Workshop on "Advances in Experimental Study and Modeling of CO_2 Fluid Flow and Heat Transfer"

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As a natural working fluid, CO_2 (R744) has no ozone depletion potential (ODP = 0) and a negligible direct global warming potential (GWP = 1). CO_2 has been receiving renewed interest as an efficient and environmentally safe working fluid in a number of applications including automotive air conditioning, residential heat pumps, as a primary and secondary refrigerant in refrigeration systems at low temperatures, various energy and power egenration systems. It also has potential applications in cooling for electronic device, particle physics detectors and other high heat flux removal. As the effects of good thermophysical properties, favorably evaporation heat transfer, two-phase flow, supercritical heat transfer and fluid flow characteristics of CO_2, smaller pipe dimensions can be used in its thermal energy systems. However, the use of CO_2 in various energy systems requires the understanding and prediction of convective boiling heat transfer, two-phase flow patterns and pressure drops and supercritical CO_2 heat transfer and fluid flow behaviours for achieving more accurate designs of evaporators, gas coolers, various compponents and more energy-efficient cycles using CO_2.

CO_2 has a relatively low critical pressure of 7.4 MPa and a critical temperature of 31°C, A consequence of this is that it can be compressed directly to supercritical pressures and readily heated to a supercritical state before expansion. In a heat engine, this can facilitate obtaining a good thermal match with the heat source. The critical temperature is also sufficiently high for ready heat rejection from the cycle at terrestrial ambient temperatures. Therefore, the system has a great potential for high efficiency since a large temperature difference is available. CO_2 near its critical point becomes more incompressible and hence, the compression work can be substantially decreased leading to high cycle efficiency. In addition, in its supercritical state, CO_2 is also nearly twice as dense as steam. The high density and volumetric heat capacity of SCO_2 with respect to other working fluids make it more energy dense, meaning that the size of most system components such as turbine and pump can be considerably reduced, which leads to a smaller plant footprint and possibly lower capital costs. SCO_2 is an ideal working fluid because it is non-explosive, non-flammable, non-toxic, and relatively cheap. CO_2 is applicable to most thermal energy sources (such as fossil fuel combustion, nuclear, solar, geothermal, and waste heat recovery), therefore, the use of SCO_2 in a power system has been explored for decades, and it has undergone constant reinvention. Modern interest and ensuing research and development in SCO_2 power cycles are largely attributed to studies of a SCO_2 Brayton cycle for power generation. Investigation of SCO_2 power cycles generally fall under two primary approaches: indirectly heated (or indirectly fired) and directly fired cycles.

To foster the research development of numerous evolving research topics, technologies and applications based on the complex fluid flow and heat transfer of CO_2. The proposed workshop specially focuses on advances of research on CO_2 fluid flow and heat transfer including experimental research and modelling of evaporation heat transfer, two phase flow and supercritical CO_2 inside channels and exchangers. It covers two phase flow regimes, evaporation heat transfer, critical heat flux, two phase pressure drops, supercritical heat transfer and fluid flow, the relevant physical mechanisms, prediction methods and simulation results. Future research needs and the relevant emerging technology using CO_2 will also be discussed. Dr. Bofeng Bai, Dr. Jinliang Xu and Dr. Lixin Cheng will give special lectures on the relevant topics according to their respective achievements during the period of the MHMT 2020.