Drainage Services Department
Research & Development Forum 2011

Morning Session
(Theme : Hydrology and Hydraulics)

Details:

Date : 24 November 2011 (Thursday)

Time : 8:30 a.m. – 12:30 p.m.

Venue : Auditorium, 5/F, CSTDI, North Point Government Offices, 333 Java Road, North Point

Programme:

TIME	TOPIC	SPEAKER
8:30 – 9:00	Registration	
9:00 – 9:10	Opening Speech (Hydrology and Hydraulics session)	Ir. C. C. CHAN Director of Drainage Services
9:10 – 9:40	Regional Frequency Analysis of Extreme Rainfalls in Hong Kong	Prof. Y. K. TUNG, HKUST
9:40 – 10:10	Impacts of Regional Climate Change and Local Urbanization in South China	Dr. J. CHEN, HKU
10:10 – 10:40	Steep Road Drainage Study	Prof. C. W. LI, HKPolyU
10:40 – 11:00	Break	
11:00 – 11:30	Project WATERMAN and the Harbour Area Treatment Scheme (HATS)	Prof. Joseph H. W. LEE, HKUST
11:30 – 12:00	Environmental Restoration of Engineered Drainage Channels	Prof. Onyx W. H. WAI, HKPolyU
12:00 – 12:30	An overview of DSD's R&D Initiatives for civil engineering aspects	Ir. P. K. CHAN AD/O&M, DSD
12:30 – 13:45	Lunch	

Drainage Services Department
Research & Development Forum 2011

Afternoon Session
(Theme : Wastewater Treatment)

Details:

Date : 24 November 2011 (Thursday)

Time : 1:45 p.m. – 5:30 p.m.

Venue : Auditorium, 5/F, CSTDI, North Point Government Offices, 333 Java Road, North Point

Programme:

TIME	TOPIC	SPEAKER
13:45 – 14:00	Registration	
14:00 – 14:15	Opening Speech (Wastewater Treatment Session)	Miss Janet WONG Commissioner for Innovation and Technology
14:15 – 14:40	Fate of triclosan and its degradation products in wastewater	Prof. Z. W. CAI, HKBU
14:40 – 15:05	Use of sewage sludge for land application in Hong Kong	Prof. M. H. WONG, HKBU
15:05 – 15:30	Dry solids dewatering centrifugation and energy savings with high-flow thickening centrifuge for wastewater treatment	Prof. Wallace W. F. LEUNG, HKPolyU
15:30 – 15:50	Break	
15:50 – 16:15	Application of high throughput sequencing in microbial analysis of biological wastewater treatment systems	Dr. T. ZHANG, HKU
16:15 – 16:40	Research projects on sewage treatment at HKUST	Prof. G. H. CHEN, HKUST
16:40 – 17:05	Reduction of hydrogen sulphide odour emissions from box culvert sediments by granular ferric hydroxide	Prof. C. SHANG, HKUST
17:05 – 17:30	An overview of DSD's R&D Initiatives for Wastewater Treatment	Ir. Michael P. K. CHEUNG AD/E&M, DSD
17:30	Forum Closing	

