FWR NEWSLETTER
...from the Foundation for Water Research
www.fwr.org
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Welcome to the winter issue of the FWR Newsletter

Water efficiency should be the default mindset for all of us, but it's clear that there is still some way to go before this becomes the case. *Waterwise* seeks to change this, tackling the public, business, water suppliers and government policymakers to name but a few. I am very grateful to Jacob Tompkins, the Director of Waterwise, who has written our lead feature, taking us through the organisation's history, their achievements to date and their future aspirations.

In our *Wastewater Matters* article, we take a look at microplastics in the freshwater and terrestrial environments. A more in-depth feature on microplastics is planned for the next newsletter. Mike Waite tells us about the latest news in the world of microbiological water quality and the issues involved. Finally, three delegations from China have recently visited us at FWR – more about this on page 7.

For information on events and news highlights please go to our website *www.fwr.org.* You can also contact us via email *(office@fwr.org.uk)* or telephone (01628 891589).

Maxine Forshaw - Editor

THIS ISSUE

'Tap into Savings' project

Prof Jacob Tompkins
Director, Waterwise

WATER EFFICIENCY: THE WATERWISE STORY

SO YET AGAIN water security and drought has been highlighted as a key global risk by the World Economic Forum.

Over the past decade business, governments and the public have begun to realise that water and water management is of vital global importance. Yet, to a certain extent, the fact that it is perceived as a global risk is problematic; when something is seen as global and huge it is often not seen as something that can be solved at a local scale.

The problem with the global water crisis is that it is a slowly unfolding crisis and the general response is 'someone should do something about this' rather than 'what can I do about this?' This is clearly because for the past couple of centuries water utilities have told people that water is something engineers will sort out and that it is none of their business; rivers have been tamed, culverted and canalized; supply has been increased, demand has been met and technology has solved everything. But in the past couple of decades we have realised that, actually, engineers can't solve everything and a hard engineering approach to water management combined with a *laissez-faire* approach to consumer action has led to an unsustainable water system. Water has to be democratised and we need to start to re-engage with the public and re-engage with natural water systems.

And this idea of re-engagement has been at the core of **Waterwise's** mission over the

River Lavant, West Sussex, during a drought in 2011

past 12 years. Waterwise is a sustainability NGO (non-governmental organisation) established in 2005 by the water industry. Its aim is to promote the efficient use of water to ensure that water is used wisely by everyone, everywhere, all the time. This is a very specialised mission focussed solely on water efficiency, but it covers all aspects of water efficiency and as such it relates to all aspects of water management and touches upon wider themes of economy, environment, society, the built environment, politics, governance and much more.

Waterwise was established by the UK water companies because of an understanding that, despite their statutory duty to promote water efficiency, this was an area where they were weak. Before 2005 the majority of water efficiency action was small scale and detached from the real business of water utilities; also, whenever water companies tried to encourage people to reduce water consumption they would face questions over their own leakage.

Therefore Waterwise was established as an independent NGO which could co-ordinate water efficiency action, set standards for projects and data, and work with consumers to change behaviour. There was some resistance to our establishment with a lot of people questioning the need to promote water efficiency and a number of people who were set against the idea of demand-side measures altogether. The fact that the water industry came together and collectively established an independent body that could potentially act against the short-term interests of the sector in favour of long term sustainability, is a credit to the foresight of the water companies and Water UK; and, unlike the energy sector, this was done voluntarily without government regulation or pressure.

When it was first established, the Waterwise Project was, as the name suggests, a five-year project to enable and facilitate water efficiency. It soon became clear, however, that water stress was a major global issue and that there was a long-term need to continually promote efficiency, therefore Waterwise became an established NGO.

Extreme water efficiency from the 1976 drought

We have undertaken a large number of initiatives, but in my view our main achievement of the past 12 years has been to raise the profile of water efficiency and make it seem normal. This may sound strange, but I remember being personally mocked in the Scottish press when we held our first water efficiency round table in Edinburgh, yet now the idea of saving water in Scotland seems a natural thing to do. This normalisation of water efficiency and shifting of public opinion has taken a long time but is now, we hope, an embedded trope.

