SERIES 17

CPD fundamentals

THE CONTINUING PROFESSIONAL DEVELOPMENT PROGRAMME

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MARK THROWER MANAGING EDITOR

energy institute

Manage your water consumption

By Paul Stevenson, director Larkdown Environmental Ltd, and chartered energy engineer and RPEC consultant

Attention to water has many parallels with energy:

• global natural resources that are under threat from over-exploitation;
• excellent cost savings through no/low cost interventions or investments;
• can be managed through a structured, systematic approach;
• can be metered and sub-metered, and techniques such as monitoring and targeting or benchmarking against industry “best practice” can be applied;
• can be recovered and re-used (energy as heat recovery, water as ‘grey water’);
• both can be generated from renewable sources (e.g. rainwater harvesting); and
• interventions in one often generate indirect savings in the other.

The prime driver for reducing water use is lower water purchase costs. Any reduction in water consumption, for the same output/commercial activity/ turnover, is a saving that goes straight to the bottom line.

Effluent charges are often related directly to the volume of water purchased. Attention to water misuse will reduce volumes of ‘end-of-pipe’ effluent treatment before discharge, thus reduce disposal costs. Also, if one can identify leaks and show that these has been ongoing for some time, it is possible to reclaim a proportion of the effluent costs from one’s utility bill.

There are indirect electrical and thermal energy savings, too. Clearly, the less water you have to pump, heat, cool or treat and discharge for the same tasks, the less energy is consumed. This is on top of the substantial electrical and thermal energy savings that can be made from:

• attention to the pump or fan system, such as installing IE4 motors, or variable speed drives for pumps or boiler fans with variable demand;
• improved efficiency of the steam/ hot-water system: at the boiler, in the distribution system or at the end-use.

Greater details for direct electrical and thermal energy savings are provided in Energy Institute’s Water and Energy Level 2 training module.

Other worthwhile cost and environmental benefits include:

• reduced consumable items: water-treatment chemicals, laundry detergents, etc.;
• enhanced product recovery;
• improved reputation with customers, business partners, staff and the local community;
• water performance can be declared as part of an organisation’s environmental statement and is almost always a key strand of ISO14001; and
• future-proofing. Currently, water does not have the same legislative or media attention as energy and CO_2; there is no water equivalent of EU ETS, CCA, ESOS, SECR, etc. But that may change.

It is strongly recommended that an organisation embarking on a mission to reduce water consumption follows a structured Environmental Management System (EMS) (see Fig. 1) which has parallels with Energy Management Systems (EnMS).

Specific activities include:

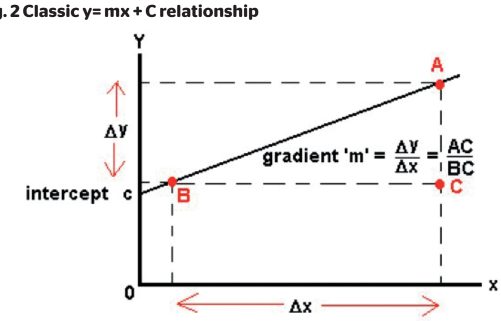
• determine the organisation’s recent water consumption (and effluent). Headline figures can be gathered from water bills, although for smaller consumers these are typically only quarterly or bi-annual, which gives poor granularity. For a base year, it is good practice to consider two adjacent year’s figures to ensure the selected year is not abnormal.

If water consumption is high yet information regarding consumption is sparse, one of the first tasks should be to introduce automatic meters at the incoming mains plus at important water centres. Sub-metering allows you to:

• compare top-down v bottom-up consumption. If the difference is large, this suggests large losses/ leaks, unknown consumption centres, or even that the organisation is providing free water to someone else! This is not unheard of when an estate has been split up;
• examine and compare consumption between operating and non-operating periods, such as day and night or weekdays and weekends. This helps

Fig. 1 Typical water management ISO14001/EMS system[1]

Fig. 2 Classic y = mx + C relationship



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understand the site's "base-load";
• examine day-day scatter. Large scatter indicates poor operational control;
• compare the performances of similar equipment within the organisation. Big differences help identify where to focus attention; and
• benchmark against industry norms and best practice.

Examine 'water performance'

The next thing to achieve is to characterise the 'water performance'. This will be the water consumption (or effluent) versus unit production or other meaningful measure of activity. This then generates the base-year of monthly (weekly or daily) consumption per unit activity. At its simplest, this would simply be straightforward m^3 water per unit activity. A more complex, but more useful relationship is a linear best-fit line relationship, similar to the energy relationship of E = mt +C. Where E = kWh energy, t = tonnage, C = base-load consumption irrespective of output, and m = the marginal increase per unit. This takes into account non-production base-load.

