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A South Australian business precinct tests new plumbing methods.

Cover image
Plumbing engineers, installers and building managers are responsible for drinking water quality to the tap. - page 8.

Reader notes:
Currency: All references are to US dollars unless otherwise stated.
Metric/Imperial: Metric measurements appear with imperial conversions. In circumstances where the same measurement is used more than once in the same article, only the first reference features an accompanying conversion. References to gallons are US values.
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TOUGH TIMES
BRING INNOVATION TO THE FORE

Like most WPR readers around the world, the recent jump in oil prices is having a direct effect upon my household expenditure and business. There appears little likelihood of oil dropping back to the ‘good old days’ when it was well under US$50 a barrel. And I get the distinct feeling the so-called experts and analysts have no real grasp of the situation anymore than we do, as we are navigating in uncharted waters. Add to that the many different market pressures, coupled with the manipulation by suppliers and traders and you have a very complicated situation.

How can we find a positive in all of this? I am a great believer that you need significant events to extract people from their comfort zones and propel them into action – and this current global predicament is certainly uncomfortable for most people.

Only a couple of years ago the discussion about oil was chiefly around how much was still in the ground and how many decades away we were from running dry. Today, this oil issue runs concurrent with climate change and the desire by most countries to retain their natural resources and not negatively impact on our environment more than is absolutely necessary. There has been a huge attitudinal shift with the general public over the past two years as well.

MOMENTUM IS GATHERING.

In this issue of WPR among the interesting range of stories, we have included an article on page 34 reviewing fuel cell energized water heater units, among other options. Heating domestic water units and other applications require significant amounts of energy and some of the work going on to reduce the impact of energy for water heating is quite exciting.

There is a Japanese company that claims it has developed a fuel cell that can power a car purely on water. The claim is that just one liter (0.26 gallons) of any kind of water will be enough to power the car up to speeds of 80kmh (49.6mph) for close to an hour.

Although I am sure there are many obstacles to overcome with such technology, imagine using this same principal in a hot water system that is actually powered by waste cold drain water drawn from the system!

Most people would like shares in that sort of innovation – hence I believe we are going to see huge amounts of equity and superannuation funds poured into energy alternative technology from now on.

If someone formulates the magic recipe they will have the investment world at their feet. We will keep a watching brief over such developments in coming editions of this magazine.
Above: Recently, while in Shanghai, China, publisher Jeff Patchell met Prof Siqing Xia from Tongji University, who explained the workings of his toilet to tap technology. See story page 18.

DRY-DRAINS DRAW INTEREST
The cover story from our last issue on the matter of dry-drains drew a lot of comment from around the world.
This is a major issue requiring leadership from regulators and suppliers who are caught up with this challenge.
WPR is delighted to announce that in conjunction with the World Plumbing Council, we will be hosting an international technical seminar on this subject at the next ISH Frankfurt in March 2009.
Already we have had positive responses from many leading experts in this field who are keen to be involved.
Full details will be available in the next issue of WPR as well as on our website – www.wpr.com.au

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WE WERE WRONG!
Due to a sub-editing error on page 54 of the March 2008 edition, industry consultant John Koeller was misquoted. The copy should have read (regarding reduced-flush toilet products) Koeller states that: “customer satisfaction with toilet fixtures has been outstanding and no drain line issues have been disclosed that were caused by these fixtures. Drain line issues with waterless urinals, however, are another story and much more investigation is needed to further isolate and resolve the solids build-up and clogging problems.”
We apologise to John and our readers for any confusion or embarrassment our oversight may have caused.

Jeff Patchell
Publisher
The European Drinking Water Ordinance safety requirement has been valid since 1998. The guideline also sets out the legal responsibility of all parties involved in construction and operation.

An important aspect is to ensure the selection of correct materials and combinations for pipes, connectors and fittings for a new installation in accordance with the water condition.

Operating conditions that favor the growth of micro-organisms in the system can permanently cause more severe health hazards than the usual migration of materials during the initial weeks and months after commissioning.

This is especially the case with large distribution networks in hospitals, sports amenities, old people’s homes, hotels or apartment blocks housing several families. Due to long pipe sections and irregular water use, the risk of bacterial growth is especially high. The effect is greater when occupants are patients and older people whose immune system is weakened.

In many regions, permanent chemical disinfection is standard procedure for protecting water from bacterial infection. This is crucial in warmer regions where stagnation temperatures of above 25°C (77°F) are often unavoidable.

However, improved drinking water quality and tangible savings on maintenance and operating costs are available. This temperature guideline can be dispensed with if water quality at point of entry to the building – and specific rules for planning, construction and commissioning of the plant – are taken into consideration.

Tried and tested measures are presented here in a brief overview.

The danger of bacterial infection of the entire system is particularly high at constant temperatures between ~30°C and 50°C (~86°F and 122°F) if:

- Drinking water is stagnant for a long time in a pipe network and cold water is heated, for example, by adjacent heating pipework;
- Wastewater is fed into the pipe network due to a system fault, such as backflow.

For instance, Legionella pneumophila can cause legionnaire’s disease if steam is inhaled when showering.

Taking regular samples from the pipe system – especially fittings that are rarely used – is the only way to determine whether the distribution network is largely free of germs.

Chemical or thermal disinfection is a short-term solution for specific numbers of colonies, but generally the problem will be permanently treated only if the causes are identified and eradicated.

Future risks can be substantially reduced at the planning stage of a drinking water plant. By using needs-based pipework dimensions...
rather than reserves based, the required water exchange is favorably regulated in the piping network.

Exact manufacturer information should be incorporated in the calculation instead of standard values for individual resistance of press-connectors, valves or equipment.

Results for large-scale pipe networks often differ so substantially that total pipe widths can be one or two sizes smaller than calculated using recommended values. Therefore, the entire water volume in the system is continually replaced quicker and the average cold-water temperature in the system is substantially reduced.

Microbial growth is thus reduced naturally.

Furthermore, regular water replacement in all parts of the plant is guaranteed if the consumer is involved in defining regular use - for example, hydraulically planning the WC tank at the end of a distribution pipe.

For the same reason, tapping points that are rarely used should be integrated into a series of closed circular piping system. Branch lines should be exempt from this and should never contain more than 1L (2.1 US pints) of water.

In addition, hygiene-conscious planning of a drinking water network primarily includes safeguarding the cold-water pipe from heating. The danger mainly exists in shafts or lowered ceilings that are fitted with other pipework for reasons of space and cost.

Legionella multiply especially well between 30°C and 50°C (86°F and 122°F), so cold-water pipes should be as far as possible from heat sources and should be securely insulated.

For warm water, it is important to differentiate between circulating distribution pipes in the cellar and riser pipe area and the consumption pipes without circulation that are usual in a single story.

Circulating systems have to be hydraulically equalized so that constant temperatures, for instance, 55°C to 60°C (131°F to 140°F) can be guaranteed in all sections. But even this temperature level probably does not match the goals of energy saving and CO₂ reduction.

Corresponding settings can be fixed at thermostatic regulating valves installed in each case at the return end of every branch line.

Distribution pipes on different floors are generally laid in the floor or walls. Due to construction conditions there is rarely any space for substantial insulation layers, such as for circulating systems in shafts or sloping ceilings.

Therefore, overall, the distribution network is to be planned so that these pipes contain only minimal water.

Short pipe lengths up to the circulating riser pipes and minimal cross-sections, will increase user comfort (hot water should reach the tap within 10 seconds) and will accelerate cooling of the water through the critical temperature range after shutting off the tap.

To install these plans, subject to...
construction conditions and a hygiene-conscious method, the use of aligned components is vital – such as pipes, press fittings and shut-off fittings.

Press connectors and fittings with a press connection that is certified as safe make it possible to dispense with welded and threaded connections. Some of the many advantages are:

- No solder and welding flux in the pipes – no hygiene problems, no heat treatment with copper pipes – no corrosion;
- ‘Forgotten’ press connections are guaranteed to be noted during a leakage test. Major time saving compared with welding – many secondary tasks and maintenance time dispensed with;
- Threaded connections can be dispensed with, particularly if concealed in the building structure, facilitating a dry leakage test, which is proven to protect the system better from microbacterial contamination, especially during the period up to commissioning.

Large distribution networks in buildings should not be tested for leakage with water, but preferably with oil-free pressurized air or inert gas. The rationale: due to resulting construction work, these plants are often commissioned for regular operation only after several months.

In the case of ‘wet’ leakage testing, the system may be contaminated due to the testing water or microbacterial growth during stagnation of a system that has never been fully emptied—particularly in the case of ambient temperatures of >25°C (>77°F) during the construction phase.

- Water remains standing in horizontal stretches of pipes, and bacteria may multiply. If the leakage test must be carried out using water it is important to test the building connection point. This should in all circumstances be flushed out with the appropriate water volume and water flow before connection to the supply network or installation of the water counter.

Depending on the length of pipework and stagnation period – often months or years – microbiotic testing is recommended in order to rule out any contamination of the building network via this route. Until that point, the building will be hygienically safeguarded.

In new residential blocks or larger-scale construction projects, closed-circuit pipes or branch lines may have insufficient throughput of water during the construction phase, so the necessary water exchange is not guaranteed.

For ‘dry leakage testing’ with oil-free pressurized air or inert gas, the leakage test is to be carried out using 110mbar (230lb/ft²) of pressure; load pressure with a maximum inspection pressure of 3bar (6,265lb/ft²) to DN50 or 1bar (2,088lb/ft²) for greater pipe diameters. If connections other than press fittings with welded, clamped or threaded connections a visual check is recommended to ensure their integrity, as well as a central leakage test.

The planning, construction and commissioning of a drinking water installation...
are only three of the important foundations for a trouble-free network.

Hygiene-conscious operation is just as important. This includes transferring the drinking water system (including all documents such as leakage test protocol, etc) to the operator, as well as information and instruction on which measures are needed for maintaining drinking water quality.

The information and instruction should be provided in case no specialist staff members are exclusively available to maintain the plant.

This maintenance involves, for example, regular filter maintenance in accordance with defined intervals, inspection of circulation temperatures, investigation of suspect cases of microbial contamination and testing relevant individual pipe sections or fittings.

For buildings that are not regularly used to the planned extent (eg: sports halls with shower rooms) or for which irregular use is expected (eg: large hotels) in addition to these measures, a flushing plan for regular water exchange should be included for little-used tapping points. Details should be confirmed with the local hygiene specialist.

**OVERVIEW OF HYGIENE-CONSCIOUS PLANNING AND COMPLETION**

- Material selection in compliance, for example, with EN 12502;
- Use of certified (approved) products;
- Determination of minimum water volume – use pressure potential, accounting for actual values (manufacturer details) for real top volume flow for individual resistances of fittings, equipment, etc;
- Plan the maximum distance between drinking water (cold) pipes and heat sources;
- Provide sufficient insulation for drinking water (hot and cold) pipes in ducts and lowered ceilings;
- Do not install appliances for the secondary treatment of (cold) drinking water in rooms with a temperature of >25°C (eg: boiler rooms);
- Set temperature should be determined in the drinking water heater and manifold;
- Ensure hydraulic equalization in warm water circulation with permanent temperatures >55°C in any part of the piping system;
- Plan test extraction valves in public buildings;
- Choose singular locking for backflow prevention – guidelines such as acc. EN 1717 recommended;
- If possible, do not fit a membrane expansion container in DW systems – or use hygienic approved systems only;
- Measures to minimize stagnation – eg: bypass and drainage pipes, do not factor in reserves;
- Separate any unused lengths from existing systems;
- Separate fire extinguisher piping systems from drinking water systems;
- Dry leakage test recommended.
- For all measures of planning, construction and commissioning of drinking water piping systems, avoid long periods of stagnation in combination with continuous temperatures between 25°C and 55°C (77°F and 131°F).
It is no longer the sole domain of water utilities to manage the growing crisis of dwindling water supply. Manufacturers, plumbers, governments, media, academia, environmentalists, builders and consumers must all work together to bring about real reductions in water use. To do so requires collaboration.

Until now, there has been no mechanism for co-ordinating water stakeholders in North America. But that has changed with a new non-governmental organization created for the sole purpose of advocating water efficiency.

Formed in 2007, the Alliance for Water Efficiency (AWE) based in Chicago, Illinois, represents the interests of all parties with a stake in long-term, successful water conservation and provides a vehicle for bringing them together along with technologies and programs. Its efforts are important in a number of ways.

