Preliminary test of friction disk type turbine for small size S-CO_2 cycle application

Seungjoon Baik[1], Jin Young Heo[1], Seong Kuk Cho[1], Jeong Ik Lee[1*]
[1]Department of Nuclear and Quantum Engineering, Korea Advanced Institute of Science and Technology, 373-1 Guseong-dong, Yuseong-gu, Daejeon, 305-701, Republic of Korea
Corresponding Address
bsj227@kaist.ac.kr, jyh9090@kaist.ac.kr, skcho89@kaist.ac.kr, jeongiklee@kaist.ac.kr*

Abstract

The small modular reactor (SMR) technology has been receiving substantial attention, since it can minimize onsite construction work as well as reduce financial burden by reducing the total capital cost of a unit. The supercritical carbon dioxide (S-CO_2) Brayton cycle can improve the SMR benefits further by having high efficiency from a compact power plant size. However, the high pressure operating condition (over 7.38MPa) and low viscosity of the fluid caused technical difficulties in designing appropriate seals and multi-stage turbo-machineries. To solve the problem in designing turbo-machineries, KAIST research team tested a Tesla turbine concept for the S-CO_2 cycle application. The Tesla turbine is a friction disk type turbine, which uses fluid shear stress (friction force) to turn the disc. Because of the bladeless design, the Tesla turbine can be driven without any concerns of phase change in the fluid. To understand the main mechanism and losses, the KAIST research team tested a lab-scale Tesla turbine with the pre-existing KAIST S-CO_2 experimental facility (S-CO_2PE). This paper describes the preliminary experimental result of the Tesla turbine and the applicability to the small size S-CO_2 cycle suitable for a SMR.

KEYWORDS

Supercritical CO_2, S-CO_2 Brayton Cycle, Power generation, Tesla turbine, Lab-scale experiment