CIWEM Chartered Institution of Water and Environmental Management

CIWEM HK INTERNATIONAL FORUM

Managing Metal Contaminants in Water Supply Systems

1 December, 2015 (Tuesday) | 9:30am - 5:00pm
Chiang Chen Studio Theatre
The Hong Kong Polytechnic University

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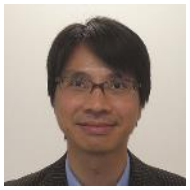
CHAIRMAN'S MESSAGE



Mr. Samuel Kwong
Chairman, CIWEM HK (2014-2016)

It is my great pleasure to welcome you to the CIWEM HK International Forum - Managing Metal Contaminants in Water Supply Systems.

The Forum echoes Hong Kong's recent scenario on lead contamination in drinking water. It aims to present a balanced technical view on the complex subject of lead/heavy metals in drinking water, recognising both the rational facts of public health implications and the enormity of the potential costs involved with further actions to be taken, and encouraging solutions that are environmentally sustainable. Experts from both overseas and local renowned institutions will equip audience with proper and pragmatic perspectives about heavy metals in drinking water.

I am grateful to all speakers from around the world and Hong Kong for sharing their professional knowledge and experiences on the subject. I would also like to extend my heartfelt thanks to our sponsors, supporting organisations, session chairperson and organizing committee members for their contributions and dedication to make this Forum happen.

We look forward to fruitful exchanges and discussions amongst stakeholders and the professionals. I hope you all find this Forum useful for generating more meaningful discussions of the subject and creating solutions to address the current concerns.

I look forward to your continuous support of CIWEM HK.

ABOUT CIWEM HK

The Chartered Institution of Water and Environmental Management (CIWEM) is a UK based Institution and has a history of working in environmental management dating back to 1895. In the succeeding decades, engineers, scientists and other professionals came together to combine their expertise across a broad range of environmental disciplines. The Institution was granted a Royal Charter in 1995 and was proud to celebrate its centenary in the same year.

As a leading professional body, CIWEM sustains the excellence of people who develop and protect our environment now and for future generations. CIWEM also aims to raise the standard of the environmental performance and awareness; and the standard of professional environmental services by members of the Institution who are Chartered Scientist, Chartered Environmentalist, Chartered Engineer and/or Chartered Water and Environmental Manager.

CIWEM HK was established in 1987 when the Institution of Public Health Engineers merged with the Institution of Water Engineers and Scientists and the Institute of Water Pollution Control to form the Institution of Water and Environmental Management. As the only branch of CIWEM in Asia, the differences in economy, climate and culture make CIWEM HK unique when compared with the other CIWEM branches across Europe. Hong Kong's rapid rate of development combined with a high population density in a relatively small area of readily developable land, present totally different challenges to professionals engaged in managing water resources and the natural environment.

The principal challenge for CIWEM members in Hong Kong is to enhance and develop the built environment in a sustainable manner. The issues generated in such a contrasting and constricted area as in Hong Kong provide a great need for the open debate and sharing of knowledge and best practices. CIWEM HK focuses on environmental issues that concern people in the territory and surrounding provinces of Southern China in the Pearl River Delta, and provides a forum for lively discussion and debate. CIWEM HK continues to act as one of the most vibrant learned societies in Hong Kong and take on challenges to treasure with the ever-changing environment in the region.