- Financial. In the United States alone, the Environmental Protection Agency projects that more than $US650 billion is needed in water supply infrastructure improvements between now and 2019. If water conservation can eliminate or delay the need for only 1% of that infrastructure the savings are immense – $US6.5 billion.
- Environmental. Rivers and estuaries are suffering from reduced freshwater flows – water that is needed to sustain fisheries and other aquatic life. Water shortages affect environmental flows, and increased withdrawals of water for urban needs are further affecting sensitive ecosystems. Even in a water-rich region such as the Great Lakes, conservation is becoming necessary.
• Energy. Supplying, treating and distributing water is an energy-intensive activity. Thus, water efficiency means energy efficiency. Every drop of water saved reduces the need for treatment, pumping and wastewater disposal, resulting in kilowatt-hours saved. Every drop of water not heated or pumped saves fuel, resulting in therms saved. Thus, water efficiency reduces greenhouse gas emissions from those energy sources.

AWE’s mission is to promote the efficient and sustainable use of water. To further that mission, it has initiated seven ambitious tasks for supporting and enhancing water conservation efforts, providing benefits to water utilities, water conservation professionals, planners, regulators, industry and consumers:

1. **Stand as a clear and authoritative national voice for water efficiency.** The Alliance intends to be a forceful advocate for the sustainable use and stewardship of our precious water resources.

2. **Provide comprehensive information on water efficient products, practices and programs—what works and what doesn’t.** AWE is creating and maintaining a web-based water conservation clearing house that offers product information, best-practice specifications, research reports, training materials, program descriptions, codes and Standards, program evaluation tools, drought planning and response and professional expertise. It will be the single most comprehensive source of water efficiency information in North America.

3. **Represent the interest of water efficiency in the development of plumbing codes and Standards.** Codes and Standards that mandate water efficiency have achieved substantial water-use savings. AWE will provide knowledgeable representation in Standards writing and advocacy.

4. **Transform the market for fixtures and appliances.** Consumers want to do the right thing, and water efficiency should be an easy choice. AWE will help ensure that efficient products are available, tested and clearly labeled.

5. **Co-ordinate with green building initiatives to institutionalize water efficiency.** New green building programs are working to integrate water conservation into other efficiency practices. AWE will co-ordinate these efforts to ensure that water savings are part of the overall effort.

6. **Train water conservation professionals.** Water efficiency is a diverse field drawing on a broad range of disciplines. AWE will develop core curriculum and technical training materials, and it will work with colleges and universities, trade organizations and other educational entities to support the development of a professional water conservation workforce.

7. **Educate water users.** Good consumer education is a key to the long-term success of water conservation efforts. AWE will provide up-to-date information on water-efficient products, practices and behavior for the general public.

Among AWE’s most important efforts is the researching and promoting of higher efficiency in plumbing products and water-using appliances. Efficient products automatically save water, irrespective of the consumer’s habits. This is therefore a cost-effective strategy for widespread reductions in water use.

To achieve these consistent product efficiencies, AWE sends a representative to all plumbing codes and Standards meetings in the US. These representatives advocate for changes in the codes and Standards where there are barriers to water-efficient technology. They work side by side with codes and Standards committees to bring about changes important to water efficiency programs. Numerous changes have already been negotiated.

The big issue in the US is whether to change the federal Standard for toilets. AWE and its partners are examining whether the US Standard of 6L (1.6 gallons) for toilet flushing should be reduced to 4.8L (1.3 gallons), as has been enacted in the State of California. Changing the US Standard will require much co-ordination and dialogue with plumbing manufacturers.

AWE is also involved in promoting water efficiency in US green building programs. The US Green Building Council has revolutionized construction in North America with its Leadership for Energy and Environmental Design (LEED) certification programs. Although water efficiency is a requirement for LEED certification, it is only a minor consideration in the points system. AWE is working to increase the profile of water efficiency, as LEED undergoes a big revision in 2009.

Another important Alliance effort is to promote the new water label issued by the EPA. WaterSense is a product label for water-using fixtures and appliances, analogous to the Energy Star label for energy-using products.

The program was launched by EPA in June 2006, and high-efficiency toilets and faucets have been labeled.

There are two requirements for the label:

• A 20% reduction in water use compared with the legal Standard;

• Third-party certification as to performance of the product.

Consumer satisfaction is a big part of the program goals. With WaterSense, conservation can now move towards center stage in the consumer’s consciousness. If consumers are convinced and purchase these high-efficiency products, EPA estimates savings by 2015 of 3.8 billion liters (a billion gallons) per day compared with today’s levels.

AWE is rapidly becoming the single-point authoritative voice on water-efficient products, practices and programs. When completed, its website will provide a single stop for best practice, product specifications, research reports, training materials, evaluation tools and any other tools that water conservation professionals might need.

A network of water industry professionals will provide an important forum for discussion of this rapidly evolving world of water efficiency. Membership is encouraged and the information for joining is available on the website www.allianceforwaterefficiency.org.

**Mary Ann Dickinson is pushing for a united front in water management.**

**Author Mary Ann Dickinson is director AWE**
The oldest zoo in Australia, the Royal Melbourne Zoological Gardens, which opened in 1862, has implemented a long-term modernization program that includes radically redesigned plumbing infrastructure at its site in Parkville, Victoria.

As a result, several animal enclosures have been rebuilt, along with enhancements to the landscape and botanical setting, in an effort to curb the site’s water use.

In the early 1990s, Melbourne Zoo used more than 1,000kL (264,000 gallons) of potable water each day, averaging 570,000kL (150,578,000 gallons) a year.

This prompted the introduction of a series of water-saving initiatives, including the placement of recirculating pumps and filters in ponds, decommissioning old leaking pools, installing modern irrigation systems, fitting toilets with dual-flush cisterns and building a multi-million dollar water recycling center.

Designed by Peter Elliott Architecture + Urban Design, the center accommodates a water recycling plant that meets the demands of a drought-stricken environment subject to tough water restrictions.

The plant captures and treats wastewater from rainfall and zoological operations then...
In the early 1990s the Melbourne Zoo used more than 1,000kL of potable water each day, averaging 570,000kL a year. The installation of a new water recycling plant has more than halved the zoo's average daily water use.

Pumps recycled water around the zoo through 4km (2.5 miles) of piping infrastructure. Since it was commissioned in May 2005, the plant has produced 50,000kL (13,208,000 gallons) of Class A water for reuse throughout the zoo.

“The water recycling project was implemented to resolve a long-term wastewater discharge problem as well as improve water conservation practices,” says Elliott, principal design architect on the project which began in July 2004 and ended in June 2006.

The total project value was $US3.25 million, with $US280,000 spent on the building component alone.

“The zoo resolved in consultation with the Environmental Protection Agency, Melbourne Water and the City of Melbourne to recycle and reuse stormwater via an on-site water recycling plant. The new plant exemplifies the zoo’s commitment to sustainable practices and the environment.”

The entire stormwater drainage system, including animal wash-down areas, converges at one point of discharge at the northern end of the site. A diversion weir has been constructed at that point with a baffle that diverts the run-off (together with first-flush
1. “The interior of the building is packed with equipment connected by a three-dimensional maze of color-coded pipe work,” says principal design architect Peter Elliott. Since its completion the plant has produced almost one-third of the zoo’s daily water demand.

2. The harvested water is recycled through a sophisticated reverse osmosis process. As part of a water management program the recycled water is then distributed throughout the zoo for ponds, animal hose-down areas and landscape irrigation.

The water recycling plant has been designed to be experienced as a working exhibit,” Elliott says. The building is a compact 129ft² (12m²) translucent cube set in an open landscape accessed via a public viewing platform. Placing the large water storage tanks underground has reduced the impact of the plant since it is buried into the landform with grassed roofs.

“The interior of the building is packed with equipment connected by a three-dimensional maze of color-coded pipework. A large picture window allows visitors to view the operation of the plant, which forms part of the interpretive display. At night the building glows like a shimmering lantern, revealing the skeletal silhouette of the working interior.”

Elliott says this is a modest building with particular functions, driven by engineering requirements.

“The task was to create interesting architecture from limited means to house and show the working of the plant. The architecture came after the engineering, as the specific footprint and volume of the building were already established by the design of the plant.

“The concept for the building was to create a light-filled box sitting on a robust base made from systemized steel and acrylic components. Color and light has been used to enliven and heighten various components of the building.”

The recycled water is used for exhibit cleaning, some pool filling, and lawn and landscape irrigation. The plant nursery also uses recycled water for all irrigation.

From January to September 2007 the plant produced 28,000kL (7,340,000 gallons) of recycled water, which equates to 110kL (29,000 gallons) a day, or almost one-third of the zoo’s daily water demand for this period.

As a result of the upgrade, the zoo’s average daily water use has more than halved, with only 380kL (100,000 gallons) of potable water being used each day in 2007. ☮
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Tongji University in Shanghai is one of China’s premier engineering campuses. Its College of Environmental Science and Engineering educates tomorrow’s environmental engineers from around China, as well as teaching English-based studies to visiting international students, particularly from a variety of African countries. The University also hosts the Tongji-German Institute, a joint initiative of the Chinese and German governments to facilitate cultural exchange and cooperative initiatives between academics from the two countries.

With its large number of students (approximately 15,000), the university’s own facilities provide an excellent opportunity to develop and test new technologies in a controlled situation. Prof Siqing Xia, Vice Dean of the College of Environmental Science and Engineering, leads a number of project teams at the campus who are aiming to solve some of China’s growing and acute water problems.

China’s population now exceeds 1.3 billion people and there are 175 cities housing over a million people each, so the need for decentralized solutions to water and infrastructure pressures is only going to grow. If engineering solutions can be found to reuse grey and black water rather than lose it to drainage, there is a great opportunity to reduce the consumption of primary potable water. The problem is an overwhelmingly negative public response to the idea of direct potable reuse (also dubbed ‘toilet-to-tap’ technology or water reclamation) which greets this sort of solution – both in China and elsewhere around the globe.

Prof Xia predicts that 2010 will be the year China embraces ‘toilet-to-tap’ water treatment technology. He plans to conduct another demonstration for the Shanghai World Expo in that year, and expects more interest and acceptance of the technology by then. In the meantime, he strives to educate the public about the technology’s benefits through an important demonstration project at the university.

Prof Xia has created a small scale toilet-to-tap treatment plant on the Tongji University campus. The plant turns wastewater from the College of Environmental Science and Engineering’s laboratory into pure potable water. This water is used for a number of purposes around the campus, including scientific procedures and irrigation of the surrounding landscape.

The professor says the water is so clean it can be used for carbon-chip washing or kidney dialysis, but the so-called ‘yuck factor’ means students and the general public are reluctant...
Toilet to tap treatment plant water is used for a number of purposes around the campus, including scientific procedures and irrigation of the surrounding landscape.
Testing at the University funnels waste water from laboratory building toilets and rainwater collected in tanks on campus into a membrane bioreactor.

To try it, and the water from the Tongji project does not end up in drinking glasses, despite its purity. Direct consumption of water that has been through the sewerage system is frowned upon, and the issue is not confined to China; it is a universal problem which has water companies and governments looking to share experiences in turning public opinion around.

But Prof Xia is optimistic that by 2010 toilet-to-tap technology will be widely accepted and the interest in direct potable reuse technologies will propel this technology forward.

“People might be reluctant to drink reclaimed water at the moment, but as the market matures, the technology will gain public acceptance,” says Prof Xia. “It is important to ensure that people are aware of how safe and pure the water is once it has been treated.”

Testing at the university funnels wastewater from laboratory building toilets and rainwater collected in tanks on campus into a membrane bioreactor, which uses membrane technology and traditional biological treatment with bacteria to remove nutrients. Pollen, colloids, silt, bacteria, protozoa cysts and large viruses are then filtered out by the membrane component.

Much of the water dispensed from the membrane bioreactor is then disinfected and reused as greywater in the lab-building toilets or for landscaping. The remaining water is treated with reverse osmosis and ion exchange, resulting in pure water that exceeds government drinking standards.

Prof Xia says that the methods he uses are cheap compared to other water extraction processes, and he can set up a 10,000L per day plant for less than US$14,000 – incredibly cost-effective compared to other methods such as desalination. With water supplies dwindling in China and many other countries, it’s only a matter of time.

In addition to his investigations into water-saving technology, Prof Xia has over the last two years been conducting a project which seeks to reserve not only the water but energy expended during shower usage. In this endeavour he is fortunate to have access to the university’s large and active sporting population and the centralized bathing facility servicing these students. Each day approximately 3,000-5,000 students shower at the facility, producing significant volumes of both waste water and heat.

The water from the showers is reclaimed and used for irrigation of the surrounding university gardens and as ‘scenic’ streams and water features around the campus.

One of the innovations of Prof Xia’s trial has been to conserve energy as well as water. The shower facility project allows heat, captured directly from the shower water, to be recycled. Copper coiled pipes are placed inside the wastewater tank collecting the used shower water. Tap water then flows through the coils to capture the retained heat from the water.