Even more complex relationships may be needed if and when two or more products have substantially different water needs. This multi-product relationship is known as a product mix and output algorithm. The advantage of this relationship is that changes to water performance are not hidden by changes to the product mix.

Seasonality should be considered, for instance, higher temperatures and lower rainfall necessitates additional ground watering.

Where possible, compare performance against benchmarks for:
• norms: i.e. sector average;
• good practice: better performers – typically the upper quartile or decile performers for a particular sector - can be used as a target; and
• best-available technologies (BAT): the most advanced technologies and techniques, although these are not always cost-effective interventions.

Conduct a walk-through audit to identify water saving opportunities. These may include:
• the need for suitable metering and sub-metering;
• attention to staff attitudes and behaviour;
• minimising avoidable losses: leaks, poor practices, process losses, boiler condensate returns, etc.;
• recovering 'grey' water (i.e. 'used'

water, but still clean enough for non-drinking purposes) for secondary re-use; and
• opportunities for rain-harvesting.

Prioritise cost-effective water-saving interventions, such as:
• enabling interventions: sub-metering and data gathering/ handling/ reporting;
• attention to employee attitudes and awareness – behaviour training;
• simple, low-cost interventions;
• investment opportunities that meet the organisation's financial criteria. This list will be organic and will change over time.

Set a long-term target

You should establish a long-term target (say to 2025), ideally with interim milestones. By understanding the organisation's current performance against sector norms and good-practice, plus understanding where cost-effective interventions can be made, it will be a challenging but achievable 'science-based' target.

Work all the above into an environmental policy and supporting strategy; ideally within a formal EMS working towards ISO14001, with regular reviews. Not only does this help verify and sustain savings, it also brings recognition from Stakeholders regarding the site's environmental stewardship.

An important issue raised above is to recognise what is current good practice across the sector. For this, one needs sector benchmarks:

• Drinks manufacturers

BIER, the Beverage Industry Environmental Roundtable, conducts bi-annual Global benchmarking of energy and water performances across its members, covering: carbonated soft drinks, bottled water, breweries, distilleries and wine-making.

The most recent survey[2] contains some excellent analyses of water and energy consumption trends across these sectors.

BIER Members are typically multinationals that have invested manpower and technology to become market leaders. Therefore, they will be among the sector's better performers. It would not be unreasonable to use their benchmark figures as long-term targets.

• Food manufacturers

Typical benchmarks of water consumption across important food manufacturers that have high water use are provided in a 2013 WRAP report: "Water Minimisation in the Food and Drink Industry"[3].

• Laundries

The USA's Alliance for Water Efficiency[4] focuses on SME laundries that mostly rely on equipment referred to as washer-extractors. Using their data as benchmarks:
• typical washer-extractor = 25-33 l/kg cleaned textile; and
• good practice = 21 l/kg textile

• Commercial and service-sector

Some years ago, the Environment Agency produced How much water should I be using?, a water consumption benchmarks for selected sectors, including: offices, schools, colleges, nursing homes, etc.[5]

Attention to water management at industrial sites can save up to 50 per cent of water use and effluent discharge, particularly if water efficiency has not been a focus for many years.

A site should regularly review and re-evaluate its production processes to identify areas where it can save water:
• Equipment cooling: equipment that needs cooling may have been connected to the main water supply, using a 'once through' process then discharging water to drain. Refrigeration units, chillers or evaporation towers can cool then re-use this water, offering substantial water savings.
• Cooling towers: Cooling towers may lose water as mist or spray. Optimised automatic blowdown control reduces blowdown losses. Also, you can re-use spray loss, rather than fresh water, to clean solid deposits from the tower.
• Liquid ring vacuum pumps: use a continuous supply of water, typically heated to 15°C, to provide a seal. Wastewater can be used for this process; it is common practice in paper-making.

Monitoring and adjust water flows:
• sprays and jets: direct the water stream, meaning one can use water more efficiently. Recent technology advances allow operators to use lower pressure sprays, which saves even more water.
• shut-off systems: operators can regulate/stop the flow in a system that does not require a constant stream of water. Otherwise, in many continuous flow systems, excess water simply flows to drain.
• conductive probes: measure acidity and alkalinity levels in a water system, which gives the operator the ability to improve the level of cleaning-in-place. In many cases, dirty or used water can be reused in other areas. Completing an audit of this 'grey' water, to evaluate how this could be re-used, can reveal significant areas for savings. Cleaning-in-place (CIP) removes contaminants from the process equipment with minimum disassembly. CIP offers many advantages over manual cleaning including:
• reduction of water consumption by 50 per cent;
• fewer chemicals;
• recovery of fluids that can be reused;
• increased automation;
• gives higher machinery cleanliness;
• counter-current rinsing: suitable for multi-stage rinsing. This process moves products through a series of tanks or rinsing stages. Product is first rinsed using dirty water, then progressively cleaner water. Typically, this saves 20-30 per cent total water consumption;
• scrapers, squeegees, brushes or hoses: mechanical cleaning can reduce cleaning time thus saves water. They also help eradicate bacterial growth, provide a more hygienic environment;
• drain-covers: if solids are likely to be

washed into drains during a cleaning process, drain covers reduce the volume of solids, which reduces effluent. The solid content can be reused, recycled, or disposed at a lower cost (and environmental impact) than as effluent.