Speakers and Presentation

	Speaker	Description of Presentation
1.	**Prof. Y. K. TUNG** is a Professor in Civil Engineering Department at HKUST. He received his PhD degree in 1980 from the University of Texas at Austin. His main areas of research are in engineering hydrology and hydraulics, risk and reliability analysis of various hydro and environmental systems including urban storm drainage systems, floodplain management, and water quality management.	**Regional Frequency Analysis of Extreme Rainfalls in HK** Hilly terrain in Hong Kong creates significant orographic effect on spatial rainfall distribution. Current drainage design practice in Hong Kong adopts uniform application of rainfall intensity (or depth)-duration-frequency (IDF or DDF) relations at HKO over the entire Territory. This may not capture spatial variability of extreme rainfalls brought by terrain variation at different part of Hong Kong. Although Hong Kong currently is blessed with a highly dense raingauge network (less than 10 km2/gauge) that is sufficient to capture spatial variation of rainfall accurately, the rainfall record length, however, at great majority of the raingauges is generally too short (not more than 30 years with many having 10 years or less) to establish accurate at-site rainfall DDF relations. Under this circumstance, the implementation of regionalization techniques, which trade space for time, is a viable way to establish a more reliable & creditable rainfall DDF relations. Under the sponsorship of the Drainage Services Department of HKSAR, rainfall frequency analysis involving 122 raingauge stations in Hong Kong by three regionalization techniques is in progress. This presentation reports the preliminary findings of the extreme rainfall regionalization study, including some comparisons of the differences in results by different methods and their implications in drainage system designs in Hong Kong.
2.	**Dr. J. CHEN,** received his Bachelor and Master degrees from the Department of Hydraulic and Hydropower Engineering in Tsinghua University, Beijing, China, in 1993 and 1996, respectively. He obtained his PhD degree from the Department of Civil and Environmental Engineering in the University of Illinois at Urbana-Champaign in 2001. From 2001 to 2004, he worked as Postdoctoral Research Associate in the Scripps Institution of Oceanography in the University of California San	**Impacts of Regional Climate Change and Local Urbanization in South China** This presentation provides the analyses of regional climate change features and the local urbanization effects on different weather variables over South China. The weather variables considered are: daily mean (T_m), minimum (T_{min}), and maximum (T_{max}) near surface air temperature, diurnal temperature range (DTR), relative humidity (RH), and precipitation (P). This study reveals that the trends in the variations of these weather variables can be separated into two periods, before and after 1984. Before 1984, there were no significant urbanization effects, and T_{min}, RH, and P steadily increased but T_{max} decreased, resulting in a considerable decrease in DTR and a slight decrease in Tm. After 1984, T_{min} and T_{max}

	Diego. Since September 2004, he has been Assistant Professor in the Department of Civil Engineering in the University of Hong Kong. Dr. Chen's research and teaching interests are in climate change, water resources, flash floods, terrestrial hydrological processes, and the interaction between the land surface and atmosphere.	increased considerably, and the urbanization influence on T_{min}, but not T_{max}, is observable. The urbanization effect causes an extra-increasing trend in T_{min} with a rate of about 0.6ºC/decade and, accordingly, extra-decreasing trends in DTR and RH. The analysis of the seasonal trends reveals that the urbanization influence results in a near-uniform increase of T_{min} for all four seasons and a strong decrease of RH in summer and autumn.
3.	**Prof. C. W. LI** graduated from the University of Hong Kong with a Bachelor degree of Science in Civil Engineering in 1982, and obtained a PhD degree in Computational Hydraulics in 1987. He is a professor in the Department of Civil & Structural Engineering at HKPolyU. His research interests include 3D modeling of flow, water qualities and near field dispersion in coastal and estuarine waters, modeling of wind flow around structures, numerical wave prediction, and wave-current-vegetation interaction.	**Steep Road Drainage Study** In the current practice of pavement drainage design the width of the surface flow along a road curb is limited to a certain value. This implies that the allowable by-pass flow will increase with the longitudinal road slope. For a steep road, the flow can be highly supercritical under an extreme storm condition. At the downstream street junction joining the steep road, a hydraulic jump will occur and the water depth will increase and local flooding may be resulted. In this presentation, a brief review of the possible causes of flooding associated with steep roads is first discussed. A computational fluid dynamics study of the hydrodynamics of flows at steep street junctions is then described. Finally some remedial measures of the steep road flooding problems are proposed.
4.	**Prof. Joseph H.W. LEE** joined the HKU in 1980 where he served as Dean of Engineering from 2000 to2003 and Pro-Vice Chancellor from 2004 to 2010. He is currently the Vice-President (Research and Graduate Studies) of the HKUST. He is the first Asian to be awarded the Hunter Rouse Hydraulic Engineering Award of the American Society of Civil Engineers on 14.8.2009, for his achievements in the civil engineering discipline. Over the past two decades, he has served as expert advisor to the Hong Kong Government and as international consultant on many hydro-environmental projects. He also serves on the Advisory Council on the	**Project WATERMAN and the Harbour Area Treatment Scheme (HATS)** The HKJC Charities Trust has donated HK$30M to project WATERMAN, a joint project between the Department of Civil Engineering and the Department of Computer Science of HKU. The project aims to develop a water quality forecast and management system for the use by government departments and by the general public. This talk will address the challenges of the EIA practices for the water environment in Hong Kong. The processes governing the fate and transport of the pollutants from the sources to the various sensitive receivers will be explained. The major components in Project Waterman's EIA system will be introduced. The development of robust modelling, advanced visualization and Internet-based graphics technologies will be illustrated together with practical application examples including the real-time control of disinfection dosage.

