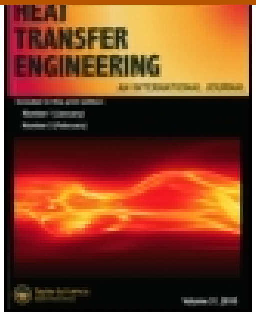

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GUEST EDITORIAL

Selected Papers From the 17th IAHR (International Association for Hydro-Environment Engineering and Research) International Conference on Cooling Tower and Heat Exchanger

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Cooling towers and heat exchangers are used in thermal power plants, oil refineries, chemical plants, HVAC (heating, ventilation, and air conditioning) systems, and many other industries. A well-designed cooling system can have a very significant positive impact on plant profitability.

The past few decades have seen new technologies developed for large cooling towers and air-cooled heat exchangers used in fossil power plants. Some representative examples are the 200-m Niederaussem cooling tower [1] and the Kusile power station in South Africa with 6× 800 MW of dry cooling using air-cooled heat exchangers [2]. A small natural draft cooling tower of 20 m was developed by the University of Queensland for small-scale renewable power plants for remote Australian communities [3]. Issues with the design of small natural draft cooling tower have been addressed by Lu et al. [4, 5].

International gatherings provide the most effective means to keep up with the state of the art in this area because they facilitate direct and quick exchange of experience and provide access to firsthand narratives from expert engineers dispersed around the world. Starting with the first conference in 1978 in France, this 17th conference was held in Gold Coast, Australia, during September 7–11, 2015, and organized by the Queensland Geothermal Energy Centre of Excellence (QGECE) of the University of Queensland with support from the Industrial Committee and Cooling Tower and Air-Cooled Heat Exchanger working group of the International Association for Hydro-Environment Engineering and Research (IAHR).

The conference has brought together academics, researchers, cooling tower manufacturers, industrial experts, suppliers, and power plant staff from all over the world in various disciplines to address the latest developments in cooling technologies, to exchange ideas, and to open chances for cooperation. It gives a unique opportunity for the participants to present the state-of-the-art technologies in both cooling towers and air-cooled heat exchangers.

Seventy-five delegates from 13 different countries attended the conference and 68 high-quality papers over a wide range of topics in cooling towers and heat exchangers are included in the conference proceedings. With the intensive program during the three days of the conference, 64 papers were presented in seven sessions.

In this special issue, we originally selected 20 papers from the conference proceedings as candidates for this special issue. These selected papers were then sent to at least two reviewers for refereeing according to the quality and the journal requirements. Among the 20 papers being reviewed by different reviewers, 15 papers have been recommended for this special issue by the reviewers. The authors were invited to revise/upgrade their manuscripts and resubmit them according to the reviewers' comments and the journal requirements.

The special issue starts with a paper on heat exchanger performance by Dai et al. from Xi'an Jiaotong University, China. The authors report the results of a thermo-economic comparison of a basic organic Rankine cycle (ORC) with a parallel double-evaporator organic Rankine cycle. The working fluids R245fa and R600a are used in their analysis and an increase of about 18% net power is stated when using the parallel double-evaporator organic Rankine cycle. Hosseini Araghi et al. from Edith Cowan University, Australia, investigated a compact multistream condenser on heat recovery for cogenerating water

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and power. They observe the multistream condenser improving the exergy efficiency by 15% compared to a configuration where two separate heat exchangers (condensers) are used. Kuruneru et al. from Queensland University of Technology, Australia, presents a novel and economical experiment method to assess industrial aerosol deposition in various idealized porous channel configurations. They found that the deposition patterns differ with porosity. The study will assist engineers to better optimise the designs of heat exchangers to minimise the fouling. Kaya et al. from Ghent University, Belgium, proposed an iterative heat exchanger design methodology that allows performing a design sensitivity analysis on a V-shaped condenser within an input range of geometric parameters and boundary conditions.

The cooling systems used by thermal power plants include wet and dry cooling; each has its advantages and disadvantages. Xia et al. from the University of Queensland, Australia, compared the water consumption of a 300-MW power plant located in Luoyang, China, between the wet and the hybrid cooling systems. They observe that although the power plant using a dry cooling system could save more than 95% of water, it increases the cost significantly with the dry cooling system. Therefore, each system has its application and efforts have been made to improve their performance. Roux and Reuter from Stellenbosch University, South Africa, tested a new spray system that aims to achieve a uniform water distribution on the fill while operating at a low pressure head. The uniform water distribution increases the cooling tower performance. Another paper in this special issue on improving wet cooling tower performance is by Zhao et al. from China Institute of Water Resources and Hydropower Research. They built a numerical model to predict the performance of natural draft wet cooling towers with water collectors under the fill. The water collectors improve the airflow into the fill so they increase the wet cooling performance. One of the concerns with wet cooling towers is the growth of *Legionella* that cause Legionnaires' disease. Consuegro et al. from Technical University of Cartagena, Spain, simulated the dispersion of drift from a wet cooling tower. They modeled the urban environment of Murcia, the city that experienced the largest recorded *Legionella* outbreak in 2001. The predicted dispersion results reported in their paper compare well against the actual epidemiological data.