Businesses that use pipes to move products can use product recovery techniques such as a 'pig', a plug or ball that is pushed along inside the pipe. Using a pig to recover materials from pipework offers:

- less water and other chemicals to clean the pipework;
- raw material or product recovery;
- water used to clean the pipework will have lower effluent loads; and
- reduced cleaning time, thus reduced downtime.

Reduce water bills 33 per cent

The Water & Resources Action Plan (WRAP) estimates that commercial businesses can reduce their water bills by 33 per cent if they manage water use more effectively. Opportunities include:

An office fitted with several 9-litre cisterns that serve 100 staff could easily save over £500/y in water and sewerage costs.

Avoid flushing-away cotton balls, cleaning tissues, etc; instead, dispose in a bin. This eliminates (unnecessary) flushes, but more importantly reduces potential blockages to the sewerage system, or plastic-pollutants entering rivers and oceans.

Add a few drops of food colouring to the cistern, then don't flush. If food colouring can be seen in the bowl after (say) one hour, there is a leak.

There are several simple, low-cost ways to retro-reduce the volume of water per flush:

- adjust the ball float to lower the water level in the cistern; repositioning can save up to 1 litre per flush;
- 'Hippo' or 'save-a-flush' bags fitted into the cistern and can save 20 per cent;
- dual flushing: a choice of two flush volumes can be retrofitted to older cisterns.
- use 'grey' water or collected rain-water for flushing.

Older systems flush even when not being used so are a major source of wasted water. Waste can be avoided in a number of ways:

- automatic timers that are programmed to turn-off the cistern-fill system overnight and at weekends;
- passive infrared sensors detect when someone enters the washroom. The sensor controls a solenoid valve that allows a pre-set volume of water into the cistern. Sensors can also be linked to toilet lights;
- waterless urinals are highly water-efficient but require specialist cleaning and regular replacement of the barrier fluids or deodorising pads.

Water consumption on washroom taps can be halved with no impact on the end-users using:

- push taps: After the user releases the tap, water flow will stop after a short delay. Payback period is 2-3 years.
- electronic tap: infrared sensor under the tap activates water flow. More hygienic because the user's hand does not touch the tap.
- spray tap: a nozzle that dispenses water as a spray, offering savings of up to 10 l/m.
- tap aerator: mixes air with water when it exits the tap, giving the sensation of higher water pressure and flow.

When it comes to showers there are two options:

- shower aerators: similar to tap-aerators; and
- push-button showers: stop water flow after, for example, two minutes. The user then has to make a conscious decision whether to re-push the button.

Saving laundry water use

Laundry facilities are substantial consumers of water, heat, detergents, etc. plus wastewater generators.

Ensure machine is fully loaded. Many loads are started under-capacity. "Eco" machine cycle settings provide the same cleaning power as a normal cycle, but use less water and energy. A business can waste water from washing longer than necessary. As a rule-of-thumb, a business should aim for 3-5 per cent of items to need rewashing. Less than 3 per cent indicates over-washing. More than 5 per cent indicates inadequate washing.

Too much detergent increases costs and can require longer rinse cycles. Automatic detergent dosing is more accurate than manual. Low-temperature detergents can reduce energy, reduce colour run, retain better colour brightness and rinse more easily.

Reduce detergent use

Water softeners are recommended so that daily salt levels reduce detergent use, therefore less rinsing water required. In addition, they reduce scale build-up, which prolongs machine life and reduces leaks.

Catering facilities should seek non-effluent ways to dispose of food-waste, such as bins or a mesh basket over a sink. Solid-disposal is generally more economical and less environmentally damaging than effluent.

Good housekeeping, awareness and training can include:

- planning ahead e.g. defrosting frozen food naturally, rather than under flowing water;
- preventing bad habits such as leaving a tap running when rinsing. A large tap can have a flow of up to 40 l/min – going straight to drain;
- using a washing-up bowl or plug can reduce water waste by 50 per cent.
- washing fruit and vegetables in a bowl rather than under a running tap. Leftover water can be used to feed plants;
- never discarding molten fats to drain.