	Environment of Hong Kong., and is a member of Shanghai Committee of the Chinese People's Political Consultative Conference.	It is necessary to assess the environmental impact of natural and man-made discharges such as hydrothermal vents in the deep ocean floor, treated sewage effluents from the HATS, contaminated cooling water discharges from nuclear power stations, brine discharges from desalination plants, or accidental toxic spills from factories.
5.	**Prof. Onyx W. H. WAI,** obtained his PhD degree from the Ohio State University in 1991 with a major in coastal engineering. His research activities are primarily concerned with the fate and transport of sediment particles in water bodies, with interdisciplinary scopes ranging from the prediction of beach erosion to the quantification of sediment-nutrient exchange rate in the water column. His research approach encompasses field investigations, laboratory experiments, and the development and application of high performance numerical models. Recently, he has expanded his research focus to include urban eco-greening. His newly-involved projects investigate the suitability and sustainability of eco-roofs and eco-flood channels in urban areas. He is an associate editor of journal titled "the Engineering Applications of Computational Fluid Mechanics" and is currently Chairman of IAHR-HK.	**Environmental Restoration of Engineered Drainage Channels** Many natural rivers and streams in highly urbanized areas were converted into concrete channels for flood control purpose. While these concrete channels can efficiently convey the flood waters from populated areas, they disrupt the natural equilibrium and eliminate the living habitats of the original rivers. In recent years, many urban cities have recognized the benefits of natural rivers and begun to restore natural features in these concrete flood control channels. However, there is a lack of design methodology for environmental restoration of concrete flood control channels. A general stream restoration approach for flood control channels in highly urbanized areas has been developed. It consists of three components: 1) conceptual design of low-flow channels to re-establish a natural and self-sustainable stream system for selected fish habitats; 2) evaluation of hydraulic and sediment transport relationships for the modified low-flow channel using numerical models; and 3) confirmation of the original flood control function after stream restoration. The focus of this talk is the numerical simulations of hydraulic and sediment behavior of the modified low-flow channel. A two dimensional hydrodynamic and sediment model is used to determine the stable bed form of the modified low-flow channel with deflectors.
6.	**Prof. M. H. WONG** is the Chair Professor of Biology (Dept. of Biology) and Director of Croucher Institute for Environmental Sciences, HKBU. Specialized in Environmental & health impact of persistent organic pollutants (POPs) and emerging chemicals of concern, bioremediation of contaminated soil and water, and environmental & human health risk assessment. One of the pioneers in the area of	**Use of sewage sludge for land application in Hong Kong** Like any other modern city in the world, Hong Kong generates a large amount of sewage sludge that is a by-product of wastewater treatments. Land application of sewage sludge, as fertilizers or soil conditioners, can conserve organic matter and assist with nutrient (especially phosphate and nitrogen) cycles. There are two basic forms of sewage sludge, namely primary and secondary sludge, which are transformed into "biosolids" (i.e., treated sludge) via digestion, thickening, dewatering, drying and lime/alkaline stabilization. In the USA, "biosolids" are divided into "Class A