The total area of the copper coiled pipes is approximately 6m² (19ft²). The temperature of the wastewater filling the tank is usually around 30°C (86°F). Once the tap water has flowed through the copper pipes its temperature is increased to between 4 (39.2°F) and 11°C (57.8°F). The retained heat increases the heat of about 70 tons of tap water by about 8°C (46.4°F) per day, which reduces the energy required to heat shower water to the temperature needed for showering.

In effect, the captured heat supplements the heating process for the fresh tap water. This is equivalent to 20-28kg (45-61lbs) of gasoline per day, meaning that the method allows 7 tons of gasoline to be saved every year – an impressive reduction in greenhouse gas emission and energy input.

“We are trying to find ways to improve both energy and water efficiency, both of which will become very important for China, and the world, in the future,” says Prof Xia.
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Sweden is the urine-separation capital of the Western world – it is leading global research into using urine-generated phosphorus for sustainability projects such as soil fertilisation.

Recycling urine could be the answer to the looming worldwide shortage of phosphorous. In fact, urine is the most concentrated source of phosphorous (about 70%) and of nitrogen in blackwater (90%).

So it makes sense to harvest and use it for environmental projects.

The stigma attached to using human waste in a treatment process is what stands against progress, but studies being conducted in Sweden, Africa, the Netherlands and now Australia are paving the way for better understanding and greater accountability.

Technology that allows urine to be separated has been used in Sweden since the 1980s. The village of Tannum in the south-west requires all new homes to be plumbed with urine-separating toilets.

These toilets assume the guise of your average, everyday flusher, but they direct urine down a second set of pipes to a holding tank, which is emptied at regular intervals by farmers who use the urine as fertiliser.

Tests continue to be carried out in Sweden. Initial problems with urine-separating toilets included stoppages in the U-bend. The function of these toilets was studied in two questionnaires, one in 1997 covering 96 households and a follow-up in 1999 covering 73.

Stoppages in the U-bend were found to be a big problem, and users did not know how to clear them.

Studies found that 76% of stoppages largely consisted of precipitation – mainly calcium and magnesium ammonium phosphates – forming on hairs and fibres. These stoppages could be cleared easily with a mechanical snake or caustic soda.

The remaining 24% of stoppages consisted of pipe wall precipitation, which could also be cleared with caustic soda. The following recommendations were derived from the studies:

- Flow from the urine bowl should not be hindered by anything (hair, fibres, etc);
- A mechanical snake can be used to clear the urine U-bend;
- Men should be able to stand up to urinate, otherwise their participation will drop;
- The flush should use little water;
- The toilet should contain no corrodioble metal in contact with the urine mixture.

In terms of pipes, the following recommendations were made:

- Installations must be watertight (pipes should be welded or similar);
- Horizontal pipes should have a slope of at least 1% and a diameter greater than 7mm (preferably 110mm), because sludge continuously precipitates from the urine mixture;
- The system should not be ventilated – if correctly constructed, the total ammonia emission stemming from collection,
transport and storage will be less than 1%;
• The tanks should be filled from the bottom and have the main hose close to the incoming pipe.
(These recommendations are also being used for the Australian EcoVillage project to be discussed.)

Flash forward to 2005 and the studies continue unabated.
One project in Denmark demonstrates a potential for developing urine-separating toilets, and from an agricultural point of view the separated urine is comparable to liquid manure.
The project at Svanholm Gods, an organic farming collective, tested residents’ urine for nutrients, pharmaceutical residue, and natural and artificial female sex hormones, to determine agricultural and environmental suitability.
Svanholm Gods is Denmark’s largest producer of organic vegetables and has more than 100 residents.
Two urine-separating toilets were installed and urine was collected in a tank of 10,000L.
The project aimed at determining whether the urine could be collected, stored and used in a way that allows its risk-free use in agriculture.
• The conclusions of this study were that:
  • Urine-separating toilets can be used without any problems in a community that widely supports the environmental project;
  • There is potential for developing urine-separating toilets with lower water consumption;
  • From an agricultural standpoint, urine is comparable to liquid manure;
  • There must be no cleaning agents or plastics that might release organic, xenobiotic substances into the urine.
The main point is that urine-separating toilets can work in communities that support the project; the technique is thought to be impractical for suburban households.
However, schools, office blocks and buildings, airports and shopping malls could consider it.

In Australia various types of waterless urinals have become fashionable, but studies into separating units are in their infancy.
One such study is being undertaken in Currumbin, Queensland, at a 144-lot development called The EcoVillage, which has a core philosophy of sustainable living.
The dwellings have high thermal efficiency, self-sufficiency in potable water from a rainwater tank and part sufficiency in energy from solar hot water and grid connected photovoltaics.
Sales and marketing manager Kerry Shepherd says Currumbin Valley was chosen for its good rain catchment so that the community would be self-sufficient in water.
“It has lived up to its reputation – and our desires – by providing much rain," Kerry says.

Ted Gardner of DNRW was the brains behind the project and had been sitting on the idea for five years until a series of fortuitous events gave the green light to the EcoVillage experiment.
Between Ted and project scientist Dr. Cara Beal, extensive negotiations were conducted with the developer, residents and Gold Coast City Council.

Of the 144 homes, 108 are on a localised sewerage and water reuse supply system. DNRW got agreement from 20 of them to try out the urine-separating toilets. Three are operational and five are ready to go. Urine from the households will be collected from the UST into

At the EcoVillage, all toilets flush with recycled water, which is just one of the sustainable alternatives used.
an individual 300 to 500L flexible polyethylene bladder tank using a combination of stainless steel pipe and plastic hosing. The bladder will be emptied monthly by a vacuum pump-out truck and transferred to a 23,000L polyethylene rainwater tank. During stage one, urine will be trucked offsite to a local sewage treatment plant. The previous outcomes of the Swedish study (mentioned above) will be considered in the design and collection of the urine.

“One toilet has been operating for four months and it has been trouble free,” Ted says. “There has been no odour, and we chose the models that allowed men to stand up.” (Most early models meant men had to sit down to urinate.)

“In the Swedish trials it was found that non-watertight pipes emitted serious odours, so we negated the problem of odour.

“If there has been any problem, it is to do with economy of scale. It costs a lot of money for each polyethylene bladder to be pumped out by the tanker,” says Ted. “Polyethylene, of which the bladders are made because of a PVC free policy of the Ecovillage, is also rather costly.”

(There is the perennial discussion about the effect on drainage systems due to reduced flow, but this is being monitored in New South Wales by Sydney Water.)

Yet, if the benefits Ted speaks about come to pass, then the result will far outweigh the outlay.

Kerry says there have been no problems at Currumbin Valley and residents are happy with the progress.

“We are self-sufficient in water anyway, and all toilets flush with recycled water. When approached to help out with the urine-separating program, Ecovillagers saw it as another step towards sustainability.”

The most important objectives from a plumbing perspective are quantifying the water savings and nutrient recovery per person achieved by UST, and how urine separation and reuse can be an acceptable and sustainable alternative to wastewater treatment.

The results will form the basis for future trials of urine-separating toilets. When this current trial is over, DNRW will cover the cost for anyone who wants a standard toilet reinstated.

Ted says regular home use is still some time away. However as discussion and recognition of global warming and carbon footprints continues to grow, and the joker factor in using recycled urine for fertilising crops is overcome, Australia could catch Europe in this advanced form of thinking.

“Discussion about the next stage of sustainable cities is focused on transport and food,” Ted says.

“So if I was to prognosticate, Australia will see more of this type of technology and thinking in the next decade. And if we can manage the reticulation network and solve blockage problems, we could introduce this into the normal suburban homes.”

The main problem is the infrastructure.

“We have yet to demonstrate the reliability of the long pipe runs we would need,” says Ted. However, considering the nutrients in urine could grow sufficient wheat to produce one loaf of bread a day per person, infrastructure changes and challenges may well be worth considering. In the meantime the first intake of urine from the EcoVillage will make its way into the first of three 23kL tanks, where pathogen die off will be tested over a six month period. Then it’s off to the local paddocks to determine the farming benefits of fertilising with urine.

This is good news for the EcoVillagers, whose goal is to educate society on the benefits of sustainable living.

“Residents here in the Ecovillage are open-minded to new and innovative things,” Kerry says. “They are contributing to the take-up of new technologies across the board. They are also using lots of tried and tested methods that have been left behind or forgotten for no real reason – ideas that should never have been lost.

“It seems that a crisis has to hit before change can be effected. Also, the marketing of an idea plays a large part in its acceptance by the wider society.”

There is much happening in urine-separating toilet research but it will be a while before the technology is available to the wider community.

CONTACTS

EcoVillage
www.ecovillage.com.au

Queensland Department of Natural Resources and Water
www.nrw.qld.gov.au
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Sanitation has always been a high priority in Japanese society, but what challenges face the nation’s sanitation sector now and into the future?

Water is the basis of all life and a resource indispensable not only for the maintenance of human life and health but also for the conservation of the ecosystem and all economic activities, such were the thoughts of Japanese Minister for Foreign Affairs Masahiko Koumura when speaking at the Water and Sanitation Symposium in Tokyo in February this year.

The symposium was titled The International Year of Sanitation – A Platform for Action in Africa and Asia.

“In the 21st century, water has become even more important than it was in the past due to urbanization and rapid population growth taking place in developing countries, combined with the effects of climate change,” Koumura said.

“There is only about 200 tonnes of water available to each person on earth. Available fresh water will last only for three years supporting global requirements for water calculated at the average use by a Japanese household.

“Although we may be using water every day without much thought, we need to recognize that it is indeed a very scarce resource.

“Although we Japanese do not suffer from a shortage of drinking water or sanitation facilities, about 1.1 billion people around the world – one-fifth of all those who are living in developing countries – lack access to safe drinking water.

“About 2.6 billion people, almost half the total population of developing countries, still do not have access to basic sanitation facilities.

“By its nature, water is a resource that is not readily available when or where it is needed. At the same time, water is essential for sanitation facilities such as toilets, which are indispensable for our daily lives."

Japan’s lead on the international sanitation front is not surprising when you consider the role of water and cleanliness in the nation’s history.

For the Japanese, water represents purity. Before entering a Shinto shrine in Japan, worshippers pour water over their hands, representing purification of body and soul. Bathing is a popular pastime, and water rituals are prominent in the culture. In Japan, rainfall is high and water is abundant.

“Serving as Foreign Minister, I often travel overseas,” Koumura said.

“And every time I come home from those visits, I am struck by how rich Japan is in terms of its water resources. With this wealth of water, as well as our geographic and climatic
As a sign of purity, worshippers pour water over their hands before entering a Shinto shrine. The role of water in Japanese culture goes a long way towards explaining the nation’s strong focus on sanitation.
conditions, we have traditionally accumulated considerable expertise and developed technologies that were useful in the field of water and sanitation."

For example, in the 1850s, Japan and Europe had the same life expectancy, despite the fact that industrialization had taken hold in the West, resulting in improved access to technology.

Japan’s life expectancy can be attributed to superior sanitary practices, says Susan B. Hanley in her book *Urban Sanitation in Pre-industrial Japan*.

The Edo period, from 1603 to 1868, marks the governance of the Edo – known as the beginning of the modern period in Japan.

As early as 1700, the population of one million was served by a network of wooden pipes that supplied clean water. In the mid-1600s Japanese bureaucrats began passing regulations regarding waste disposal, and toilets along the banks of rivers – from which water was sourced – were removed.

By comparison, Western city dwellers rarely cleaned pits and cesspools, and human excrement was collected. In the mid-1800s, the English university town of Cambridge had almost 3,000 uncovered cesspits and London sewage was flushed into the River Thames, from which much of the city’s water supply was taken.

Japan’s historical concern with cleanliness goes some way towards explaining why the nation now leads the world in many areas of sanitation.

Today the Society of Heating, Air Conditioning and Sanitary Engineers has more than 20,000 members.

At the commercial end of this culture of sanitation are plumbing fixture market leaders Toto and Inax, responsible for the space-ship like toilet seats prominent throughout Japan.

Dr Noriyoshi Ichikawa is a professor in the department of architecture, graduate school of environmental sciences at Tokyo Metropolitan University. He says high-tech low-flush toilets are prominent across the country.

“Low-flush toilets are popular in Japan, and there are also some non-flush, vacuum variety toilets, but these can cause problems of their own. Vacuum and pressure systems represent a very small market in Japan.”

Graywater and rainwater utilization are also strong trends, according to Nishihara Engineering research and development manager Kazuyoshi Aoki. He says climate change is permeating the national psyche.

“Under-pit tanks are popular in public buildings, and some private homes have small yard tanks. All of this is more popular in city areas, rather than country areas. This is particularly so in the larger cities of Tokyo and Osaka.”