Website: www.ciwem.org/branches/hong_kong

Email: secretary.ciwem@gmail.com

PROGRAMME

Time	Programme
8:30 – 9:30	**Registration / Tea & Coffee with Refreshment**
	Morning Session Chaired by Ir Norman Cheng, Past Chairman, CIWEM HK
9:30 – 9:40	**Opening Remarks** – Mr. Samuel Kwong, Chairman CIWEM HK
9:40– 10:00	**Welcoming Address** – Prof. Rafid Alkhaddar, President, CIWEM
10:00-10:40	**Water Quality Monitoring and Management of Metals Including Lead in Western Australia** – Dr. Andrew Bath, Australia
10:40-11:00	**Networking Break with Tea & Coffee and Refreshment**
11:00–11:40	**Lead Concentrations at the Tap: How Should I Sample and What do My Results Mean?** – Prof. Michèle Prévost, Canada
11:40-12:20	**Managing Heavy Metal in Potable Water in a University Community** – Prof. Joseph Kwan, Hong Kong
12:20-12:40	**Q&A Session** – Moderated by Prof. Rafid Alkhaddar, President, CIWEM
12:40-13:50	**Luncheon**
	Afternoon Session Chaired by Ir Dr. Anthony Ma, Past Chairman, CIWEM HK
13:50-14:30	**Can Regulators Help Consumers Help Themselves: The Challenge of Lead in Drinking-water** – Dr. Jeff Charrois, Canada
14:30-15:10	**Lead Monitoring and Compliance in the New York City Water Supply** – Mr. Steven Schindler, USA
15:10-15:30	**Networking Break with Tea & Coffee and Refreshment**
15:30-16:10	**Sustainable Management of Water Quality of Dongjiang (The East River) : From Source to Pipe** – Prof. Kin Chung Ho, Hong Kong
16:10-16:50	**Current and Developing Strategies for Plumbosolvency Control in England and Wales** – Ms. Jeanette Sheldon, UK
16:50-17:10	**Q&A Session** – Moderated by Prof. Rafid Alkhaddar, President, CIWEM
17:10-17:15	**Closing Remarks** – Ir Lee Ping Kuen, JP, International Vice President, Hong Kong

Keynote Speech :
How Education can Help Communities to Understand the Importance of Environmental Issues to Promote Proper Sanitation and Safe Water Resources

Prof. Rafid Alkhaddar (UK)
President, CIWEM /
Head of the Department of Civil Engineering,
Liverpool John Moores University

BIOGRAPHY

Rafid has been a member of CIWEM for over 20 years, regularly acting as a Professional Reviewer for new prospective candidates for Institution membership. He sits on the Trustee Board and a number of panels, is an active member of the Editorial Board for the Water and Environment Journal and acted as Chair of the North Western and North Wales Branch in 2003.

Rafid is a Professor of Water and Environmental Engineering and Head of the Department of Civil Engineering at Liverpool John Moores University and is a Visiting Professor to a number of International Universities in Turkey, Egypt and Iraq.

HIGHLIGHT OF THE PRESIDENT'S SPEECH

This Forum does highlight the technical issue of heavy metals, particularly lead, in water supply systems in Australia, Canada, Hong Kong, UK, USA, and how to attempt to find a solution to alleviate them. The UK has suffered and still in a number of areas from such contamination. A lot of efforts are being made to resolve this problem and the UK has introduced a number of initiatives to tackle it. However a lot of work is still needed. The European Union standard for lead in drinking water was tightened from 25 µg/l to 10 µg/l in 2013. CIWEM has published a policy statement with regards to Lead in drinking water and has presented a number of recommendations. The policy statement does call for tightening the lead standard due to the increase in health concerns. It also calls for improving the sampling regime to ensure accurate monitoring of Lead levels in water.

Finally I would like to thank again for inviting me and supporting CIWEM I look forward to your comments and suggestions during this year.

Water Quality Monitoring and Management of Metals Including Lead in Western Australia

Dr. Andrew Bath (Australia)
Advisor CIWEM, Active in National and International Technical Advisory Committees on Water Quality and Public Health /
Water Quality Policy Specialist, Water Corporation, Western Australia

BIOGRAPHY

Dr. Andrew Bath has over 30 years' experience in the field of drinking water quality, public health and water resource management. His Bachelor and Masters Degrees were completed in the United Kingdom and he then moved to South Africa where he completed his PhD in public health. He worked for the South African Government as a hydrologist and then worked in the private sector as a consultant for a large engineering company. Projects included the design and operation of water quality monitoring systems, development of catchment plans, numeric modelling, resource systems planning and development of decision support software. Andrew currently works in the Water Quality Branch of the Water Corporation in Perth. The Corporation is responsible for the supply of drinking water and wastewater services to over 2 million customers, across Western Australia. Over the past twelve years he has managed water quality operations and source protection and he is now water quality policy specialist. Andrew is a chartered member of CIWEM, Water Research Australia's Scientific Advisory Committee, and member of the Australian Water Associations Catchment Specialist Committee. He is an external examiner for a number of local and overseas universities, member of 2 journal editorial boards, and published over 50 scientific papers, reports and articles.