And what else have we learned about water efficiency during Waterwise's first 12 years? Firstly, the most effective actions we have undertaken have been done in partnership – water companies, for instance, housing associations and NGOs can deliver a lot more together compared to separately. Secondly, one of the least valued but most important activities is facilitation: bringing together groups of actors, ensuring that policies align, and oiling the wheels is key to delivery. Thirdly, the most effective actions combine technology and sociology: clever kit combined with winning hearts and minds really works. Fourthly, money is king: we have found that environmental arguments are not enough – we have to show costs and benefits and use the right language to persuade people that water efficiency means economic efficiency. And finally, it's not just about water companies – everyone has an interest in water and it is essential that we harness the activities of commercial organisations, NGOs and citizens to augment what water companies are doing.

There are many areas where we have made progress. Working closely with manufacturers, we have promoted the development of new water-saving devices and products. We pioneered the first large-scale water efficiency retrofit programme which demonstrated that door-to-door installation visits work as a way to reduce household consumption and engage customers; this approach is now commonplace amongst UK water companies.

The Waterwise evidence base was the first attempt to formally collate and

The retro-fitting of a water efficient toilet

analyse water efficiency activities and to estimate the costs and benefits of various interventions. We have also worked extensively on policy to try and establish a framework for water efficiency; we helped establish the 'Ministerial Water Saving Group' and were also one of the founder members of *Blueprint for Water*, which is a coalition of green NGOs with over seven million members between them. The Ministerial Water Saving Group was a cross-departmental group that embedded water efficiency concepts into building regulations and set water efficiency targets for water companies, but it was too short-lived to fully secure these outcomes. *Blueprint for Water* consolidated the green water policy agenda down to a ten-point plan which included water efficiency and metering, and used this plan as a tool to press government and the water sector to adopt pro-environmental approaches, including securing the Ofwat resilience duty in the last Water Act.

Over the years we have seen a shift in attitudes to water efficiency. Originally, the Environment Agency was the main proponent of demand-side management, but their engagement has declined. At the same time there was some scepticism from Ofwat but again this has changed and now we see them as one of the main drivers of sustainable consumption. What seems to have happened is that water efficiency has evolved from a predominantly environmental concern to a serious viable water resource option. We have seen a lot more focus on economics and logistics of delivery. The environmental aspects are still vitally important but now we are also seeing interest in resource efficiency, business continuity, and cost savings and key drivers. This means that UK water companies are now carrying out very large-scale water efficiency programmes that are contributing to their supply-demand balance. And we are also seeing a lot more involvement from the business and industrial sectors. This mainstreaming of water efficiency is a very positive development.

But the promotion of water efficiency is still very much a work in progress and there are quite a few areas where we have, as yet, failed to make progress. There is a lot of academic research and innovation that is still not being adopted by the water sector. There is more work to do on labelling of water efficient products. The house building sector is still not fully on board with the concept of water efficiency. It is true that we have established an acceptance of the need for water efficiency and that people understand the need for water-saving behaviours, but we cannot yet say that we have established a water-saving culture. There is a lot more work to be done around the use of behavioural techniques, gamification and engagement in the water sector.

From a policy perspective there is still a lack of understanding of the pressing need to be water efficient, and how water efficiency could contribute to a wide range of other policy areas; the efficient use of water and its role in the water-energy-food nexus is not understood by politicians. In addition, the way that water efficiency could meet the UK's carbon targets is underestimated; the role of water efficiency in reducing abstraction which will benefit the aquatic environment and also help mitigate flooding is certainly not appreciated; and the role of water efficiency in developing the green economy is still not being seen.

Water efficiency can create skilled jobs, it can reduce household utility bills, it can boost manufacturing productivity and profitability and, given that smart water tech is a massive global growth area, it could act as a catalyst for green tech.

And finally, we still have not achieved our aim of putting water efficiency at the core of water company thinking. Most, but not yet all, UK water companies have water efficiency teams and programmes and these are a vast improvement on what we saw a decade ago; many of these companies are carrying out tens of thousands of water efficiency home retrofits and some of them are looking at behavioural approaches. But water efficiency is still not second nature. Waterwise was key in moving Ofwat from a Capex/Opex approach to a Totex one and this has had a major impact on enabling companies to deliver new types of water resource schemes which can include water efficiency, but many companies still don't value water efficiency.

