programmes.

Development of Regulations

- One of the main factors in developing National Regulations is Governmental policy
- EU Directives often create the need to develop policies and legislation to improve the environment
- Before policy can be created some data is required to measure the impacts of any policy
- Historical data regarding the situation to date may be available, but extrapolations of that data to take account of hypothetical policy scenarios need to be developed
- One of the tools that is currently being used as a basis for policy development is the Market Transformation Programme

MTP Key features

Market projections and policy scenarios

- These help to 'reality test' the explicit market transformation policy rationales against consumer expectations and industry's own business plans

Policy Brief

- This is the main deliverable and focus for the sector review
- It is a clear statement of the issues, priorities and actions needed to deliver quantified improvements in resource efficiency over time
- It is a public domain document and is intended to be referred to in policy discussions and in support of Government decisions

MTP – examples of the current focus:

- improving the delivered energy performance of domestic and non-domestic products
- established sector reviews in 10 major sectors, covering 27 product types, representing 75% of UK electricity consumption. These include all major domestic energy consuming appliances and traded goods in the commercial sector
- incorporates DEFRA's work in support of Ecolabelling and the Centre has recently opened a new programme to look at household water consumption
- UKEPIC (**www.ukepic.com**) is a new initiative to provide access to reliable public domain product information. It will support a variety of key policy measures such as labelling, buyers guides, standards and green procurement.

BRE's Water Centre is currently contracted to develop Policy Briefs and Briefing Notes on water issues. This work is being overseen by the National Water Conservation Group (NWCG). For information on how to get involved with the NWCG, please contact John Griggs.