Ichikawa says there are also a number of challenges regarding backflow, water quality and piping materials, and plastic and stainless steel are the key to avoiding corrosion.

“In all areas of sanitation at the public level, facilities are very good, but at the private level they still need improving.”

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Design and functionality are the key drivers behind any new product, particularly in an age of high consumer expectation. It is therefore imperative for any company whose product is based on design to continue to pursue the ongoing challenge of matching function with a pleasing aesthetic to meet buyer demand.

Kohler has been at the forefront of design for many years. This is what attracted Kohler Kitchen Faucets senior product manager, Les Petch to the company. Les, in collaboration with senior industrial designer Niels Eilmus, has overseen the manufacture of the new Karbon range for which considerable testing was done on new technologies as well as consumer demand.

“The key driver for a lot of kitchen faucets is based on consumer research, in particular we look at how consumers use the kitchen," says Petch. “One of the interesting areas we discovered was that while people appreciated the functionality of pullout faucets, they would enjoy the same flexibility as the pullout, while having both hands free.”

This means that the user can position the faucet and leave the sprayhead where it’s needed, thereby freeing up both hands for kitchen prep and clean-up tasks.

The original design impetus of the Karbon faucet was inspired by lighting and construction equipment with articulating joints. The past, faucet tubes tended to be inflexible or move only in a series of basic pre-determined directions. The Karbon range is made up of a series of flexible tubes that can be manipulated in any manner of kitchen-functional positions that meet household demands.

Research was undertaken to find out where joints separated in previous lines and where the weight was light enough to offer little resistance to the joint. As most faucets are made with brass tubing that requires strong resistance and therefore compromises practical use, Kohler had to look at a different compound to meet their functionality requirements.

This experimentation led them to carbon fibre, a strong, yet lightweight and flexible material that allows for an aesthetically pleasing look.

The actual construction of the faucet is a combination of traditional brass and innovative carbon fibre composite tubing. The logic behind the use of carbon fibre lies in its superior strength and light weight, allowing for tight movement tolerance and exceptional performance. The joints connecting the four sections of the faucet employ a novel patented technology that provides exceptional resistance to support the spout while allowing for smooth and effortless handling.

So after 18 months of research and development – and over 12 different prototypes -- a series of parameters was established including: ensuring movement around the sink and modelling the movement.
in 3D and developing functionality around sink-based activities such as scrubbing a pan or filling a pot.

“The key was to differentiate ourselves and evaluate against the test program, appraising what we had with consumers through a series of in-depth trials,” says Petch, who goes on to say that the kitchen is full of experiential events and to provide that experience requires strong, unique and pleasing design.

The R&D team at Kohler worked through the design component by component, investigating how various joints operated and what materials worked best.

Yet, as Petch points out, technology is only one aspect of success in kitchen design.

“One of the great advantages is consistent and close attention to what the consumer is looking for; this is only one product but it is advancement consumers want and new technology is a measurement of that.”

Design and technology is in a constant state of change. It has seen the faucet morph from a static, plain tap to something that reflects fluid, streamlined movement.

The Karbon faucet is unique, and although it won’t suit every application, it leads the world in design trends and functionality. It relies on flexible connections and installation rings and installers will want to take note that the joystick valve requires non-standard holes of two inches in diameter.

“Form really does follow function, in this case,” says Petch. “But that doesn’t take away from the fact that the Karbon faucet is an outstanding piece of modern industrial design.”

Niels Eilmus and Les Petch are responsible for the design and engineering of the Karbon faucet.
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In the 1950s and 1960s, the use of fuel cells was largely confined to the National Aeronautics and Space Administration (NASA) in the United States.

Interest in fuel cells as a viable alternative to electricity generation and hot water started to evolve during the oil shortages of the 1980s, coinciding with the push for environmentally friendly electrical production.

A fuel cell is similar to a battery in that it provides continuous DC electricity from a chemical reaction. Again, similar to a battery, a fuel cell has an anode, a cathode and an electrolyte – but it cannot store electrical energy.

Fuel cells continuously generate electricity as long as they have a supply of fuel and air. Unlike other electricity generators, such as internal combustion engines or coal/gas powered turbines, fuel cells do not burn fuel; they produce electricity through a silent electrochemical reaction.

Fuel cells are being used in the Japanese residential co-generation market in hot water applications. Ebara Ballard Corporation, a joint venture between manufacturers Ballard Power Systems of Canada and the Japanese Ebara Corporation, is integrating Ballard’s Mark1030 fuel cell into boiler units around the country.

The systems are being distributed by Tokyo Gas under the name Lifuel and by Nippon Oil under the Ecoboy brand name.

The two-unit system is installed directly at consumers’ homes and simultaneously generates electricity and hot water, reducing consumers’ dependence on the electricity grid. The first unit, less than 92cm (3ft) tall, houses the fuel reformer that converts natural gas or kerosene to hydrogen, as well as the Mark1030 fuel cell, which generates electricity from a mixture of hydrogen and air. The second unit, about 1.8m (6ft) tall, houses a 200L (53 US gallon) hot water tank.

“Residential fuel cell co-generation systems deliver key advantages over conventional power generation methods, including reduced energy consumption and reduced emissions,” says Ballard Power Systems residential co-generation market director Mark Kirby.

“With combined energy efficiency of greater than 85%, compared with only 40% via conventional generation, Ebara Ballard’s fuel cell co-generation systems can reduce...
Fuel cells are being used in the residential co-generation market. The unit is similar to a battery in that it has an anode, a cathode and an electrolyte – but it can’t store electrical energy.

Primary energy consumption by 20-30%.

“Consumers gain increased independence from grid electricity and receive average annual savings of up to $US600, based on results of the current large scale monitoring program (LSMP) in Japan.”

The LSMP has shown the residential fuel cell co-generation system reduces carbon dioxide emissions by up to 40% compared with conventional energy generation and hot water systems. This equates to an annual reduction of about one and a half tons of carbon dioxide per household.

Ebara Ballard’s co-generation systems include a monitor the size of a digital thermostat mounted in the home that shows how much electricity the household is drawing from the system and how much is coming from the grid. In addition, the monitor displays the temperature and level of water in the hot water tank.

“This information allows users to schedule daily activities, such as laundry, bathing and cooking to achieve the most cost-effective use of the co-generation system and minimize dependence on expensive grid-sourced electricity,” Kirby says.

“Ballard has identified strong opportunities for residential co-generation in several other markets including Europe, Asia and specific areas of North America where high power costs are prevalent. In general, regions with a substantial difference between power rates and natural gas costs, coupled with a good balance in demand between electrical power and hot water, are strong candidates for residential co-generation.”

As a result of Japan importing 84% of its energy, home-owners experience some of the world’s highest electricity costs. This, coupled with the rising demand for energy in residential and commercial sectors, has led the Japanese Government to develop a national policy focused on sustainability, energy independence and stringent goals for reducing greenhouse gas emissions – particularly CO².

“Ballard has identified strong opportunities for residential co-generation in several other markets including Europe, Asia and specific areas of North America where high power costs are prevalent. In general, regions with a substantial difference between power rates and natural gas costs, coupled with a good balance in demand between electrical power and hot water, are strong candidates for residential co-generation.”

By the end of 2008, more than 3,300 co-generation units will be installed in Japanese homes through the LSMP program.

“Widespread use of residential co-generation would provide the opportunity to shut down high CO² emitting power generation facilities, or avoid the installation of them.”

In the United States, electric motor manufacturer Honda has developed the experimental Home Energy Station IV.

The Home Energy Station is more compact and efficient than its predecessors, with a lower operating cost.

Honda’s technology is designed to facilitate the broader adoption of zero-emissions fuel cell vehicles by developing a home refueling solution that makes efficient use of an existing natural gas supply for production of hydrogen, while providing heat and electricity for an average-size home.
Compared with the average US home using grid-supplied electricity and a gasoline-powered car, a home using the Honda technology to produce heat and electricity can reduce emissions by an estimated 30% and energy costs by an estimated 50%.

“We are striving to address the need for a refueling infrastructure for hydrogen fuel cell vehicles,” says Honda R&D Americas vice-president Ben Knight.

“The Home Energy Station represents one promising solution, while offering the added benefit of heating and powering the home more efficiently.”

Combining gas purification and power generation components in the unit allows overall dimensions to be reduced and efficiency to be increased. It can also switch from hydrogen refining to power generation when needed.

Several companies are using different designs to tailor a fuel cell’s performance for co-generation applications. The main groups of fuel cells are polymer electrolyte or proton exchange membrane fuel cells, phosphoric acid, alkaline, molten carbonate or solid oxide fuel cells (SOFC).

“A fuel cell is a very efficient way of turning a range of gases into electricity,” says Ceramic Fuel Cells Limited (CFCL) legal and commercial manager Andrew Neilson.

CFCL, listed on the Australian Stock Exchange and London Alternative Investment Market, is developing a micro combined heat and power unit (MCHP) that incorporates the company’s proprietary SOFC technology. This operates at a much higher temperature than hydrogen fuel cells – about 750°C (1,382°F) - and is constructed from a solid ceramic material.

SOFC systems use natural gas as a fuel. The gas is treated to remove sulphur then combined with steam to remove other gases, leaving methane-rich gas. In SOFCs the electrolyte is a solid non-porous ceramic-based metal oxide.

“We are making a fuel cell module that will be integrated in boiler units running on the same natural gas network and producing the same level of hot water and heat as current models do,” Neilson says.

“It will also export power back to the electricity grid.”

“Our fuel cells operate on an electrochemical reaction similar to a battery – fuel goes in one side, air goes in another and an electrolyte sits in the middle.

“In our case the electrolyte is zirconia, which is a type of ceramic. The fuel passes over the anode side, which breaks down the methane-rich gas under high temperature, releasing hydrogen. High-temperature oxygen is blown across the cathode side. The oxygen ions then travel through the electrolyte membrane and hook up with the hydrogen from the fuel to create an electric current, plus water and heat.”

Hydrogen fuel cells, such as the Ebara Ballard unit and others that are being developed for cars and buses, run at a much lower temperature than SOFCs - about 100°C (212°F) - but they require a pure supply of hydrogen to operate.

“Our fuel cells reform gas inside the cell itself,” Neilson says.

“That way we can use the existing natural gas network serving people’s homes. We can also use bottled gases like LPG, and in future we plan to use renewable fuels such as ethanol, biodiesel and, when it’s widely available, hydrogen.”

He says there’s a lot of interest in tri-generation projects – the production of electricity, heating and cooling from one unit.

“This would be good for the tropics and the Mediterranean countries, but our main markets at the moment are Western Europe and Japan, and the best products for those markets are our MCHP units.”

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agreements with large utility companies and heating appliance manufacturers in Germany, France, the United Kingdom, the Netherlands and Japan.

“We are building a factory in Germany to move into volume manufacturing,” Neilson says. “We are also working with our partners to develop a product that is roughly the same size, shape and weight as an existing boiler so it can be installed easily as a retrofit.”

The MCHP units can produce an electrical efficiency of 50%, compared with 25-35% for coal-fired power, and re-using the heat byproduct increases total efficiency to about 85%. The units produce up to 60% less greenhouse gas emissions than coal. Each home unit is expected to save up to three tons of carbon dioxide emissions a year compared with coal.

The government of the German State of North Rhine-Westphalia, where the CFCL factory is being built, is supporting the project with funding of about $US5 million. The plant is planned to be commissioned in June 2009 with an initial capacity of 10,000 units a year.

CFCL is investing about $US19 million in this first phase of the plant, and it has plans to expand capacity to 160,000 units a year.

Neilson says the number of deployed MCHP units in the region is still quite low but it is growing quickly, due in part to local governments providing a range of installation incentives.

“The UK Government has reduced the value-added tax from 17.5% to 5% on MCHP units. It is also looking at a range of incentives for installers, such as in-feed tariffs similar to the solar package in Germany. The German Government has set up a fund of about $US775 million to commercialize and distribute fuel cell technology.”

In February 2008 the company announced its first volume order to Dutch energy company Nuon, which will order 50,000 units over five years, based on the CFCL unit meeting performance targets.

“This deal indicates there is a market for our product in the region, and it reduces the risk in investing in our factory. It also enables us to go to our suppliers to show that there is a real market and that they need to develop low-cost small components.”

Installation of SOFC boilers will be much the same as for any other gas appliance, apart from a meter out to the electricity grid to allow the unit to export power.

“In terms of connection, the unit plugs into the same natural gas pipeline and water supply. There is also a telecommunications connection, because the unit can be remotely monitored over the Internet.

“Some additional work is required over and above the installation of a boiler, but it’s not substantial. The beauty is that it runs on the same fuel, so it doesn’t need any additional fuel treatment.

