Building Technologies Research and Integration Center

Science Research Seminar Series

"Science of Vapor Compression System Modeling—DOE/ORNL Heat Pump Design Model"

Tuesday
September 16, 2014
1–2 p.m.

Building 4500, Room 250
Wigner Auditorium

Abstract

Buildings account for 39% of US carbon emissions and the consumption of 40% of the nation's total primary energy, 73% of the electricity, and 55% of the natural gas. More than half of the electrical energy is consumed by building equipment using vapor compression systems. The US Heating, Ventilation, Air Conditioning and Refrigeration (HVAC&R) industry focuses its practice on developing vapor compression equipment. An effective vapor compression system modeling tool is the cornerstone for reducing development cost, accelerating the process of designing high-efficiency equipment, and guiding research projects to exploit new energy saving techniques. ORNL's Building Equipment Research Group is at a leading position in the vapor compression system modeling field. For more than 30 years, we have been providing the Heat Pump Design Model (HPDM) software to support the US HVAC&R community. In recent years, we have upgraded HPDM to be a comprehensive modeling package for vapor compression systems and components. It is a component-based platform capable of modeling complicated system configurations, and it contains advanced component models, such as microchannel heat exchangers, brazed plate heat exchangers, etc. HPDM integrates expertise in thermodynamics, heat transfer, fluid dynamics, numerical analysis, nonlinear equation solving, and object-oriented programming, with optimization tools for the design and control of highly efficient vapor compression technology. Dr. Shen will present an overview of HPDM and how it supports research at the Building Technologies Research and Integration Center at ORNL.

Dr. Bo Shen

is a member of ORNL's Building Equipment Research Group in the Energy and Transportation Science Division. He received his PhD from Purdue University in 2006. For his PhD research, he conducted extensive testing and modeling on unitary air conditioners and heat pumps, contributed to the Purdue vapor compression system simulation model, and detailed heat exchanger modeling. His industry experience includes four years working for Trane Commercial Systems and three years for Hitachi. While working at Trane, he authored the company's internal advanced heat exchanger design models of fin-&-tube, shell-&-tube, and evaporative condenser, which can guide product design by identifying local flow mal-distribution, phase-separation, and dry-out, etc. He also contributed to the company's next-generation equipment system design tool. Since joining ORNL in 2010, his work has focused mainly on vapor compression equipment design and modeling, building energy simulation, etc. He is a member of the DOE EnergyPlus Developer team, which has developed modules of variable-speed, water source and air source heat pumps, etc. Working with Dr. Keith Rice, Dr. Shen develops and maintains the HPDM software. He was a team member of the 2013 R&D 100 award for the development of the Trilogy Integrated Ground Source Heat Pump.

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