While dry cooling helps water conservation and environmental protection, dry-cooled power plants suffer lower efficiencies when the ambient air temperature is high [6]. A Queensland coal seam gas (CSG) company had problem with dry cooling in its gas processing plant. When ambient temperature is high, the compressor engine trips due to the low efficiency of the dry cooling system. The paper by Lu et al. of the University of Queensland, Australia, conducted an investigation on the performance of the dry cooling system of this CSG plant. Both a computational fluid dynamics (CFD) model and field instrumentations have been conducted, and suggestions were made to improve the dry cooling system of the plant. Another paper on enhancing the dry cooling system was by Owen et al. from the University of Stellenbosch, South Africa. They examined the benefits of retrofitting an air-cooled condenser (ACC) with a hybrid (dry/wet) dephlegmator. They concluded that the turbine power output can be increased by up to 10.8% in certain cases when a hybrid dephlegmator is attached to the ACC.

China has undergone a rapid spell on large power plant construction during the last two decades, and hundreds natural draft cooling towers were built in this period. The paper by Li et al. of Electric Power Planning and Engineering Institute, China, presents a comprehensive report on natural cooling tower statistics in China. They report that a total of 495 natural draft cooling towers were built before the end of September 2013. Among them, 455 are wet natural draft cooling towers and 40 are dry natural draft cooling towers. Zhao et al. from China Institute of Water Resources and Hydropower Research studied the cross-wind effect using three-dimensional (3D) numerical modeling, and Li from the same institute studied the influence of flue gas discharge in the natural draft cooling tower.

The reinforced concrete (RC) tower shells are designed to provide sufficient bending and buckling strength, and their erection requires high precision and the control of the shape and the wall thickness. Hara from National Institute of Technology, Japan, investigated the stress distributions on an RC cooling tower shell under a lateral load with a nonuniform foundation and relates the importance of the foundation preparation. The final paper, by Zhao et al. from Tongji University, China, presents an improved multi-objective equivalent static wind loads (ESWLs) method combining the wind vibration characteristics of large cooling towers itself. The study demonstrates the rationality and the efficacy of the method in cooling tower applications.

As the guest editors of this special issue, we thank Professor Afshin J. Ghajar, the editor-in-chief, for providing us the opportunity of this special issue and for his dedicated support for the entire process. We also express our sincere gratitude to all reviewers, who have made valuable contributions in carefully evaluating the papers for including in this special issue.

Notes on contributors

Kamel Hooman completed his Ph.D. at the University of Queensland. He is a teaching and research (T&R) academic staff member within the School of Mechanical and Mining Engineering. His research interests are in thermofluids and energy. He is the director of QGECE (Queensland Geothermal Energy Centre of Excellence) and has a strong research record in the field of heat transfer and energy. He is recognized worldwide for his work on heat exchangers, which are essential technology for power generation and energy management. He has pioneered the use of metal foams in fuel cells, supercritical heat exchangers for geo/solar thermal power plants, and scaling of natural draft dry cooling towers.

Zhiqiang Guan is a senior research fellow at the School of Mechanical and Mining Engineering of the University of Queensland, Australia, and has many years of industry experience in mining equipment and structure design, dynamic modeling, conditional monitoring, and reliability analysis. His current research interests include natural draft cooling systems design and analysis for solar thermal power plants, CFD modeling, heat exchanger design, hybrid cooling research, and solar mirror cleaning.

Hal Gurgenci is a professor of mechanical engineering at the University of Queensland. He has been involved with mining and energy research in various industry and academic appointments, starting in 1982 with a QE2 fellowship in the area of solar energy. His past accolades include a 1986 Australian Design Award; a 2003 Commendation by the Engineers Australia Queensland; and an ACARP Research Excellence Award in 2005. He was the founding director for the Queensland Geothermal Energy Centre of Excellence. The center is now globally recognized through its work on novel renewable thermal power generation. He is a lead researcher in the Australian Solar Thermal Research Initiative, the $87-million national program announced in 2013.

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