“The people who install the unit will vary between markets, but generally we expect it to be the same people who install a gas boiler. The fuel cell stack looks a bit like a large box of tissues and is interchangeable. It’s like changing a battery – just slightly more involved.”

**CONTACTS**

Ballard
www.ballard.com

Ceramic Fuel Cells Limited
www.cfcl.com.au

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Amsterdam, the capital and largest city of The Netherlands, was founded in the late 12th century as a small fishing village on the banks of the Amstel River.

The city's famous canal system was designed in the 17th century to improve the transport network. However, living on the water became popular after World War II when there was a severe housing shortage and a surplus of old cargo vessels.

The inner waterways are now inhabited by about 2,400 families living on houseboats, about 750 of which are moored in downtown Amsterdam.

Currently moored in the city's harbor, the geWoonboot is an entirely self-sufficient prototype houseboat that treats its own wastewater and supplies its own drinking water.

For all intents and purposes its exterior is no different from any other houseboat in the marina, but several differences lie within. In order to make the houseboat self-sufficient, a large number of eco-friendly solutions were adopted during construction.

For example, the water used for flushing the toilet comes not from the potable supply but from rainwater collected onboard. Wastewater is channeled to an onboard septic tank for initial treatment then transferred by sump pump to floating reed beds alongside the houseboat.

To get the best results, wastewater from the toilet (blackwater) passes through the septic tank, and graywater – from the shower, kitchen sink, washing machine and dishwasher – passes through a degreaser.

“Our basic premise is that when rain falls on the roof it will be collected by our tanks,” says Victor Michielse, consultant at the housing association deltaWonen.

“It could just as well be thrown overboard, but in this case it would be better to add water to the system and to flush the toilet. If the tank is empty for any reason, water can be drawn from the effluent tank attached to the reed beds.

“The system uses a three-chamber tank. The first chamber holds half the total volume, and the others each hold one-quarter.

“Like all septic tanks, the geWoonboot tank is designed to separate solids from liquids, but it needs to be emptied occasionally because the solids slowly build up over seven years or so.”

Most of the plumbing network is made up of PVC pressure pipes, and the rainwater tanks are of polyethylene – a more environmentally friendly option, Michielse says.

“The diameter of the tubing connected to the pumps is relatively large, resulting in minor pressure loss while minimizing the energy needed for pumping the water through the boat. In order to be eco-friendly the amount of energy had to be minimal.

“If energy is from solar or wind systems it’s no big deal, but for this project we used rather large piping and rather small pumps to ensure true autonomy.”

Designer and contractor Frank van Dien of the constructed wetlands manufacturer ECOFYT
Wastewater from the geWoonboot, a Dutch prototype carbon-neutral houseboat, is channeled to an onboard septic tank for initial treatment then transferred by sump pump to floating reed beds alongside the houseboat.
The helofytenfilter uses natural processes including biological activity, chemical reactions, mechanical filtration and absorption to clean wastewater. The overall result may see an improvement in water quality up to 95%. Wastewater is divided just below the surface of the garden with the assistance of a pump.

The reverse osmosis system, with additional carbon and fiber filters, delivers two kinds of water: potable, and a waste stream containing dirt filtered out of the source water. The waste stream is added back to the separation tanks and runs through the entire purification process once more.

If rain leads to too much water in the system, either that supply or the water that has passed through the constructed wetlands is automatically discharged overboard.

Unprocessed waste water is never discharged by the geWoonboot. Michielse says water-saving techniques were not required, as total reuse was the aim in this project.

Other facets of the geWoonboot include a heating system that relies on energy present in the water on which the vessel floats. No matter how cold the external water is, water in the underfloor heating system can be as high as 48ºC (120ºF).

This houseboat also produces its own electricity using solar panels, which provide the energy needed to power the lights and run the water pump. Excess power is stored in an collection of large batteries.

The boat also features heat-reflecting glass in the windows.

“The design process for this project was fairly brief – it was completed within a year,” Michielse says.

“Commercialization was not the purpose behind the geWoonboot. The prototype craft was created as a special project to mark our company’s 100th anniversary.”

Although deltaWonen is not a producer, Michielse says the publicity and feedback from people interested in acquiring a geWoonboot shows there is potential for commercialization.

**CONTACTS**

deltaWonen
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In the last week of May I timed a trip to coincide with the Kitchen & Bath China 2008 exhibition in Shanghai.

Such events provide some guidance as to where the ‘world’s production floor’ is in terms of market development for the local region.

I was told the event was growing rapidly and any European or North American exhibition company would like to get their hands on it.

The 80,000 or so attendees were mostly from China, with about 5,000 from outside the region.

Even though the event was spread over 11 large exhibition halls, there was a certain frenzied buzz around the event on the opening days.

Having previously attended a couple of smaller plumbing sector events in China, I wasn’t quite sure what to expect.

Although the event was marketed as co-locating with the International Building and Construction Trade Fair, the place was overrun with bathroom and kitchen fixtures, taking up about 80% of the floor space.

There was very little in the way of plumbing systems, virtually no piping and very few valves.

From what I could learn, there is a sizeable shift going on in terms of the Chinese manufacturers servicing a growing local market (under their own brand name) and their original equipment manufacture obligations for markets outside China.

As more Chinese citizens aspire to Western middle-class ways, they want the brand names and designs from Europe and North America.

What WPR readers might have found a little unusual was the constant push by vendors coming up to visitors in the aisles to sell a ‘copy’ watch, as they do in downtown Shanghai.

And that was after passing through the locals offering ‘massage parlor’ cards at the front door. Now you wouldn’t see that at ISH Frankfurt or US (the Europeans and North Americans are far more discreet).

There are more than 2,000 faucet manufacturers and 1,100 sanitary manufacturers in China, and those at the top end of the market were there in force to display their wares.

Even though parts of the world, particularly China, have limited access to potable water supplies, water-saving technologies were not recognized as a mainstream issue by many exhibitors.

Perhaps that’s not surprising. The Chinese population, many of whom have finally got some money in their hands, want to spend it on design and function – and as outsiders, who are we to criticize them?

The event also gave me the opportunity to meet senior management from several of this publication’s valued corporate supporters – including Sloan Valve, Kohler, Caroma, Neoperl and the International Association of Plumbing and Mechanical Officials – which were in Shanghai for the event.

If the intention was to find exotic new
The entrance to the Shanghai exhibition reflected China's preparation for the 2008 Olympic Games.
designs at the exhibition, there might have been some disappointment.

There is only so much you can do in making water pour from an outlet and most Chinese manufacturers are still emulating the tried and tested ways of European designers.

Many had fallen for the illusion of LED lights and were applying them all over their faucet outlets, but not necessarily with the style and panache that the likes of KWC, Hansa and others from Europe first introduced.

Only one ‘take your breath away’ new product was obvious, and that was from Kohler. Earlier in the month the company had launched its Karbon kitchen faucet in New York. You will see a separate report on page 28 of this issue about the development of this interesting new product.

There was some refinement to various electronic faucets, but in general most stands featured variations on existing styles seen the world over.

Sloan Valve was pushing hard with its water-conserving products and, being one of the earlier entrants in the Chinese market, has learned a thing or two about what local buyers want.

International sales director John Lauer saw some promising signs of developers and builders visiting the exhibition looking for products that offer a point of difference – one being water-saving fixtures for projects.

That category included Sloan’s PowerFlush toilet technology and its Dual-Flush Electronic Flushometers. One nice idea from Sloan was to give away small plants to highlight the issue of sustainability.

IAPMO, the US-based product certification business and testing authority was very busy at the event. Building on established relationships with faucet and sanitary-ware suppliers throughout the region, IAPMO China operations manager Si Min Wu initiated an industry meeting for faucet suppliers.

She organized the get-together to highlight upcoming changes in the US on allowable lead levels in brass faucets (see our report in the March 2008 issue of WPR).

With a global reputation in faucet component design and supply, Neoperl used the event to demonstrate its latest water-control valves for faucet outlets.

There are few suppliers in the market whose products play such an important yet unobtrusive role in the function of faucets around the world. Neoperl has invested heavily in research and development in recent years to achieve market leadership in reducing water flow without compromising faucet performance.

You could be forgiven for thinking there...
must have been a toilet suite for every person attending this exhibition, so prolific were they. Most local ranges included an electronic toilet, which emulates the original design and functionality that Toto made famous.

Like most other brands, global leader in dual-flush water-saving toilet technology Caroma, though not appearing at this exhibition, is using China as a sourcing facility for global expansion.

China general manager for GWA Trading (Caroma) Dr Kesi Yu sees a great business opportunity in supplying the country with high-performance water-saving products.

The market has moved towards reduced-flush fixtures in recent times but they are not fully mandated at present. He believes there will come a time when products will be performance rated using schemes similar to Water Sense (US) or WELS (Australia).

One point of interest noted from Kesi was that things are changing in apartment fit-out in China. Until recently the sector has influenced the market to the degree that 90% of sales are at the retail level.

The general public (not the top-end market) purchased their apartments as bare concrete shells with entry points for utility services. They then had to buy and install fittings or arrange for a contractor to finish their apartment.

That process has not led to the most desirable way of finishing the likes of 20-story apartment blocks. It has resulted in differing standards of finish, do-it-yourself owners working all hours of the night and disturbing residents, and many apartments never being finished due to budget constraints.

There are now moves to introduce finished apartments, which means that energy and water consumption can be better managed through standardized fixtures and acceptable levels of liveability can be met.

In reality this exhibition ran one day too many. As with the economy, China’s industrious exhibition patrons are fast moving. Smaller crowds on the fourth day meant that exhibition stands were being ripped apart by midday, even though the event was due to finish at 3pm.

The sight of fire-extinguishers being taken out of the venue and centralized for safe-keeping before everyone had moved out highlights the way we Westerners view things in China. But who’s to say we are right and they are wrong?

If you missed this year’s event, Kitchen & Bath China 2009 takes place in Shanghai during May 25-29. My advice is to experience China before it loses its magic spontaneity.

5. Brass shavings left from faucet manufacture are given a Chinese tribute.

6. The elephant bath, a nod to Chinese culture.

7. The apartment sector has influenced sales in China to the degree that 90% of sales are at retail level.

8. A Reitano host shows off printed designs of your choice on metal surfaces of faucets.
The DEUS 21 concept has three main water recycling aspects: collection and treatment of rainwater from roofs, collection and treatment of surface run-off (stormwater) and treatment of wastewater.

The system was developed in Germany by a team including Professor Walter Troesch and Dr Werner Sternad at the Fraunhofer Institute for Interfacial Engineering and Biotechnology (IGB) in Stuttgart, and Dr Harald Hiessl at the Fraunhofer Institute for Systems and Innovation Research (ISI) in Karlsruhe.

Implementation is taking place in a new residential area with about 100 homes in the municipality of Knittlingen. Fraunhofer ISI was responsible for the conception, development and application of a computer-based system for modeling water, energy and nutrient flows for the area as well as providing life-cycle and economic assessments.

Dr Hiessl says the DEUS 21 concept is a real alternative to conventional systems of water supply and wastewater disposal, because of its semi-decentralized approach and efficient use of water, energy and nutrients.

“It opens up sustainable solutions for ‘mega cities’ and for sparsely populated districts in industrial countries, even under changing climate conditions. Our concept is distinguished by its comprehensive approach and high flexibility and sustainability thanks to the use of innovative technologies.”

In conjunction with partners from industry and the municipality of Knittlingen, Fraunhofer IGB’s main function was to design the overall infrastructure for the DEUS 21 residential area. This includes the treatment facility for run-off from streets, rainwater collection from roofs, a rainwater treatment and distribution system for each property, and construction of a semi-central wastewater treatment plant.

As Professor Troesch says, about one-third of household water consumption in Germany is used for toilet flushing.

“Water is one of our most valuable resources, and far too precious to waste on transporting faecal matter.

“In the DEUS 21 framework, rainwater from roofs is collected in a subterranean system of drains then treated using an ultra-filtration membrane process.

“This water conforms to the specifications of the German Drinking Water Ordinance. It is supplied to households via a dual piping system for purposes such as hot water preparation, showering, clothes washing, bathing, cleaning, toilet flushing and garden irrigation.

“In Germany, potable water from the public water supply has to be supplied to each house through a separate piping system.”

Because the treated rainwater is relatively ‘soft’, it is particularly suitable for hot water applications such as washing machines, dishwashers and showers. De-scaling agents are not required, and the use of soap and detergent can be reduced.

A vacuum sewer system has been installed...
Troesch says vacuum toilets can save about 80% of the flushing water used by conventional toilets. The domestic wastewater is transported to the 'water house' – a building in the DEUS area providing all water treatment technology for the system – where it is treated by an anaerobic process.