SYNOPSIS

This paper describes the design, implementation and operation of the drinking water quality monitoring program serving over 2 million people in Western Australia. Drinking water is sourced from 90 groundwater bore fields, 60 surface reservoirs, 2 seawater desalination plants and 6 regional desalination plants. In WA, the supply of drinking water to 245 localities has to deal with challenges from remoteness, long pipeline length, extremes in climate, and variable source quality. This paper examines the design and operation of one of the most extensive drinking water monitoring programs operated by a water utility in Australia with over 34,000 km of drinking water pipeline. Case studies focus on monitoring and management of metals, with particular focus on lead, in drinking water.

The Australian Drinking Water Guidelines (ADWG) form the basis of the management of drinking water which recognises the importance of multiple contaminant barriers, understanding potential sources of contamination, and the health requirements of consumers. 3 monitoring programs are used in WA. Operational monitoring of the supply chain ensures the barriers provide safe drinking water. Verification monitoring of the distribution system assesses the quality of drinking water provided to consumers. Customer satisfaction

monitoring provides information on the public's perceived changes in the water supply. Assessment is also undertaken of materials in contact with drinking water to minimise potential contamination from metals and other chemical constituents.

Operational monitoring is documented within a water safety plan for each scheme and describes water quality variables, locations, target limits and corrective action. Operational monitoring allows intervention of a water supply so the quality supplied to consumers is never knowingly jeopardised.

Verification monitoring provides an assessment of the quality supplied directly to consumers and has direct importance in terms of metals and lead. Case studies describe the design of a typical distribution sampling program, use of dedicated sampling points, selection of materials in contact with drinking water, training of sampling staff, flushing of sampling points and analysis of metals data. Experience shows the importance of flushing a sampling point before collecting a sample, the use of dedicated sampling points and challenges faced from using non-routine sampling points. Data reporting includes generation of automated email alerts and production of routine performance reports for our Health regulator. Exception alerts are generated when targets are exceeded and initiate the incident management system to restore the supply within operational limits. The latest ADWG has moved away from compliance reporting in favour of the use of Short Term Evaluation triggered when an operational limit is exceeded. After repeated exceedances, Long Term Evaluation provides a rigorous assessment of the water supply. Monitoring of customer contact information reflects changes in water quality within distribution systems. GIS is used to map customer contacts and identify clusters that may trigger deployment of staff to check for any faults, talk with customers and take extra samples.

Water quality monitoring forms a key component of the delivery of safe drinking water. Each year over 70,000 water samples are collected and analysed for over 270,000 individual constituents. In WA, monitoring and management of drinking water has ensured extremely high health performance. With regard to the management of metals, and particularly lead, the quality of the source, water treatment, flushing rate, and choice of materials used in distribution systems play an important part in meeting quality requirements.

Lead Concentrations at the Tap: How Should I Sample and What Do My Results Mean?

Prof. Michèle Prévost (Canada)
Active in National and International Technical Advisory Committees on Water Quality in Distribution Systems and Buildings /
Industrial Chair on Drinking Water of the National Science and Engineering Council of Canada, Polytechnique Montrea

BIOGRAPHY

Prof. Prévost has more than 30 years of experience in research and technology in the areas of water treatment and distribution. Prof. Prévost holds an Industrial Chair on Drinking Water of the National Science and Engineering Council of Canada (NSERC) at the Department of Civil Engineering of Polytechnique Montreal since 1992. She has conducted pioneer demonstration of biological filtration, focusing on methods to measure biodegradable organic carbon and on process optimization of first stage biological filters and leading to the first full scale design of first stage dual media biological filters in North America. Prof. Prévost has completed applied R&D on source protection (discharge characterization, detection of emerging contaminants, risk assessment), water treatment (impact of water quality on disinfection, biological treatment, high rate filtration, nitrification, oxidation of emerging contaminants such as toxins, hormones and pharmaceuticals, etc.) and various aspects of distribution systems (bio-stability, pathogen regrowth, integrity & intrusion, data mining, hydraulic and quality modeling). Recently, she has directed the Canadian initiative to reduce lead at the tap through a suite of laboratory, field and epidemiological studies. With extensive industrial experience in consulting and technology development with manufacturers, Prof. Prévost has also been active in numerous technical advisory committees to utilities and international organizations (IUVA, IWA, AWWA, etc.) and is a reviewer for international journals (Water Research, EST, etc.). She was a member of the technical advisory committee to the Walkerton Commission and presides the Quebec AWWA-RESEAU Advisory Committee on Drinking Water Regulations since 2003. Prof. Prévost has authored over 145 refereed publications, is the editor of a reference book on Biodegradable Organic Matter and has given over 500 conferences in regional, national and international conferences, many as a guest speaker.

