

Experimental and Numerical Study of Heat Transfer Characteristics of an Oil-Free Valved Linear Compressor for J-T Throttle Refrigerator

J. Sun, J. Lib, Y. Ma, Z. Huang, Y. Liu and J. Cai, Univ. of CAS, Beijing, China and Key Lab of Tech. on Space Energy Conv., Tech. Inst. of Physics and Chemistry, CAS, Beijing, China

As the core component of the pre-cooled J-T throttle refrigerator, the efficiency of the valve linear compressor has a decisive influence on the performance of the whole refrigerator. At present, the motor and mechanical efficiencies of linear compressors for J-T throttle refrigerator are relatively higher than the isentropic efficiency and very close to their limits. Therefore, it is very important to carry out research on the heat transfer characteristics of linear compressors and improve their isentropic efficiency. This paper presents a thermal analysis of an oil-free valved moving coil linear compressor focusing on the overall heat transfer characteristics in linear compressor, and the energy loss of each component in the linear compressor was found. First, the linear compressor was divided into several control volumes, and its thermal performance was analyzed by maintaining the whole energy balance throughout the heat transfer analysis for each control volume. Next, during the steady-state operation of the J-T throttle refrigerator, the basic measurement of temperature and pressure was performed by some thermometers and pressure sensors, and a heat transfer network of all control volumes by using a correlation for the energy balance. In addition, a thermal infrared imager was also used to obtain the temperature distribution in the compressor. The energy loss of each control volume of the compressor was ranked. Meanwhile, the overall heat transfer simulation of the linear compressor was developed, and the simulation results are in good agreement with the experimental results. The studying is useful to the design and optimization of linear compressors.