“The anaerobic wastewater treatment plant has the advantage of also being able to process biological waste from the kitchen, so the houses are all equipped with a waste grinder or macerator that discharges waste via the vacuum system to the treatment plant.

“Joint treatment of wastewater and kitchen waste reduces the amount of waste, and the organic material increases the biogas yield, which can be used for energy generation.”

The concept developed at Fraunhofer IGB aims to reclaim valuable products including recycled water, energy and fertilizer. The DEUS 21 wastewater treatment system consists of four modules: membrane filtration of wastewater, anaerobic decomposition of the highly polluted fraction, aerobic membrane bioreactor for the less polluted fraction, and nitrogen and phosphorus recycling.

In the first module, the focus is on using modern membrane techniques to separate wastewater into a highly polluted concentrate and a less polluted filtrate. The separated wastewater flows can then be treated in the most appropriate way, and compounds can be extracted – carbon as biogas, nitrogen as ammonium and phosphorus as phosphorous fertilizer.

A rotating disc filter with ceramic membranes that is used for wastewater separation was developed at Fraunhofer IGB.

In Module 2 the concentrated wastewater is metabolized into biogas (methane/carbon dioxide) via anaerobic technology for use in a power plant to generate energy.

Module 3 uses an aerobic membrane reactor to transform the less polluted wastewater into CO₂ and biomass. Excess biomass can contribute to the generation of biogas in the anaerobic process.

In Module 4, stripping systems are used for capturing ammonia from biogas generated in Module 2. Nitrogen compounds are also present and can be stripped out and recycled as a product; phosphorous compounds can be removed and recycled as a fertilizer.

The wastewater treatment facilities are near the Knittlingen housing development, together with the rainwater treatment plant and the vacuum sewer station. The modular design of the DEUS 21 system enables the facilities to be enlarged in steps as the residential development expands.

Dr Harald Hiessl emphasizes the importance of the comprehensive sustainability assessment that was carried out to ensure continued viability and effectiveness.

“A system dynamics model was used to quantify and analyse the water flows of the
Infrastructure concepts and the specific technical sub-systems,“ he says.

“Factors that were taken into account included demographic change and the government projection that the population in Germany is likely to decrease.

“Climate change and its possible consequences was another factor we looked at, because of the effect it might have on the operation of the water and wastewater infrastructure.

“For example, studies have shown that short and intense rainfall is on the increase, which has implications for the size of sewer systems.

“In addition, the introduction of technological change in reducing water consumption needed to be considered in the modeling, especially in relation to household appliances such as washing machines and low-flush toilets.

“System dynamic modeling has enabled analysis of water stocks and flows of water and wastewater in the Knittlingen area. This has made it possible to model different urban water infrastructure concepts and to carry out economic assessments of alternative systems.”

Fraunhofer ISI also assessed the implications of various water infrastructure systems on ecological factors such as the greenhouse effect, on economic criteria such as the flexibility and expandability of components, and on social aspects such as transferability of concepts to developing countries.

Dr Hiessl says the main benefit of DEUS 21 is that it can obviate the need for complex and costly conventional sewer systems and centralized wastewater treatment. An adapted form of the concept will be relatively easy to implement in newly industrialized and developing countries.

At Knittlingen, all the necessary infrastructure on public land has been installed, and about 35 houses are occupied (of a total of 100).

“However, due to the slow growth of the residential area, not all sub-systems (such as the nitrogen and phosphorous recycling module) are fully operational.

“These additional process steps will be phased in when the number of people connected allows for successful operation.”

**CONTACTS**

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www.isi.fraunhofer.de
SUCCESSFUL MEETING TAKES PLACE IN ZURICH

Health issues in developing countries, the environment and training for plumbers were among the important matters discussed in Switzerland.

More than 30 people attended a general meeting of the World Plumbing Council (WPC) in the offices of full member organization Suisse Tec in Zurich, Switzerland, on 9 and 10 April 2008.

The meeting, chaired by WPC chairman George Bliss III (US), dealt with a broad range of topics, which are summarized below.

CO-OPERATION WITH THE WORLD HEALTH ORGANIZATION

Dr Jamie Bartram and Jennifer Mercer of WHO Geneva made a presentation on the work that WPC and WHO are doing together to promote the link between plumbing and health in the areas of water and sanitation.

Dr Bartram said co-operation between the organizations had started in the early 1990s and covered several activities, including the joint publication of Health Aspects of Plumbing in 2006.

This publication was an important factor in WHO’s official recognition of WPC as a non-governmental organization (NGO) in January 2007. The appointment of WPC’s John McBride (Australia) as liaison between the two organizations marked a further milestone in the mutual co-operation that now has WPC firmly embedded in WHO as the voice of the global plumbing community.

Mercer described her work with a network of water regulators and said it would soon discuss a paper on the regulation of plumbing and plumbers that was being prepared by McBride, who has been appointed by WPC to work on a range of projects with WHO.

There is also a plan to incorporate this paper in a future revision of the WHO Drinking Water Quality Guidelines, which are followed by most of the world’s purveyors of public water supplies.

McBride updated members on the projects he is undertaking on behalf of WPC. In addition to the paper for the regulator network, he is developing a series of definitions of plumbing terms for an international ‘lexicon’ being published by WHO.

One of the principal parts of his work is the creation of training materials for use in developing and developed countries that will strengthen plumbers’ awareness of the important health aspects of their work. It is planned to pilot this material later in the year in India and Solomon Islands.

A further report on progress will be provided at the forthcoming World Plumbing Conference in Calgary, Canada, on 24-27 September 2008).

FUTURE WORLD PLUMBING CONFERENCES

The 2008 World Plumbing Conference will be followed three years later by a conference in Edinburgh, Scotland.

World Plumbing Conferences have been held triennially since their inception but a decision has been made to increase the frequency to every two years after the 2011 event.

The Indian Plumbing Association has lodged an expression of interest to host the 2013 conference, and a formal bid presentation will be made at Calgary, when members will have the opportunity to consider and approve the venue.

Continued next page >
WPC ANNOUNCES 2008 TRAINERS SCHOLARSHIP

WPC is inviting applications for its 2008 Trainers/Lecturers Scholarship. Details of the application process are contained on the WPC website www.worldplumbing.org

The scholarship was first awarded in 2003. It enables the recipient, who must have an involvement in plumbing training, to visit another country to investigate plumbing industry education and training practices.

Scholarship winners receive funding up to US$10,000 to enable them to carry out their visit. Previous recipients are:
- John Smartt (Ireland) – visited US;
- Arnold Iru (Solomon Islands) – visited Australia;
- Phil Campbell (US) – visited UK;
- Geoff Moore (Australia) – visited Denmark;
- Subhash Deshpande (India) – visited Australia.

The winner of the 2007 scholarship, Subhash Deshpande of Pune in India, attended the WPC meeting in Zurich on 8-9 April 2008 when he presented his formal report on his recent visit to Australia.

He is chairman of the Pune chapter of the Indian Plumbing Association and a trustee of the Indian Institute of Plumbing, and has been at the forefront of developing plumbing training programs in India.

During his trip to Australia he visited training centers, trade associations, construction sites and the Plumbing Industry Commission (PIC) in Victoria. He met the Governor of New South Wales and the NSW Minister of Fair Trading.

In expressing thanks to WPC for allowing him to undertake this visit, he hoped some of the lessons he had learned could be used to the advantage of plumbing industry training in India.

Applications for the 2008 WPC Scholarship must be received by the WPC secretariat no later than 1 October 2008.

IMPROVING THE QUALITY OF LIFE

In a presentation to the WPC meeting in Zurich, WHO representatives revealed the following statistics to delegates:
- 1.8 million people per year, most of them children under five years of age, die because of diarrhoeal diseases;
- 1.1 billion people lack access to improved water sources;
- 2.6 billion people lack access to improved sanitation;
- In South Africa 1,000 people were affected by diarrhoea during 2006, due to contamination of piped water by sewerage water;
- That same year in Zimbabwe cholera and typhoid outbreaks were caused by infiltration of pathogens in worn-out or broken mains;
- In the US between 1991 and 1996, 22% of waterborne disease outbreaks were caused by unsafe plumbing;
- In the UK between 1911 and 1995, 36% of waterborne disease outbreaks were caused by problems in the distribution system;
- Between 1975 and 1991 in Scandinavian countries, 20% of waterborne disease outbreaks were caused by cross-connections and backflow;
- The 2002 Amoy Gardens, Hong Kong, plumbing-associated SARS outbreak cost Asian countries US$60 billion;
- The estimated cost of the 2007 UK foot and mouth disease outbreak from faulty drainage installation was the equivalent of US$198 million.

But it was not all bad news: 2005-15 is the WHO-sponsored Water for Life decade and 2008 is the International Year of Sanitation. Both initiatives are designed to alleviate the above problems.

The targets include halving the proportion of people without sustainable access to safe drinking water and basic sanitation by 2015.

It is estimated that by the same year 97 million people a year will gain access to drinking water and 138 million people a year will gain access to sanitation.

Jennifer Mercer of WHO describes the development of a global database of plumbing terms that will form part of the WHO water and sanitation lexicon, and a policy paper on the regulation of plumbing that could form part of WHO guidance on water law.
PLUMBERS: THE FORGOTTEN HEALTH WORKERS

Robert Burgon, Deputy Chairman of the World Plumbing Council, chaired a session on the importance of plumbing to water safety during a recent conference in Lisbon, Portugal on water safety plans. The conference, organised by the International Water Association and co-sponsored by the World Health Organisation (WHO), took place on 12-14 May 2008 and attracted some 200 water industry and health organisation delegates from a wide range of countries.

Water Safety Plans are being promoted by WHO as ‘the most effective means of consistently ensuring the safety of a drinking-water supply through the use of a comprehensive risk assessment and risk management approach that encompasses all steps in water supply from catchment to consumer’.

In the conference session on ‘Safe Water in Buildings’, Robert Burgon presented a WPC viewpoint stressing the important role which professional plumbing had to play in maintaining the integrity of safe water which had been delivered to a building. He referred to plumbers as the ‘forgotten health workers’ and suggested that in many developing countries today the plumbing industry could make the kind of dramatic improvements to health which had been seen in 19th century Britain and other developed nations. Referring to the type of problems which improper plumbing design, installation or maintenance could create, he urged delegates to remember that plumbing and consumers were important stakeholders in the process and that it was dangerous to ignore the impact of plumbing and consumer action or inaction in the process.

Robert concluded his presentation by stressing that “plumbing must not be the missing piece in the water safety plan jigsaw”.

Pem Kubbe, a retired plumbing contractor from the Netherlands, then described the work which the European plumbing and heating organisation, GCI-UICP, had undertaken in conjunction with the European water supply association, EUREAU and provided an example of a water safety plan as it applied to plumbing work. In a strong plea for the recognition of plumbing, he urged water suppliers to ensure that water connections were only provided where there was evidence that the plumbing work had been carried out professionally. He also recommended the ongoing inspection of plumbing systems to ensure that safe water remained safe.

The final presentation of the session was made by Dr Annabelle May of the Drinking Water Inspectorate in England and Wales who illustrated the importance of good plumbing through a description of work which is being undertaken in the UK particularly in the field of educating consumers on the importance of their plumbing systems. Her talk also included some graphic illustrations of what can go wrong when plumbing is not done properly.

The three formal presentations led to a lively period of questions and answers from a range of delegates including those from Uganda, Germany and the UK.

In a subsequent conference session, Professor Kumar Jyoti Nath, Chairman of the Arsenic Task Force for the Government of Bengal, India demonstrated that water quality samples taken in Kolkata, India showed that the largest concentration of contaminated samples were not in the supply system but in overhead or underground tanks inside houses. This message emphasised in a dramatic way that good plumbing is needed.

Commenting after the event, Robert Burgon said that “this conference was a superb opportunity to promote the message that safe water relies on good plumbing. So much of the good work of water suppliers and regulators can become undone unless plumbing is taken seriously. We got a positive response from delegates and can only hope that the good plumbing message is now understood in more countries than before.”

WPC APPOINTS SUPPORT SERVICE PROVIDER

WPC has appointed the Institute of Plumbing Australia to provide administrative and accounting support services for a three-year period commencing 1 October 2008.

The appointment, which follows competitive tendering open to all full members of the organization, marks the start of new arrangements for administering WPC that were agreed at the 2007 annual meeting in Tokyo, Japan.

Existing secretary Andy Watts, MBE, retired from his position as chief executive of the UK’s Institute of Plumbing and Heating Engineering (IPHE) in 2006 and indicated he would not be seeking re-election as WPC secretary (a position he has held since 1996).