SYNOPSIS

Sampling for lead at the tap is the basis for compliance monitoring and can serve to evaluate the importance of the health hazard associated with lead in tap water. However, when assessing the contribution of lead from drinking water to the overall exposure to lead, it is important to understand if other sources of lead are present and to be able to reconstruct realistic and worse case exposure scenarios at the tap.

Different sampling protocols have been used across the world for compliance, the detection of lead service lines and the investigation of lead sources and exposure. Some protocols are better adapted to single households or large buildings, others present maximum potential exposure concentrations, while others grossly underestimate the concentration of lead at the tap. Factors influencing the occurrence of particulate and dissolved lead in tap water using

different sampling protocols (flushed, 30 min stagnation, random daytime, profiling, >6 hour stagnation, etc.) were investigated and results used to determine the sources of lead in households (lead service lines, lead containing faucets, valves, etc.) and to investigate the extent of galvanic corrosion of taps and lead service lines (LSLs). High particulate lead (Pb) levels were measured in some systems, and the hazard linked to particulate Pb ingestion estimated. in vitro testing of the bioaccessibility of Pb particles from tap water applied to lab-generated particles and field particles shows relatively high bioavailability. This confirms the importance of the potential exposure to lead if lead bearing particles are present at the tap.

Extreme and often sporadic lead concentrations have been reported in large buildings. These elevated concentrations result from the combination of three factors: water quality which is favorable to lead corrosion, long stagnation times, and the presence of lead-bearing components. Leaded solders and brass fittings are typically the major sources of lead in large building tap water. These materials can contribute to lead at even significantly higher levels as compared to those measured in households with lead service line. Lead results from 78,971 water samples collected in elementary schools, daycares, and other large buildings using different sampling protocols were gathered and analyzed according to lead concentration distributions. Worst case buildings showed dramatic concentrations with up to 13,200 and 3,890 µg/L after long and short stagnation.

Biokinetic modelling can be applied to show the overwhelming influence of different sampling protocols on the estimation of exposure and resulting Blood Lead Levels (BLLs). It can also serve to evaluate the benefits of implementing treatment to lower lead levels in households and large buildings. BLL predictions are very useful to assess the urgency and efficacy of remediation measures and to ensure the identification of areas of most concern to prioritize interventions. For example, data from dwellings with/without a lead service line [LSL] sampled for lead in tap water during different seasons were used as input to a batchrun mode of the Integrated Exposure Uptake Biokinetic (IEUBK) model. BLL results showed that children's exposure to lead at the tap in the presence of a LSL varies seasonally, and according to the type of dwelling. The wide seasonal variations in lead exposure resulted in a minimal fraction (0-6%) of children with a predicted BLL >5 µg/dL in winter, as opposed to a significant proportion (5-25%) in summer. In dwellings supplied with a Lead Service Line (LSL), Pb in tap water contributed significantly to children's exposure and was often the dominant source of exposure to lead. Results demonstrate the need to direct interventions and advisories to sub groups of households. Simulations of measured exposure in large buildings, revealed that exposure to lead at most taps is unlikely to increase children blood lead levels (BLL). However, buildings or 'bad' taps showing extreme concentrations represent a significant health risk to young children attending to school or daycare, as estimated BLLs far exceeded the 5 µg/dL threshold. The ingestion of water at certain taps could even lead to acute exposure. Such buildings and taps must be identified and their use banned in order to prevent child lead poisoning.

The relative contribution of drinking water to the environmental (house dust, paint, etc.) exposure of 306 young children in households was studied through a cross-sectional survey conducted from September 2009 to March 2010. Despite relatively low BLLs, tap water and house dust lead contamination contributed to an increase of BLLs in exposed young children and the presence of a LSL was shown to be the critical factor affecting the likelihood of increased BLLs.

Our findings highlight the importance of measuring total lead at the tap (including particulate lead) and of selecting different sampling protocols best adapted to assess lead levels in single/ multiple dwellings and large buildings. Finally, biokinetic models can assist water managers and regulators in determining the urgency, the target and extent of remediation programs to reduce lead at the tap of households and large buildings.