	pollution ecology in Asia - Coordinator of Central and East Asia of the project "Regionally based assessment of persistent toxic substances" sponsored by UNEP and GEF (Global Environmental Facility). Ranked no. 1 of World Top Chinese Scientists under Environmental Science/Ecology based on total citations.	sludge" and "Class B sludge", where the former has been treated to reduce bacteria prior to land application, whereas the latter has not. "Biosolids" have been used in the UK and European agriculture for more than 80 years, but there is increasing pressure to prohibit this practice on land. This is mainly due to the release of high levels of potential toxic chemicals, such as heavy metals (notably cadmium) and persistent organic pollutants, and emerging chemicals of concern. This presentation attempts to review different issues related to land application of sewage sludge including: characteristics of sewage sludge; contents of toxic chemicals and pathogenic organisms; long-term effects of sludge on soils and crops; human health risks with regard to land application; and alternative pathways for sludge reuse.
7.	**Prof. Z. W. CAI** is the Chair Professor and Head, Dept. of Chemistry, and Director of Dioxin Analysis Laboratory, HKBU and Associate Director of the Joint Institute of Environmental Sciences of HKBU and the Research Center for Eco-Environmental Sciences, The Chinese Academy of Sciences. Specialized in fundamentals and applications of mass spectrometry and other advanced instruments for environmental, biological, pharmaceutical analyses; trace analysis of dioxin.	**Fate of triclosan and its degradation products in wastewater** Triclosan, 5-chloro-2-(2,4-dichlorophenoxy) phenol, is an active ingredient in many household disinfectants and has been extensively used in improving environmental hygiene. The chemical can be found as an antiseptic component in medical products such as hand disinfecting soaps, medical skin creams, dental products and many household cleansers. Triclosan is a relatively stable, lipophilic compound. As a consumer product ingredient, the majority of triclosan enters sewer systems and is transported to wastewater sewage treatment plants. The toxicity of triclosan on human had been investigated for many years. The adverse effects include mild itching and allergic redness on sensitive skins. Thus, triclosan is generally regarded as a low toxicity chemical. However, attention has been drawn to triclosan and its degradation products recently due to their chemical structural similarity with highly toxic contaminants, such as dioxins. Recent studies suggested that triclosan can be undergone cyclization to form 2,8-dichlorodibenzo-p-dioxin (2,8-DCDD) in aqueous solution under UV irradiation. Triclosan can also be easily chlorinated by sodium hypochlorite solution to produce chlorinated derivatives, which can be converted to chlorinated dioxins upon heating and UV irradiation. Furthermore, 2,4-dichlorophenol and 2,4,6-trichlorophenol have been detected as the degradation products of triclosan in water with the presence of low concentrations of free chlorine or in chlorinated waters. Therefore, it is necessary to develop sensitive and selective analytical method for triclosan in order to support investigations its

		environmental fate. A method for the determination of triclosan in wastewater samples was developed. The procedure combining SPE extraction and GC-MS/MS analysis with isotope dilution technique provided good recoveries and sensitivity for the analysis of triclosan. $^{13}C_{12}$-triclosan was used as internal standard for the quantitative analysis. Water samples were prepared and cleaned-up by using a C_{18} solid-phase extraction cartridge. The recoveries of triclosan in spiked coastal water at three different concentrations ranged from 83% to 110%. The method detection limit was 0.25 ng/L for triclosan in 1-L water and the relative standard deviations and relative error were less than 11.0% and 12.3%, respectively (n = 6). The method was successfully applied to analyze water samples collected from wastewater treatment plants at ng/L levels. Although triclosan can be removed extensively during wastewater treatment, investigation on its degradation products is needed.
8.	**Prof. Wallace W.F. LEUNG** is the Chair Professor of Innovative Products & Technologies, Dept. of Mechanical Engineering, and Director of Research Institute of Innovative Products and Technologies, Hong Kong Polytechnic University. Specialized in "Product innovation, design, development and commercialization; air filtration with nanofiber filter media; physicochemical hydrodynamics; separation and filtration, centrifugation, membrane separation and processes, micron-sized particle suspension classification and deliquoring; and mechanical vibration". He has written a McGraw-Hill text – Industrial Centrifugation Technology, held 36 United States patents and many foreign patents. He is currently authoring an Elsevier text entitled Centrifugal Separation in Biotechnology.	**Dry solids dewatering centrifugation and energy savings with high-flow thickening centrifuge for wastewater treatment** In wastewater treatment, centrifuge has been commonly deployed in two applications. A centrifuge is used to thicken the underflow of the secondary clarifier (0.5% w/w) to a pumpable sludge typically less than 5-6%w/w to be sent to the digestor. Here, the flow rate can be large up to 200 m3/h. Separation is measured by solids recovery in the cake which should exceed 90-95% with small dose of polymer, or 85% without polymer. Given the high flow rate, the major concern is the specific hydraulic power consumed by the centrifuge. Typically, the value as recorded for the large thickening centrifuge usually exceeds that determined theoretically due to a good subtle cause. The presentation discusses some innovative measures to curtail this specific power consumption. Also, the digested sludge (typically for anaerobic, about 3-5% w/w) is fed to a dewatering centrifuge to dewater the sludge to a cake dryness of 30%w/w suitable for landfill. The technology has evolved for over 20+ years. The key to the success of getting dry solids and clean effluent while keeping polymer dose (i.e. operating cost) to a minimal will be discussed.