In addition, the work of the treasurer had increased as membership and activity of WPC grew. It was therefore decided to combine the functions of secretary and treasurer and appoint an organization that would be contracted to provide these services.

Secretary of IOP Australia, Stephen Movley (who currently sits on the WPC executive board) will be responsible for providing the services. He said his organization is pleased to have been awarded the contract and he looks forward to supporting WPC over the next three years.

WPC chairman George Bliss III said it was encouraging that three full member organizations submitted detailed tenders to provide these services.

“This demonstrates a good degree of enthusiasm from our membership. We are looking forward to working with IOP Australia in its new role. I would also like to pay tribute to Andy Watts and to the IPHE for the excellent support he and the organization have provided to WPC over many years.”

WPC has now replaced the two elected positions of secretary and treasurer on the executive board with a new position of honorary secretary/treasurer, and the role will include supervision of the contracted service provider.

Elections for the executive board 2008-2011 will be conducted at the forthcoming World Plumbing Conference in Calgary, Canada, from 24-27 September 2008.
SOUTH AFRICA’S NEW SYSTEM OF REGULATION AND REGISTRATION

The end of apartheid in South Africa brought about big upheavals in the country’s society and economy.

Racial discrimination under the old regime extended to trades, wages and training. But after 1994 the old systems fell apart and in the new era many previously well-regulated professions became a free-for-all.

Plumbing was one area in which just about all controls were removed. However, with help and guidance from WPC member the Institute of Plumbing South Africa (IOPSA), the government is seeking to redress this anarchic state with regulation and registration.

IOPSA was established in 1989 by 14 plumbing companies, and in the intervening years it has increased its membership to 765 representing more than 3,500 qualified plumbers and about 10,000 semi-skilled people working in the industry.

The principal aims of IOPSA are to maintain standards in the industry by using only quality plumbing products and carrying out compliant plumbing installation work.

It works with the South African Sanitaryware Manufacturers Association and is the representative body for the plumbing industry to which the government refers on plumbing matters.

National building regulations require that the trade of plumbing be carried out by a trained plumber or by someone working under the supervision of a trained plumber or approved competent person.

In practice, the system falls down because there are few regulatory procedures in place. However, the government hopes to introduce appropriate legislation, and at present it has proposals open for public comment. If approved, these proposals will mean compulsory registration, as well as approved Standards being included in the country’s National Water Act.

IOPSA is working with the various government legislative departments. Meanwhile, voluntary registration has begun, and some municipalities require plumbers to be registered with IOPSA in order to work in their areas.

Of course, to get qualified plumbers there must be suitable training opportunities. Editor of IOPSA’s monthly magazine Plumbing Africa Rory Macnamara says the training situation is not a ‘happy’ one at present.

“But there are encouraging signs through legislation that a plumber must complete an apprenticeship or ‘learnership’ through a recognized training college and undergo a trade test at an official trade test center.”

Plumbing training schemes are the responsibility of the Construction Education Training Authority, which has been mandated by the Department of Labor to administer plumber training schemes in South Africa. Training is carried out under the supervision of qualified instructors at CETA-accredited training colleges throughout the country.

Those entering the apprenticeship training program have to be employed by a registered plumbing contractor, who will be responsible for the apprenticeship agreement.

A total of 46 training modules must be passed, and apprentices have to work on site for 24 months under the supervision of the employer. Only then are they eligible to take the trade test.

The cost of the college training is equivalent to about US$2,000, and employers can claim a tax deduction if they fund an apprentice.

The training scheme makes provision for those disadvantaged under apartheid to demonstrate their knowledge under recognized prior learning (RPL). This is aimed particularly, but not exclusively, at older people and it allows unqualified ‘plumbers’ to show their practical ability even if they don’t have all the fundamental learning skills.

The relationship between IOPSA and WPC is in its infancy, but IOPSA chairman of training and registration Lea Smith is bullish for the future.

“We are creating stronger ties with WPC,” Smith says. “But I don’t think we have even started to scratch the surface of the benefits that WPC can offer.”

Those sentiments are echoed by IOPSA president Steve Brown.

“I believe we can learn from WPC, enabling us to implement the Institute’s goals,” Brown says.

Clearly South Africa’s plumbing industry is in a period of change, and there seem to be considerable difficulties to overcome. However, with the help and guidance of IOPSA, perhaps calling on WPC expertise, there is room for optimism and practice change.

INTERNATIONAL YEAR OF SANITATION 2008

WPC is supporting the International Year of Sanitation (IYS) 2008 as designated by the United Nations.

IYS was created in response to the UN General Assembly call for action. It aims to accelerate progress on sanitation and hygiene, and ensure that related health concerns are addressed.

WHO is supporting IYS and has arranged a series of meetings and events in support of the year.

As sanitation is a central part of the work done by the plumbing industry, WPC has obtained approval from the UN to use the IYS logo. It hopes that use of the logo will help to create awareness of the importance of this subject.

This article first appeared in the April edition of UK magazine Plumbing Heating and Air Movement News.
WPC member organization the Indian Plumbing Association has published a Uniform Plumbing Code for India (UPCI). The code seeks to promote standard plumbing practice across the country and will be distributed free of charge to plumbing and building companies, and relevant government departments and officials.

Sudhakaran Nair, president of the IPA and member of the WPC board, said there is no formal opening in India for proper education on plumbing.

“To reform the sanitation system, good plumbing is a necessity. To spread the word about how to do good plumbing, we have created the UPCI document.”

Nair was in Pune, Maharashtra State, for the inauguration of the first plumbing laboratory in the country, set up at College of Engineering Pune (CoEP).

CoEP is a partner in this venture with the Indian Institute of Plumbing (IIP), a charitable trust set up by IPA to propagate training and education in plumbing. Plumbing will become an elective course for third year BTech students, and there are plans to start a diploma course in the near future.

IPA members deliberated on the draft of the code for about 18 months before coming up with the published version. Another WPC member organization, the International Association of Plumbing and Mechanical Officials also contributed.

“We say that one rupee spent on good plumbing saves 3,000 rupees on medicines,” said IIP president S.G. Deolalikar. “Because of poor sanitation, many people fall prey to hazardous diseases. This can be stopped by good plumbing.”

WPC chairman George Bliss III, who officially opened the college, said almost three billion people in the world are without proper sanitation facilities, and this is a common cause for communicating diseases.

“In the US, the American Medical Association has found that a good flushing system in toilets has reduced the rate of spreading these communicable diseases.”

The UPCI, which has drawn on the US model, will be reviewed after three years. Meanwhile, comments and suggestions will be carefully considered.

**HEALTH ASPECTS OF PLUMBING – CHINESE VERSION**

The joint WPC/WHO publication Health Aspects of Plumbing will soon be available in a Chinese version. Work to produce this was undertaken in conjunction with WHO by the UK Institute of Plumbing and Heating Engineering, Hong Kong Council; and the CCMSA of China. It was facilitated by WPC board member Henry Hung.

**APPLICATION FOR MEMBERSHIP**

Your organization can apply to become a member of the WPC either by visiting our website http://worldplumbing.org or by faxing your details to us for an application form. The by-laws of the organization can also be viewed on the website.

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Applicant must be a *bona fide* representative organization in the plumbing industry, such as a trade association, professional body, trade union, registration/licensing body or association of manufacturers/wholesalers.

*Annual fee is US$500*

**AFFILIATE MEMBER**

Applicant must be a *bona fide* organization or company in the plumbing industry that wishes to be associated with the World Plumbing Council. This could include the likes of individual manufacturers, wholesalers, service companies or publishers in the industry.

*Annual fee is US$200*
In Pima County, Arizona, a program to install low-flush toilets at taxpayer expense has stalled due to concerns that new toilets would reduce sewer flows too much. The new toilets had a capacity of 6L (1.6 gallons) per flush, compared with the usual 13.25L (3.5 gallons).

Wastewater officials keen to test the sewer lines of neighborhoods running at high capacity (65%), were involved in the toilet trial, but they soon understood that low flows could result in a build-up of solids, sewer corrosion, odor and back-ups.

In 2006 the Regional Reclamation Waste Water Department agreed to pay the Water Conservation Alliance (WCA) US$525,000 for the installations. However, a consultant’s study last year prompted the council to restrict the areas where the toilets were to be plumbed. They could not be installed in the first home on a sewer line, because there was not much liquid waste to begin with.

“Let’s not pretend we’re doing conservation when we’re not,” says WCA director Val Little. “To us, it looks like they didn’t have their act together.”

The consultant did not completely oppose the use of low-flush toilets, but he did warn of impending problems, particularly in areas where the tests were being conducted.

A report shows that 5,800m (19,000ft) of sewer lines in the test areas in Pima County have slopes that do not meet minimum Standards. The report also states that sewers were already being cleared with potable water, and flushing would have to increase with the use of graywater.

Little disagreed with the study, saying her own investigations found that most lines met county Standards.

However, the problem is a universal one, particularly in older homes where water use is much higher.

In Australia the need to more carefully monitor water flow (or lack of it), through the country’s networks of drainage pipes is an important one. There is much discussion about low-flush toilets and waterless urinals, and their effect on drain lines. How much lower can the flush possibly be?

Chairman of the National Plumbing Regulators Forum (NPRF) Michael McGuinness says intervention is justified if flushing volumes continue to be reduced.

NPRF members are concerned that if flushing volumes are further reduced, there could be implications for internal plumbing systems as well as external infrastructure.

An international study led by Australia and New Zealand is being scoped to look into the problem of dry drains, but the results could be two or three years away – too long to wait for an answer.

The Australasian Scientific Review of Reduction of Flows on Plumbing and Drainage Systems (ASFlow Project) is extremely important given the reduced volumes of water in building drainage systems, but what can be done in this climate of lower rainfall and global warming?

NPRF advisory committee chairman Jeffrey Clark, who represents South Australian Water, says there are a several obvious actions that can be taken to minimize the risk of dry drains. He lists good practices that plumbers and plumbing engineers should take into account in all future installations.

These suggestions are not yet regulations...
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in Australia, but some may be included in the Australian Plumbing Standards.

The first problem to be tackled is gradient fall, an issue that faces communities around the world.

“When installing pipes, the minimum gradient must be adhered to,” Clark says. “Plumbing Standards state that the DN100 pipe should have a minimum fall of 1.65%, or 1 in 60. Flatter gradients are allowed under AS/NZS3500 2 (2003) and Part 5 (2000).”

It is proposed to have this clause removed from AS/NZS 3500, and if plumbers choose to lay drains at a lesser gradient they will need to meet performance-based requirements as stated in the Plumbing Code of Australia (if permitted under the regulations of various States).

“Drains need to be designed according to the number of fixture units that are discharging - the length of the drain being as short as possible and avoiding unnecessary changes of direction,” Clark says.

Drain junctions may also be a concern, and sweep junctions can cause some backflow. Clark says the proposed amendment to AS/NZS3500 defines the use of 45° and sweep junctions in drains. The 45° junctions reduce the likelihood of backflow, which is vitally important.

Clark also states that sweep junctions should be eliminated when connecting soil fixtures.

Where a water closet pan is connected as an ‘end of line’ fixture, the discharge carry length – without the assistance of further upstream flushing of the drain – should be considered.

“Present regulations permit a water closet pan to be connected to an unventilated branch drain up to 10m (33ft) in length,” Clark says.

“Consideration should be given to the length of drain – irrespective of whether the drain is vented – when water closet pans are the only fixture connected. Suspended solids may become stranded in the drain.”

As mentioned, some older homes are not ready for new technology, having been built in an age when water conservation was something to be dealt with far into the future. Yet retrofitting old drain lines is a big concern.

“With new-technology pans – for example, with a dual flush of 4.5/3L (1.18/0.8 gallons) - being retrofitted to old drain lines, you need to ensure that these drain lines are in good working condition.”

This is not always the case, and the plumber must be aware of which technology meets the needs of particular homes.

The advent of waterless urinals has also caused a stir. There is now clear evidence of uric acid build-up in sanitary plumbing systems where a waterless urinal is the end-of-line fixture.

“A proposed amendment to AS/NZS 3500.2 (2003) will require two upstream fixtures of any waterless urinal installation,” Clark says.

“With retrofit situations, plumbing engineers are encouraged to advise property owners or managers of the possibility of uric acid build-up, particularly in existing lines, due to changes in drainline fall over time.

“In such cases, a drain camera check or removal of walling material for visual inspection is suggested as good practice.”

In Australia all plumbing products installed must meet WaterMark Standards.

By following a few simple rules, problems that seem to be occurring in global plumbing can be avoided. The problem of dry drains is not conducive to a quick fix, but in time the effects can be reduced by following commonsense procedures.
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A joint venture between developer Axiom Properties and engineering company Coffey International has been designed to revolutionize working environments.