Fixes to taps and sinks could include:

- fitting spray heads and flow restrictors to reduce maximum flow;
- installing automatic shut-off taps or timers; and
- using trigger-operated sprays. The operator has to consciously keep a tap running.

In some facilities, waste food is scraped into channels with constantly flowing water:

- turn off when not-needed, either manually or using an infrared sensor; and
- avoid multiple disposal channels to give a more concentrated disposal stream.

The dishwasher offers opportunities for savings, too, including:

- waiting until fully loaded;
- avoiding pre-rinsing. Detergents are highly effective, simply scrape off any excess;
- optimise cycle times. Modern machines offer an 'economy' setting, which uses less water and energy than standard; and
- when replacing old units, consider water and energy efficient machinery. Look for A* rated units.

When it comes to grounds maintenance it is essential to plan ahead. Check that the soil actually needs watering and it's not just done routinely. Check the forecast. If it is likely to rain, switch off any automatic sprinkler or irrigation systems. If the rain fails to arrive, switch back on. Mulch exposed soil to retain moisture. This can reduce watering by up to 70 per cent.

Keep lawn grass length longer in dry months. Constant cutting increases a lawn's water demand. For sprinklers make use of "grey" water or collected rain-water, choose or retrofit a hose that has an automatic shut-off valve, and use sprinklers that operate low to the ground.

Finally, set the irrigation system to come-on first thing in the morning before the air temperature has risen.

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ENTRY FORM

WATER MANAGEMENT

Please mark your answers below by placing a cross in the box. Don't forget that some questions might have more than one correct answer. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet, return it to the address below. Photocopies are acceptable.

QUESTIONS

1. Product recovery using a 'pig' to recover materials from pipework offers:
- ☐ Less water and chemicals to clean
- ☐ More concentrated effluent loads
- ☐ Raw material and/or product recovery
- ☐ Reduced downtime

2. What would be a realistic medium-term water-saving target for a commercial organisation that has not paid a lot of attention to water for several years?
- ☐ 10-20 per cent
- ☐ 20-30 per cent
- ☐ 30-40 per cent
- ☐ >40 per cent

3. Which of these in NOT an efficient cleaning and rinsing technique?
- ☐ Counter-current rinsing
- ☐ Sump tank recirculation
- ☐ Use of scrapers or brushes
- ☐ Use of drain-covers

4. For ground maintenance, which one of these is good practice?
- ☐ Use "grey" waste-water or rain-water for irrigating
- ☐ Keep grass well-trimmed, especially during summer
- ☐ Ensure daily use of a sprinkler system in the morning
- ☐ Avoid mulch on flower-beds and other exposed soil

5. Which of these is recommended good-practice for water-efficiency in laundries?
- ☐ Running the machine on its quick-wash cycle
- ☐ Ensuring there is sufficient water-softener
- ☐ Set the wash-cycle to eliminate the need for re-washes
- ☐ Operate below the design capacity recommended by the supplier

6. How much water would a large tap, left on, discharge in a typical 8-hour shift?
- ☐ 5,000 litres
- ☐ 10,000 litres
- ☐ 15,000 litres
- ☐ 20,000 litres

7. Why should an organisation consider water-management?
- ☐ Offers direct and indirect water-related cost-savings
- ☐ Offers indirect savings to energy, raw-material consumption and waste
- ☐ Demonstrates environmental stewardship to clients, suppliers, staff and other stakeholders
- ☐ All of the above

8. Which of these statements is incorrect? Flushing cotton buds, wet-wipes and similar items down the toilet:
- ☐ Is no problem whatsoever
- ☐ Wastes clean water through unnecessary flushing
- ☐ Potentially causes blockages in the sewerage system
- ☐ Ends up as non-decomposable solid waste that can harm marine life

9. What is the ideal proportion of re-washes one should target for optimum laundry-washing?
- ☐ 0 per cent
- ☐ Less than 1 per cent
- ☐ 3-5 per cent
- ☐ 5-10 per cent

10. Which of these interventions is an enabling step rather than a water-saving step?
- ☐ Installing sub-meters and an M&T system
- ☐ Leak detection and repair
- ☐ Staff awareness and training
- ☐ PIR sensors in the male toilets.

Please complete your details below in block capitals

Name .... (Mr. Mrs, Ms) ....

Business ....

Business Address ....

....

.... Post Code ....

email address ....

Tel No. ....

Completed answers should be mailed to:

The Education Department, Energy in Buildings & Industry, P.O. Box 825, GUILDFORD, GU4 8WQ. Or scan and e-mail to editor@eibi.co.uk. All modules will then be supplied to the Energy Institute for marking

C P D **fundamentals**

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Energy in Buildings and Industry and the **Energy Institute** are delighted to have teamed up to bring you this **Continuing Professional Development** initiative.

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