Managing Heavy Metal in Potable Water in a University Community

Prof. Joseph Kwan (Hong Kong)
Director of Health, Safety and Environment,
Adjunct Professor, Division of Environment,
Hong Kong University of Science and Technology

BIOGRAPHY

Prof. Joseph Kwan is the Director of Health, Safety and Environment at the Hong Kong University of Science and Technology. He received academic training in occupational and environmental health from the Schools of Public Health of the University of California at Berkeley and Los Angeles. Prior to his current employment, he served as a hazards control professional in a national laboratory and in the aerospace industry in the United States. His experience includes conducting research studies on non-conventional pollutants in drinking water, and the management of potable water quality.

SYNOPSIS

Prof. Kwan will discuss the anticipation, recognition, evaluation and control of challenges associated with the assurance of proper potable water quality in a university community, with particular emphasis on heavy metals risk management.

The presentation will summarize the university's potable water quality management effort in the past two decades, covering both technical and management aspects during the design, construction, testing and commissioning, and routine operation phases of building facilities. It will include the rationale, approach and details of the potable water quality management program. Case studies will be used to illustrate how problems and deficiencies were detected, investigated and followed through on remediation. He will also share the unique challenges of managing environmental health in a university setting, and how the University has scaled up effort in response to the current community-wide concern. The future outlook and directions for further program enhancement will also be discussed. References will be drawn from various local practices as well as international approaches.

Can Regulators Help Consumers Help Themselves: The Challenge of Lead in Drinking-water

Dr. Jeff Charrois (Canada)
Manager of the Drinking Water and Wastewater Section, with Alberta Government, Canada /
Associate Adjunct Professor, Curtin Water Quality Research Centre, Curtin University, Perth, Australia

BIOGRAPHY

Jeff Charrois is Manager of the Drinking Water and Wastewater Section, with Environment and Parks , Alberta's Ministerial Government, mainly responsible for the delivery of outcome-based provincial programs for drinking water, municipal and industrial wastewater as well as for providing advice, assistance, and support to senior Ministry officials on a variety of strategic, policy, and operations functions.

Additionally, he is an Associate Adjunct Professor, and former Director, of the Curtin Water Quality Centre at Curtin University (Australia). Jeff has 14 years of internationally related experience in the areas of: drinking-, waste-, and recycled-water quality, disinfection by-products, analytical method development, environmental chemistry, and environmental risk management. Dr. Charrois completed his PhD at the University of Alberta in Public Health Sciences, after which he was awarded an NSERC Industrial Post Doctoral Fellowship, which he undertook at the Alberta Research Council. Jeffrey has worked in academic, government, and industry sectors; including 4 years international experience in Australia.

SYNOPSIS

In their 2011 document "Lead in drinking water" the World Health Organization concludes its review of the issues around lead with the following statement, "It needs to be recognized that lead is exceptional, in that most lead in drinking-water arises from plumbing in buildings, and the remedy consists principally of removing plumbing and fittings containing lead, which requires much time and money. It is therefore emphasized that all other practical measures to reduce total exposure to lead, including corrosion control, should be implemented.[1]"

This presentation's title is a question, "Can regulators help consumers help themselves?" and to a large extent this has been answered in the quote above. The most effective action to reduce lead in drinking-water lies with owners of premises where lead pipes or lead-containing drinking-water plumbing components occur through the removal of these items and not through regulatory tools wielded by drinking-water quality regulators on drinking-water systems. In the presentation, a brief and selected review of drinking-water regulations for lead in Canada, US and EU/UK will be discussed. The unintended consequences of chloramination/DBPs in Washington, DC will also be presented. In particular, case studies of lead in drinking water in Scotland and Alberta will be used to demonstrate the challenge behind in terms of Health, Lead Sampling and Analysis.

[1] *Lead in Drinking-water. Background document for development of WHO Guidelines for Drinking-water Quality. WHO/SDE/WSH/03.04/09/Rev/1. World Health Organization 2011. p15.*

Lead Monitoring and Compliance in the New York City Water Supply

Mr. Steven Schindler (USA)
Director of Water Quality, Bureau of Water Supply
New York City Environmental Protection

BIOGRAPHY

Steven Schindler holds a Bachelor of Arts degree in Biology from Lafayette College and a Master of Science degree in Environmental Forest Biology from the State University of New York in Syracuse. He began his career with the City of New York Department of Environmental Protection (DEP) as an Assistant Chemist in 1987. Over his 28 years at DEP, Mr. Schindler has held various positions with responsibilities over laboratory operations and water quality monitoring programs both in New York City's Water Supply watershed and the distribution system.