The WorldPark 01 Adelaide project, with an estimated cost equivalent to US$140 million, will facilitate and encourage interaction, innovation and communication between individuals and across companies.

According to Paul Rouvray, Axiom general manager for South Australia and the Northern Territory, this environmentally sustainable development is aimed at setting new benchmarks for world best practice in relation to the environment and working concepts.

“This project will be sympathetic to the environment by dealing with water and energy use, carbon emissions and recycling,” Rouvray says.

“The 3ha (7.4 acre) site can accommodate in excess of 30,000 square metres (323,000ft²) of environmentally sustainable office accommodation built in a campus-style setting. It will include cafes, gymnasium, childcare center, car parking and secure storage for bicycles.

“WorldPark 01 Adelaide will have on-site blackwater and graywater treatment plants, as well as rainwater and stormwater collection, waterless urinals, and low-flow fixtures and fittings. This will help to create a business environment that is 100% water efficient.

“The mains water for drinking that is required by regulation will be offset by the export of Class A water from the site. In fact, we expect the amount exported will more than offset the volume of water drawn from the mains.”

Glen Simpson is chief executive of Coffey International Development and executive director of Coffey International Limited. He says all precipitation on the site – on buildings and open areas – will be collected, filtered and treated.

“Rainwater and stormwater will be directed through vegetation swales and collected in the site detention pond for use in the blackwater treatment plant.

Similarly, wastewater from air-conditioning systems, showers, hand basins and toilets will be treated by the graywater and blackwater treatment plants to provide Class A water that can be used for toilet flushing, air-conditioning units and irrigation purposes.

“Rainwater will be harvested from roof areas via a siphonic roof drainage system. It will then be disinfected by UV sterilization in accordance with water authority requirements to achieve a potable standard to serve basins, showers and tenancy requirements. The water will be stored in centralized rainwater tanks.

“A uPVC sanitary drainage system will be provided throughout the buildings. The wastewater will run by gravity to a pumping
pit, then to a central bio-reactor blackwater treatment plant for eventual reuse for toilet flushing and cooling towers.

“We expect all the treated water to be recycled on-site. Any excess will discharge to the water authority sewer.

“Trade waste will drain to 2,400 liter (634 gallon) grease arrestors with a suction line to enable remote pump-out. The remaining waste will bypass the central blackwater treatment plant and discharge to the water authority’s sewer.”

Simpson says WorldPark 01 Adelaide has been designed to be extremely efficient in water use and will feature a range of low-flow fixtures and fittings, including waterless urinals.

“Trade waste will drain to 2,400 liter (634 gallon) grease arrestors with a suction line to enable remote pump-out. The remaining waste will bypass the central blackwater treatment plant and discharge to the water authority’s sewer.”

It is planned that stormwater from the large car parking area will drain to an oil plate separator, where oil from the car park will be removed. The water will then be stored in reed bed swales and used for irrigation of gardens.

Simpson says WorldPark 01 Adelaide has been designed to be extremely efficient in water use and will feature a range of low-flow fixtures and fittings, including waterless urinals.

“A standard building uses more than 77,000 liters (20,340 gallons) of water per day, and even a low-demand building uses about 30,000 liters (7,925 gallons) per day. The entire 3ha precinct will incorporate three office buildings capable of housing more than 3,000 employees, yet it will use only 7,500 liters (1,980 gallons) of water per day.

“This represents an annual saving of 90% of mains water consumption, or 25 million liters (6.6 million gallons) – enough water to fill 10 Olympic-sized swimming pools each year.

“An additional benefit is that these initiatives will cut sewage discharge from WorldPark 01 Adelaide by 96%, substantially reducing the load on municipal treatment plants.

“The WorldPark 01 Adelaide site will be landscaped and revegetated with Adelaide Plains species that have been lost to the area. This will encourage the return of native birds and small animals.

“Other green initiatives include monitoring of energy and water consumption and implementation of waste management systems, together with installation of solar hot water systems and a thermal energy storage system to reduce peak energy demand on the grid system.

“Recycled materials will be used in construction of the buildings, which will incorporate extensive insulation. And cooling tower refrigerants will have zero ozone-depleting potential. Showers will be provided, together with secure storage for bicycles to encourage employees to cycle to work, thereby reducing carbon emissions even further.”

The South Australian Water Corporation has involvement in many successful water-saving initiatives throughout the State and fully supports water-efficient and sustainable plumbing systems.

Corporation plumbing services and compliance manager Jeff Clark says the WorldPark project in Adelaide demonstrates advanced plumbing design and water-saving innovation.

“This project is akin to the recycled water
scheme at Adelaide’s Mawson Lakes, where an alternative water supply service is provided to each residential and commercial building.

“The WorldPark project will be able to deliver recycled water to each building in the development, where it will be used for such purposes as toilet flushing, cooling towers and irrigation. An on-site wastewater treatment plant will be installed to treat the water to Class A level.

“To maximize the water reuse potential for this project, hydraulic services have been designed to encompass all available water supplies, taking full advantage of rainwater and stormwater run-off from roofs.

“SA Water’s involvement with this project, as the technical regulator for plumbing and the network utility operator, is to provide it with water and wastewater services. Our customer technical services branch, in consultation with the Department of Health, will approve the wastewater treatment plant and hydraulic plumbing systems design.

“Before commencement of the project, discussions were held with the hydraulic design consultant and plumbing contractor to ensure the recycled water systems are designed and installed in accordance with AS/NZS 3500:2003, the Australian Plumbing Standard.

“During construction, SA Water will perform regular on-site audits of the plumbing installation to ensure compliance.

“Developments such as these will assist South Australia’s efforts in providing sustainable developments to help conserve the State’s precious water resources.”

Coffey International will anchor the first of three stages of WorldPark 01 Adelaide a commitment to occupy 7,000m² (75,350ft²) in Stage 1, of a total of 9,000m² (96,875ft²).

The companies that will co-locate include Coffey Geotechnics, Coffey Environments, Coffey International Development, Coffey Mining, Coffey Training, Coffey Projects and Coffey Natural Systems.

A second Australian WorldPark green business precinct is due to begin construction in Melbourne, Victoria, late in 2008.

Simpson says the development is expected to total about 30,000m² (323,000ft²) of campus-style ‘green’ office accommodation with an estimated end value equivalent to US$170 million,

“Like the Adelaide project, the WorldPark in Melbourne will be environmentally friendly, people friendly and space friendly,” Simpson says.

“It will be carefully designed using the latest in green building technology. Substantial interest in the concept is being shown by the business community, and it could result in the development of similar precincts in other capital cities around Australia.”

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Researchers at Heriot-Watt University, Drainage Research Group, are about to embark upon a new project, to be funded by the UK Engineering and Physical Sciences Research Council (EPSRC), that aims to develop a decision-making tool for building drainage designers and operators that will allow the determination of the most appropriate and cost-effective adaptation strategy to mitigate flood risk. This work, due to commence October 2008, arises from the need to assess the extent of any under-capacity of building and small-scale drainage when subject to, in particular, the anticipated increase in short-duration high-intensity rainfall events predicted by climate change scenarios.

The research will coincide with the release of new climate change data, presented in probabilistic terms, by UKCIP - the UK Climate Impacts Programme set up by Defra (the Department for Environment, Food and Rural Affairs). This new ensemble data, referred to as UKCIP08, will yield information on a range of possible outcomes each with an estimated probability of occurrence and will be used to provide the rainfall information required to drive roof and building drainage simulation models developed at Heriot-Watt under previous EPSRC-funded awards.

Currently, many rainwater drainage systems are designed to cope with rainfall intensities that are based on a defined ‘return period’ (i.e. the average duration between events of a stated magnitude) and on the nature and intended use of the building. However, this approach means that, often, average precipitation rates are used, thereby neglecting the impact upon performance of the natural temporal variation in rainfall. In addition, component parts of property drainage systems are often designed in isolation and with the aim of removing rainwater as quickly as possible, leading in many cases, to the coincidence of flows at key conveyance points.

With flows in roof drainage systems reflecting the temporal variation displayed by rainfall patterns and with these, in turn, dictating conditions within roof gutters and down pipes, it can be seen that the overall system response is strongly time-dependent. Rainfall patterns also dictate the occurrence and frequency of priming and, where there is under-capacity, the overtopping of gutters and the surcharge of...
The use of steady-state principles in design calculations is seen to ignore the time-dependent nature of system flows, and neglect, in some cases, the risk of flooding and in others, the potential to use attenuation to relieve system loading.

The approach to the work to be undertaken at Heriot-Watt is hence two-fold. Firstly, the research requires the alignment and application of the group’s numerical simulation models, ROOFNET and DRAINET. These models are based upon the Method of Characteristics finite difference technique and, individually, have previously been used to enhance the design approach for relevant systems. ROOFNET simulates the transient response of both conventional and siphonic rainwater drainage for buildings, whereas DRAINET deals with the transient analysis of partially filled, i.e. free surface, pipe flow. Although the main focus for the development of DRAINET has, in the past, been on the simulation of internal building drainage, its application has recently been extended to encompass local external drainage systems where the flow regime may still be characterized by wave attenuation. Together, these models allow a holistic simulation of the unsteady conveyance of water through a property and provide a better understanding of flow and network interactivity. Secondly, by using rainfall data extracted from UKCIP08 probability density functions (PDFs), the probability of a particular event (or series of events) and hence the loading imposed upon the drainage system will be more accurately defined. Coupled with the ability to assess the performance of component parts of the network, this means that the likely causes, and location, of future localized surcharge or flooding can be identified, and hence also the ‘where and how’ practical and cost-effective adaptation strategies should be introduced.

The range of drainage systems the project will address includes conventional and siphonic rainwater systems, green roofs and rainwater harvesting systems. Adaptation options will be prioritized in terms of flood risk reduction and cost, and will take the form of, for example: pipe work and/or gutter re-sizing or re-routing; the integration of attenuation through the installation of offline storage, rainwater harvesting or a green roof; or the re-configuration of local permeable ground surfaces. Although the proposed decision-making tool may be used to assess existing systems, it is intended that it will be better applied at the design stage, where matrices in the form of ‘look-up’ tables will provide performance indicators categorised by building typology, curtilage dimensions and PDF-based climate change scenarios.

The provision of site access for both observation and monitoring will be vital to the success of the project and will be facilitated by Arup, National Archives Scotland, Scottish Water and Paisley Abbey. Dissemination routes and guidance on potential schemes for inclusion as adaptation options will be provided by World Plumbing Review, CIRIA (Construction Industry Research and Information Association), the Chartered Institution of Building Services Engineer’s Society of Public Health Engineers (SoPHE), BuroHappold, World Plumbing Council, SNIPEF (Scottish and Northern Ireland Plumbing Employers Federation) and IAPMO (International Association of Plumbing and Mechanical Officials).

The overall aim of the project is hence one of developing a new approach that will provide property owners and/or managers as well as the public health engineering profession, designers, consultants, land mangers and Local Authority Planning officials with the information required to implement practical, efficacious and cost-effective adaptation strategies for flood mitigation.

For further information, please contact Dr Lynne Jack on l.b.jack@hw.ac.uk
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<tr>
<th>EXHIBITIONS &amp; CONFERENCES</th>
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| **12th Indian Plumbing Conference and Exhibition**  
25 – 26 July, 2008  
Jaipur – India  
www.ipaevents.com |
| **34th International Symposium – Water Supply and Drainage for Buildings**  
8-10 September  
Hong Kong – China  
www.bse.polyu.edu.hk/wsdb2008 |
| **World Plumbing Council Conference & Exhibition**  
24-27 September 2008  
Calgary, Alberta – Canada  
www.worldplumbing.org/2008.html |
| **ISH North America**  
1-3 October 2008  
Atlanta, Georgia - USA  
www.usa.messefrankfurt.com |
| **WaterSmart08 Innovations Conference**  
8-10 October 2008  
Las Vegas, Nevada – USA  
www.watersmartinnovations.com |
| **Engineered Plumbing Exhibition – EPE**  
25-29 October 2008  
Long Beach, California – USA  
www.aspe.org |
| **World Toilet Summit and Expo**  
4-6 November 2008  
The Venetian Macao-Resort-Hotel, Macau  
www.worldtoiletevents.com |
| **Canadian Waste and Recycling Expo**  
5-6 November  
Toronto, Ontario – Canada  
www.cwre.ca |
| **The Big 5**  
23-27 November 2008  
Dubai, UAE  
www.thebig5exhibition.com |
| **AHR Expo**  
26-28 January 2009  
Chicago, Illinois – USA  
www.ahrexpo.com |
| **PlumbexIndia ’09**  
30 January – 1 February  
Bombay Exhibition Centre, Goregaon (East), Mumbai – India  
www.plumbexindia.in |
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