Hopefully the next decade will see a move beyond water efficiency to a consideration of water in the circular economy and a better appreciation of the water-energy-food nexus. I am leaving Waterwise in April and Nicci Russell is taking over and, given her skills in policy and delivery, I am very hopeful of a further step change in the way water is efficiently managed. ❖

Find out more at:
www.waterwise.org.uk

Images, courtesy of Waterwise.

Refitting a tap with a flow regulator

FWR Water Supply
the information centre for water, wastewater and related environmental issues

MICROBIOLOGICAL WATER QUALITY ISSUES AND CONTROL

November 2016

Mike Waite, *FWR Water Supply Co-ordinator*

Interactive session to explore how microbiological results can help to identify and resolve water fittings non-compliance.

FOLLOWING CIWEM'S SUCCESSFUL *DRINKING WATER 2015* CONFERENCE, this technical seminar allowed us to share new information and experiences on topics relating to microbiological issues for drinking water.

We started with a presentation from Laura Marsh (DWI) who reminded us about the **regulatory framework** and drew attention to the significant changes embodied in the recent Water Supply (Water Quality) Regulations 2016. The Regulations specify the requirements for wholesomeness and give expanded and updated requirements for disinfection. They also specify the need for risk assessment of all sources and for details of risk assessments to be notified to DWI. She referred to a significant number of events related to loss of disinfection. Carrying out audits on implementation of the recent revised guidance on UV disinfection, DWI found that while most public supplies were compliant, 12.8% of private supplies had *E.coli* and 13.4% had enterococci. Users often had little understanding, and information from suppliers was often lacking.

Robert Pitchers (WRc) outlined the work of the **European Aquavalens project** which is looking to improve methods for pathogen detection, mainly using genetic techniques. It has developed polymerase chain reaction (PCR) for hepatitis A and norovirus, and progress is also being made with methods for *Cryptosporidium, Giardia* and *Toxoplasma*. Using nine different markers it is possible to distinguish human from animal pollution sources with 86% accuracy, although humic substances can interfere.

A brief account of research on **chlorine resistance in coliforms** was provided by Cara Wray (Newcastle University). Laboratory studies on source water from five water treatment works using a range of chlorine concentrations and contact times, led to the conclusion that chlorine resistance is not genetic and resistance is unlikely to develop because of multiple cellular targets and high chlorine doses. There was some difference between chlorine resistance of laboratory, environmental, and human strains of *E.coli* but only at low chlorine doses. Coliforms might survive conventional disinfection by being adsorped onto particles, shielding in biofilms, or by being ingested within zooplankton.

Simon Osbourne (Wessex Water) spoke about **the challenges of retrofitting UV** at Durleigh Treatment Works in Bridgwater, Somerset. He outlined the considerations that led to the choice of a UV system and the decision to position it after the contact tank rather than after the granular activated carbon (GAC) filtration system.

A UKWIR project on **disinfection of microbes attached to particles** was described by Pete Jarvis (Cranfield University), with particular reference to the effect of turbidity on disinfection efficiency. He discussed the outcomes of a range of experiments on the effect of a number of possible turbidity-creating materials. Key observations were that different concentrations of particles could give the same turbidity, and chalk and iron provided the most significant bacterial attachment, while free chlorine residual or UV transmittance are the most important controlling parameters for efficient disinfection.

Laura Murray and Nicola Hepburn (Scottish Water) then spoke about **optimising treatment using flow cytometry.** [Flow cytometry is a technology that is used to analyse the physical and chemical characteristics of particles in a fluid as it passes through at least one laser.] They observed that over 99% of bacteria in water are unculturable. Using vital stains and flow cytometry they were able to count live and dead bacteria and found 10^3 –10^4 bacterial cells in waters with nil viable counts, of which about 10% were viable cells. Using flow cytometry they could identify service reservoirs at increased risk of bacteriological failure.

We then enjoyed a thought-provoking remote presentation from Ameet Pinto (Northeastern University, Boston, USA) via a telephone link who said that it should be possible to **predict microbiological incidents** rather than relying on inefficient and expensive monitoring. DNA sequencing which cost $10,000 per million basepairs in 2001 now costs as little as $0.03. Using hand-held sequencers and continuously sending data to the cloud (computing services hosted over the internet) could permit modelling of community dynamics over space and time in drinking water distribution systems.

Katherine Fish (Sheffield University) spoke about her research into the **microbiology of distribution systems, looking at biofilm life cycles**, wanting to know more about the influence of hydraulics on biofilm structures in pipelines. Biofilms can be a major cause of turbidity problems in drinking water.

