Mechanical Engineering Doctoral Defense

Improvements to Heat-driven Cooling Cycles

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abstract

Air-conditioning and refrigeration systems are one of the most crucial systems in anyone's house, and car these days. Energy resources are becoming more scarce and expensive. Most of the currently used refrigerants have brought an international concern about global warming. The search for more efficient cooling/refrigeration system with environmental friendly refrigerant has become more and more important so as to reduce greenhouse gas emissions and ensure a sustainable and affordable power supplies. Widely used air-conditioning and refrigeration systems, vapor compression cycle, is driven by converting electricity into mechanical work which is high quality type of energy. However, these systems can possibly be driven by heat, solid-state, gaseous, etc. This research explores several thermally-driven cooling systems in order to understand and further overcome some of the major drawbacks associate with its performance as well as its high capital costs. In the second chapter, we propose investigates the opportunities for integrating single- and double-stage ammonia-water (NH3–H2O) absorption refrigeration systems with multi-effect distillation (MED) via cascade of rejected heat for large scale plant. Similarly, in the third chapter, we explore a new polygeneration cooling-power cycle's performance based on Rankine, reverse Brayton, ejector, and liquid desiccant cycles to produce power, cooling, and possibly fresh water for various configurations. Different configurations will be considered from energy perception and will be compared to stand-alone systems. In the last chapter, a new simple, inexpensive, scalable, environmentally friendly cooling system based on an adsorption heat pump system and evacuated tube solar collector will be experimentally and theoretically studied. The system is destined for small-scale system to harness solar radiation to provide cooling effect directly in one system.

June 6, 2018; 10 AM; ERC 490