9.	**Dr T. ZHANG** is an Assistant Professor (Environmental Engineering), Dept. of Civil Engineering, the HKU. Specialized in environmental microbiology, toxicology, anaerobic membrane technology, and microbiology in wastewater engineering.	**Application of high throughput sequencing in microbial analysis of biological wastewater treatment systems** Molecular microbial analysis is stepping into a new chapter of high throughput sequencing. This presentation will demonstrate its applications in a few case studies, i.e. major and unique microbial populations in activated sludge. A total of 259 K effective sequences of 16S rRNA gene V4 region were obtained from AS samples of 14 sewage treatment plants of Asia and North America. These sequences revealed huge diversities of bacterial populations in activated sludge which have never been found before, forming 1234~3554 operational taxonomic units (OTUs) per sludge sample at 3% cutoff level. Clear geographical differences among the AS samples from Asia and North America were revealed based on abundances of OTUs or the genus/family/order assigned by RDP. In addition to certain unique bacterial populations in each AS sample, some genera were dominant and core populations shared by multiple samples. Pyrosequencing analyses of multiple AS samples in this study also revealed the minority populations that are hard to be explored by traditional molecular methods, and showed a large proportion of new sequences which could not be assigned to taxonomic units even at the phylum level.
10.	**Prof. G. H. CHEN** is a Professor of Environmental Engineering, Dept. of Civil & Environmental Engineering, and Director of HKUST MSc program in Environmental Engineering, Hong Kong University of Science and Technology. Specialized in water and wastewater treatment and invented new treatment processes such as SANI® and MEPT®. Active and highly recognized in international community, especially IWA.	**Research projects on sewage treatment at HKUST** This talk presents the main results of the study on mathematical sewer biofilm modelling for sulphide control and some new research initiatives including granular-SANI development, a pilot trial of MOST process, seawater-urine P recovery and etc.
11.	**Prof. C. SHANG** is an Associate Professor, Dept. of Civil & Environmental Engineering, HKUST. Specialized in Physicochemical processes including disinfection processes, adsorption processes, and redox processes; environmental chemistry and instrumentation; chlorine	**Reduction of hydrogen sulphide odour emissions from box culvert sediments by granular ferric hydroxide** This presentation discusses an innovative granular ferric hydroxide (GFH)-based technology for in-situ control of hydrogen sulphide odour emission from sediments in box culverts. This technology makes use of the natural iron-sulphur redox cycle to fix odorous

	chemistry; and formation and control of disinfection by-products.	hydrogen sulphide to odourless iron sulphide in the sediment phase. After exhaustion, the used granular ferric hydroxide (GFH) can be oxidized back to iron (hydr)oxide by dissolved oxygen to regenerate the iron granules, which are then reused in the sediment phase. This technology provides a sustainable, long-lasting, in-situ solution to the hydrogen sulphide odour problem originated from the sediment phase in box culverts.