The final presentation was from Simon Cole (Wessex Water) who discussed the significance of ***Pseudomonas aeruginosa* in drinking water**. As only 5–15% of people may be harbouring *Ps. aeruginosa* at any one time, it is not of use as an indicator of faecal pollution, but the SCA (Standing Committee of Analysts) in their publication *The Microbiology of Drinking Water (2010)* say it should not be present in drinking water. Tests on water fittings in use have shown an increasing number of random taps to be positive for *Ps. aeruginosa*. It is an opportunistic pathogen and cases of infection from water systems have been reported.

The meeting concluded with a hosted interactive session based on a real-life contamination incident associated with water fittings. ❖

FWR Wastewater
the information centre for water, wastewater and related environmental issues

WASTEWATER MATTERS
Microplastics

Steve Bungay, *FWR Wastewater Section Co-ordinator*

THE PRESENCE OF PLASTIC PARTICLES IN THE ENVIRONMENT IS OF GROWING ECOLOGICAL CONCERN. Small pieces of floating plastics in the surface ocean were first reported in the scientific literature in the early 1970s. The term *microplastics* has since become widely used to describe small pieces of plastic and although there is no formal definition, microplastics is used as a generic term for pieces of plastic in the size range 1 nm to < 5mm. Their persistency and ubiquity in the marine environment, and their potential to contain or adsorb persistent organic pollutants may facilitate the entry of such chemicals into the food chain.

Credit: MPCA Photos

Microplastics can originate from a variety of sources, including cosmetics, clothing, and industrial processes. The origin of the plastic distinguishes it between 'primary' and 'secondary' microplastics. Primary microplastics are manufactured and are a direct result of human material and product use, whereas secondary microplastics are fragments derived from the breakdown of larger plastic debris. Primary microplastics include industrial 'scrubbers' used to blast clean surfaces, plastic powders used in moulding, microbeads used in cosmetics, and plastic nanoparticles used in a variety of industrial processes. Secondary microplastics can arise from the breakdown of textiles, plastic paint and tyres.

While the effects of microplastics on marine ecosystems are well documented, little is known about the release and retention of microplastics in freshwater or terrestrial environments. Sources of microscopic particles to the environment are numerous and varied. Microplastics will be released into river networks from households, industry, roads, and from sewage treatment works (STWs). STWs are a critical link in the transport and distribution of microplastics, given that many plastic particles including microbeads and synthetic fibres will enter the treatment works. However, although discharges from STWs are a potential route to the sea and other aquatic environments, the majority of microplastics encountered at STWs are retained and not discharged in the treated final effluent. A large fraction of these microplastics are removed from the water line with the microplastics being retained within the sewage sludge. Therefore, a significant route of microplastic to terrestrial environments is via agricultural soils, which have great potential to accumulate microplastics released by sewage sludge application. It has been estimated that 110,000–730,000 tonnes of microplastics are transferred every year to agricultural soils in Europe and North America. This level of microplastics exceeds the estimated total burden of microplastics currently in ocean water.

Under normal operating conditions, discharges of treated effluents from STWs are not responsible for significant levels of microplastics discharged into rivers. Other sources such as plastic packaging, particle runoff from roads in the form of tyre wear particles, and polymer paints are likely to constitute more significant sources of microplastics to aquatic environments and river sediments than STWs. Levels of microplastics being discharged from STWs will be elevated during storm conditions and discharges from sewer overflows, but generally, sewage effluent may be a less significant source of large microplastic particles compared with direct runoff from land. Plastic pellets associated with tarry residues or attached to tar-based substances also indicate that road-derived particles enter river systems.

Microplastics are observed in river sediments in both rural and urban locations. Typically, they arise from locally derived secondary microplastics rather than primary microplastics from consumer products or secondary artificial fibres introduced by discharges from STWs. However, the utilization of sewage sludge on agricultural soils can represent an important pathway for the diffuse emission of microplastics to the environment. Microplastics in sewage are transferred at the STW from the water line into the sludge line. Once the sludge containing microplastics is applied to agricultural soil, the microplastics can, in turn, be transported from the agricultural soil to the river system. The retention efficiency of microplastics in soils and river sediments will be affected by the density and size of the plastic particles. Microplastics with a density higher than water and larger than 0.2 mm are effectively retained. Whereas particles lighter than water with a particle size less than 0.2 mm will eventually be conveyed from the soil, to the river system, to river sediment, and subsequently to the marine environment.