Mr. Schindler currently serves as the Director of Water Quality for DEP's Bureau of Water Supply, a position he has held since January 2003. In this position, Mr. Schindler is responsible for maintaining and ensuring the drinking water quality for the entire City of New York. This includes maintaining an extensive water quality monitoring program throughout the City and the upstate 2,000 square mile watershed, managing four water quality laboratories performing field sampling and analyses for microbiological, chemical and physical measures of water quality, supporting water supply treatment operations, directing scientific and research efforts related to water quality, and for ensuring compliance with all federal, state and City regulations regarding drinking water.

SYNOPSIS

The New York City Department of Environmental Protection (DEP) manages New York City's water supply, providing approximately 4.2 billion liters (1.1 billion gallons) of high quality water each day to more than 9 million New Yorkers. This includes approximately 8.4 million residents of New York City and over 1 million customers in more than 70 communities upstate. This water is supplied from 19 reservoirs and 3 controlled lakes in a nearly 5,000 square kilometer watershed 200 kilometers north and west of New York City. DEP has an extensive water quality monitoring program which includes conducting testing at streams, reservoirs, and tunnels in the watershed, and at approximately 1,000 sample stations throughout the City's distribution system.

New York City water is virtually lead-free when it is delivered from the water supply system, but can absorb lead from solder, fixtures, and pipes in the plumbing of some buildings and homes. DEP has an active corrosion control program aimed at reducing lead absorption from service lines and internal plumbing, and to manage compliance with federal and state drinking water regulations for lead. To proactively assist customers in understanding risks associated with lead in homes, DEP offers a Free Residential Lead Testing Program that allows New York City residents to have their tap water tested for lead and copper at no cost. This program, the largest of its kind in the United States, includes sampling immediately following a stagnation

period and up to 2 flushing intervals to provide detailed lead data to the customer and DEP. The data collected from this program supplements first flush lead data collected from high risk homes for compliance and provides an overall assessment of the effectiveness of DEP's corrosion control treatment.

The presentation will provide an overview of New York City's water supply system, details of DEP's extensive water quality monitoring programs, background of the World Health Organization guidelines for lead, DEP's experience and compliance history with the United States national drinking water regulations for lead, and information on DEP's free residential lead program and lead sampling research efforts.

Sustainable Management of Water Quality of Dongjiang (The East River) : From Source to Pipe

Prof. Kin Chung Ho (Hong Kong)
Dean, School of Science and Technology
Open University of Hong Kong

BIOGRAPHY

Prof. K. C. Ho got his B.Sc (with Honours) degree in Biology from the Chinese University of Hong Kong, M.Sc degree in Environmental Resources from University of Salford at Greater Manchester and Ph.D from the University of Hong Kong. His doctoral thesis related to significance of red tides in subtropical waters with particular reference to Tolo Harbour, Hong Kong. Prof. Ho was appointed the Dean of School of Science & Technology of OUHK in May 2008. Having served as Dean of S&T in OUHK, he has been concurrently appointed the "Ng Chun Man Professor in Environmental Science and Conservation" from February 2014 after rigorous internal and external assessment.

Professor Ho was awarded the Bronze Bauhinia Star (BBS) badge by the Chief Executive of HKSAR. Moreover, he was conferred the "National Character Environmental Achievement Award" in 2009, "People of the Year - Scientific Chinese 2010" in 2011 and "Leader of the Time Award" in 2013. From July 2014, Prof. Ho has been appointed a Justice of the Peace (JP). Prof. Ho was appointed (by open-election) one of the 1200 members of the Chief Executive of HKSAR Election Committee (representing the Higher Education Sector) in 2012.