Microplastics are becoming ubiquitous in the environment. Particle runoff from roads, and runoff from land containing degraded plastic litter will be the major source of microplastics directly entering the freshwater environment. In contrast, sewage sludge provides an indirect source of microplastics entering freshwaters. However, sewage sludge used on agricultural soils will be the major source of microplastics directly entering the terrestrial environment. Ultimately, chemical-based microplastics are not only entering the human food chain via the marine environment but also through the terrestrial environment via food grown for human consumption. ❖

FWR Wastewater
the information centre for water, wastewater and related environmental issues

Urban Drainage Conference

9-11 November 2016, Blackpool

Steve Bungay, *FWR Wastewater Section Co-ordinator*

CIWEM's Urban Drainage Group (UDG) (formerly known as WaPUG, the Wastewater Planning Users Group), has been promoting best practice in the field of urban drainage since it was formed in 1984.

Credit: John M Wheatley.

The UDG annual conference and exhibition spans three days and is the industry's main event of the year. There is a conference, workshops, dinner and a research forum, all supported by an industry-led exhibition, including representation from FWR, as we are a long-term sponsor of the event.

The event opened with a UDG R&D workshop: an update on the UDG Modelling Code of Practice. The main conference opened the following morning with the keynote address. During this, tributes were given for Andy Eadon and Jamie Margetts who both sadly passed away just prior to the conference. Andy and Jamie have made tremendous contributions to the Urban Drainage Group over the years, and they will be dearly missed.

Day 2 of the conference included sessions on strategic modelling programmes, managing modelling risk, and understanding inflow and infiltration. The day continued with three workshops covering *The Future of Flows, Understanding Uncertainty in Urban Drainage Modelling, and Urban Drainage Modelling & Asset Management*. Prior to the conference dinner, there was an early evening reception where Andrew Walker from *Innovyze* gave a live preview of their latest software applications in action. For most, the day concluded with the dinner, but the New Members Group carried on socializing, going on to explore Blackpool's nightlife…

Day 3 included sessions on optimising model use, a series of mini papers covering insights from around the UK, with the final session involving modelling case studies. The UDG autumn conference continues to be a high-class event. This year there were around 200 delegates, bringing together established experts in the field with young, fresh engineers just embarking on a career in urban drainage. A number of the papers presented can be found on CIWEM's website at: *http://www.ciwem.org/events/urban-drainage-group-autumn-conference-exhibition/*

European Biosolids Conference

15-16 November 2016

The European Biosolids Conference is Europe's foremost conference for the biosolids and biowaste industries. This year it moved from its traditional home of Manchester Town Hall to the Edinburgh International Conference Centre.

Prior to the conference there was a site visit to Seafield Wastewater Treatment Works. The conference proper started with a plenary session where Scottish Water set out their plans for updating their National Sludge Strategy; Alex Sinclair (SAC Consulting) then gave an update on the Brian Chambers Soil Fund, which was established to provide grants and help fund the learning and development costs of students and early career scientists. The conference included the usual number of high-quality papers covering technical advances in biosolids treatment and use. With potential changes facing the UK biosolids industry arising from both Brexit and Ofwat's proposed deregulation of the sludge market in England, the conference reflected this with sessions covering the UK regulatory framework for sludge, and a panel discussion on regulations post-Brexit.

Edinburgh Castle. Credit: Andy Stephenson

Appealing to both UK and non-UK delegates, the first technical session of the day, chaired by Keith Panter (Ebcor), saw a number of papers on anaerobic digestion. As well as the customary papers on advanced digestion and thermal hydrolysis, Matt Smyth (Aqua Enviro) presented a predictive model for determining ammonium levels in digestate liquors. The model was originally developed by Helix ECL and then refined and calibrated by Aqua Enviro. It has become a key tool in the design of liquor treatment plants at both municipal and commercial anaerobic digestion sites.

Other sessions included *Thickening and Dewatering, Biosolids Recycling, Quality of Organic Materials, and Changes in Biosolids Regulation*. In the session on *Biosolids Regulation*, Alec Llewellyn (ABL) gave an update on the Biosolids Assurance Scheme (BAS). Although a voluntary scheme, it is likely to play a key role when Ofwat's plans for deregulating the sludge market are rolled out. Day 2 included sessions on *Thermal Hydrolysis, Optimising Biogas Use, Energy and Nutrient Recovery,* and a panel discussion on *improving regulation of organic waste post-Brexit*, plus a workshop on the *R&D needs of the water industry*. In the session on *Thermal Hydrolysis*, Michael Theodoulou (GE Water & Process Technologies) gave a very illuminating presentation comparing the long term performance of a number of full-scale biological and thermal digestion facilities, where the best MWe (megawatt electrical) yields per tonne of dry solids digested were achieved using biological hydrolysis.

Matt Smyth, Aqua Enviro – introducing a model to determine ammonium levels in digestate liquors

Reinforcing the European and international standing of the conference, presentations were given by speakers from America, Canada, China, Germany, Ireland, the Netherlands, Nigeria, Norway, Spain, and Switzerland. The conference was a huge success, with over 200 delegates attending. ❖

1ST UK-Brazil Workshop on Sustainable Wastewater Treatment

Steve Bungay, *FWR Wastewater Section Co-ordinator*

Delegates at the workshop

In November the Federal University of Minais Gerias (UFMG), COPASA (Water and Sanitation Company for the State of Minas Gerais), Newcastle University, and Cranfield University organised the 1st UK-Brazil workshop on Sustainable Wastewater Treatment, in Belo Horizonte, Brazil. The workshop was part of the Prosperity Fund initiative *Minas Gerais Sustainable Sewage and Wastewater Management*, a bilateral project between the British Embassy and the Brazilian government.

The purpose of the project is to improve Brazil's sewage system and implement sustainable sanitation infrastructure, based on UK expertise. A delegation of experts from the UK travelled to Belo Horizonte to take part in the workshop; this comprised a two-day conference and site visits to the UFMG centre for research and training in sanitation at Arrudas Sewage Treatment Plant, and Onça Sewage Treatment Plant.

UFMG centre for research and training in sanitation, Arrudas ETE

The conference was attended by about 200 delegates, with a mixture of technical presentations given by speakers from Brazil and the UK. The workshop was organised by Dr Cesar Mota, Professor Carlos Augusto de Lemos Chernicharo, and Thiago Bressani Ribeiro from UFMG. The twelve speakers from the UK included myself and speakers from Anglian, Northumbrian, Severn Trent, Thames, and Scottish Water; Ofwat, Mott MacDonald; Cranfield University and Newcastle University.

The first day of the conference saw sessions covering technology overview, nutrient removal-recovery, closing the water-energy-waste loop locally, sustainable rural communities, and micropollutants removal. On day 2 the sessions covered regulatory framework (water reuse, sludge, energy, water and sewerage providers' regulation), and sludge management, combined heat and power, biogas upgrading and grid injection. The two days were very successful, presentations being given in English and Portuguese, with live translations for the speakers and delegates. Each session concluded with a panel question and answer session.

The final day involved two site visits: to the research centre and pilot-scale wastewater treatment facilities at UFMG (Arrudas sewage treatment plant), and then to Onça sewage treatment plant. The sewage works at Arrudas includes anaerobic digestion with gas turbines for energy recovery. The research centre there has a variety of large-scale pilot plants, including combined anaerobic and aerobic treatment plants, packed towers, and ponds, with an emphasis on low-energy sewage treatment. Onça is the largest sewage treatment plant in Latin America to adopt anaerobic reactors for mainstream sewage treatment. It uses upflow anaerobic sludge blanket (UASB) reactors for carbonaceous treatment followed by nitrifying trickling filters, treating 1,800 l/s.

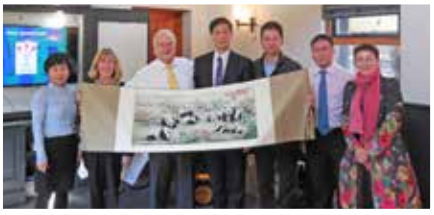
Prof Carlos Augusto de Lemos Chernicharo explaining the sewage feed and distribution system in the UASB reactors at Onça ETE

One of the objectives of the conference was to disseminate the UK experience, which has a highly developed sewerage network and treatment infrastructure. However, Brazil clearly leads the world in terms of low-energy mainstream sewage treatment. ❖