SYNOPSIS

On the basis of a priority water-supply agreement, Hong Kong is guaranteed for importing potable water from a major tributaries of Pearl River, namely the East River (Dongjiang). Nowadays, about 80 per cent of Hong Kong's potable water supply is imported from the East River. Due to increase in human activities in the watershed since 1980s, unfortunately, the East River has been contaminated by nutrients, microbes, heavy metals and persistent organic pollutants (POP) to certain extents. Moreover, pollution trended to be extended from point-sourced to non-point-sourced due to soil erosion, increased surface runoff and large scale application of agricultural chemicals in the Pearl River Delta. Yet, the level of lead (Pb) has been maintained at acceptable level over the years. With increased collaboration cross the border in the past 15 years, and the construction and commissioning of a 'closed-managed' water duct, water imported from the East River has been significantly improved in chemical quality. Therefore, recent incidents of lead contamination in potable water of some household seem not relevant to contamination in the East River. Anyway, the Water Supplies Department of Hong Kong (WSD) is responsible for providing safe and healthy drinking water to citizens in the Special Administrative Region. In a long term, WSD shall enthusiastically adopt the concept of "Total Water Management (TWM)" in managing the supplies of potable water. Moreover, the Water Safety Plan as recommended by the World Health Organisation (WHO) shall be actualised by public participation, environmental education and enhanced professional engagement. The fundamental approaches are: 'From Cradle to Grave" and "From Government to Governance".

Current and Developing Strategies for Plumbosolvency Control in England and Wales

Ms. Jeanette Sheldon (UK)
Panel Member, Water Supply & Quality, CIWEM /
Water Quality Manager, South East Water

BIOGRAPHY

Jeanette Sheldon is the Water Quality Manager at South East Water and has worked in the UK water industry for nearly 20 years within water companies and the Drinking Water Inspectorate. Jeanette has worked with both conventional and advanced drinking water treatment processes, initially in research and subsequently as a process scientist and manager. Jeanette spent three years working for the Drinking Water Inspectorate, covering all aspects of Drinking Water Quality Regulation in England and Wales. Jeanette is currently managing the Water Quality team in South East Water, covering sampling, process science at treatment works, catchment management, distribution management and drinking water safety plans.

SYNOPSIS

The water industry in England and Wales comprises of 27 companies and supplies approximately 14,500 million litres of water a day to 57 million customers. Drinking water quality standards are set out in the Water Supply (Water Quality) Regulations for England and Wales; most of the standards for these Regulations are derived from the European Drinking Water Directive. Water companies take and analyse samples as prescribed in the Regulations. The independent water quality regulator, the Drinking Water Inspectorate (DWI), checks and evaluates these results. The DWI also assesses the actions the companies take in response to sample failures, operational events and customer complaints to ensure appropriate actions have been taken to prevent a reoccurrence. Where improvements to the water supply are required legally binding programmes of work are instigated. In addition to the compliance with the individual standards, water companies are required to instigate a drinking water safety plan approach for all supply systems. The DWI and the current regulatory framework were established in 1990.

Under the regulatory framework, the standard for lead at the customer taps has reduced from 50 µg/l in 1990, to 25 µg/l in 2004 and since 2013 the standard has been 10 µg/l. In 1990, approximately 3% of the samples taken to demonstrate compliance failed the standard at that time. As a result, a significant number of programmes of work have been completed throughout England and Wales to improve plumbosolvency control.

Drinking water in England and Wales is derived from a number of natural sources, including river and borehole sources. The characteristics and quality of the source water varies significantly throughout England and Wales, this influences plumbosolvency and the required control strategies. A common plumbosolvency control measure implemented is the dosing of orthophosphate at the supplying treatment works or suitable asset. Orthophosphate forms a

lead-phosphate complex on the interior of pipework and this protective layer acts as a barrier to corrosion. The required orthophosphate dose has been optimised over a number of years, typically with higher doses required initially to develop the protective layer. Extensive monitoring has been completed through the use of customer tap sampling strategies, lead test rigs and other mechanisms to ensure the dosing has been optimised and compliance with the required standard achieved.

A significant reduction in the concentrations of lead at customer taps since the instigation of the plumbosolvency control programmes in the 1990's has been achieved. Research and development in association with a safety plan approach continues to identify further possible strategies for minimising lead concentrations, for example, lead pipe relining and lead pipe replacement. In addition all sources of lead in drinking water have been or are under investigation, for example illegal use of leaded solder and plumbing fixtures and fittings as well as mechanisms for their minimisation.

ACKNOWLEDGEMENT

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Address: P.O. Box 4258 , General Post Office, Hong Kong
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