CHINESE DELEGATIONS VISIT FWR

IN NOVEMBER AND JANUARY we hosted three separate groups from the Provinces of Zhejiang, Sichuan and Hubei. The groups were visiting the UK as part of a wider tour to Europe. Neil and Maxine gave presentations on the Water Framework Directive: the background and key features of the Directive, followed by the implementation of WFD at the catchment level, using local examples. ❖

Delegates from Zhejiang



Sichuan

Hubei

Foundation for Water Research
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An update on the activities of the FWR

Caryll Stephen

Chief Executive of the Foundation for Water Research

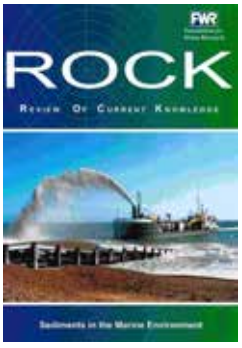
2016 WAS A BUSY YEAR FOR US in which we produced a number of publications, exhibited at various venues and hosted a couple of delegations from China. We also answered many technical inquiries throughout the year.

I am pleased to say that this trend seems set to continue. We have already hosted a further group of Chinese (from Hubei Province) in January and have launched two further Reviews of Current Knowledge, with a third publication well on the way, and it's only February!

One of our main tasks during **2017** is to revamp the FWR website, bringing it up to date with our catchment work and generally updating much of the existing information – there will be more about this in the next newsletter. In the meantime, we would like to thank all the contributors to our newsletters – your input is very much appreciated and we wish both you and all our readers a good year ahead. ❖

FWR Publications

Copies of these reports are available from the Foundation for £15 each, less 20% for FWR members.



Sediments in the Marine Environment

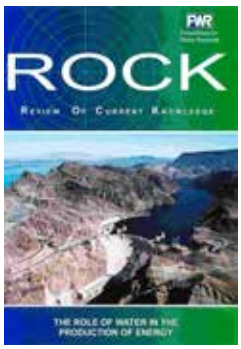
FR/R0025

The movement of sediments in the marine environment is an important subject with influence on all nations with a coastline. Sediments are the result of erosion of the earth's surface since the planet was formed. The processes of erosion and deposition are natural phenomena which were largely unaffected by humans, but civilisations developed and the changes then intensified, particularly since the start of the Industrial Revolution.

Coastal development may result in erosion or deposition on the coastline as it disturbs the equilibrium between the energy of the water motion and the availability of mobile sediment; this can cause significant problems to the use of ports and beaches. Knowledge of the balance of supply and loss of sediment to marine systems, and of their motions in the marine environment, enables us to predict future changes as affected by the climate and human activities. For example, in port development, the ability to predict the volumes of maintenance dredging will determine the viability of the port and the operating costs.

Topics covered include:

- Marine sediments – characteristics, sources and coastal sedimentary features
- Movement of sediments in the marine environment
- Marine sediment issues
- Estimation of sediment movement
- Methods of marine sediment control
- Future concerns
- Further reading.



The Role of Water in the Production of Energy (revised)

FR/R0016

Water is just one of many sources of energy; others include solid fuels, oil, natural gas, nuclear fusion, biofuels and waste, together with smaller contributions from geothermal, solar, wind and heat. This revised edition of the ROCK updates the information for an energy market which is changing rapidly.

Hydropower makes a relatively small contribution towards the overall supply of energy worldwide. By far the largest energy supplies come from solid fuels, oil and natural gas. However, energy from water is probably the most abundant renewable source of energy. It is currently dominated by large scale hydroelectric schemes but alternative methods involving rivers, tides and waves are either available or are being developed.

The first part of the review looks at energy derived from all sources, with both a worldwide and then a UK focus. Later chapters consider the various methods of extracting energy from water, including large scale hydroelectric schemes; run-of-the-river hydroelectric schemes; pumped storage; tidal barrage; and energy from waves and tidal currents.

COMING SOON – A Review of Current Knowledge publication on:

Climate Change: The Fundamentals

Design Agency - http://www.connellmarketing.com

Publication Nº : FWR-NEWS 26-0

Foundation for Water Research
Allen House, The Listons, Liston Road,
Marlow, Bucks SL7 1FD.
T : +44 (0) 1628 891589
F : +44 (0) 1628 472711
E : office@fwr.org.uk
W : www.fwr.org