The 2019 IERE - PLN Bali Workshop
March 11-14, 2019

Effects of regenerator structure on performance of free piston stirling engine (FPSE)

Wonshik, Park
Principal Researcher, R&D Strategy and Policy Office, KEPCO Research Institute
Seoul, KOREA

Keywords: *Free piston Stirling engine (FPSE); Solving and optimizing engineering models (SAGE); Regenerator; Porosity; Woven screen structure; Random fiber structure*

Abstract

As the worldwide demand for energy increases, depletion of the main fuel source, fossil fuel, is accelerating. In addition, the problem of environmental pollution caused by exhaust gas emitted by indiscriminate use of fossil fuel is also becoming an issue. It is therefore necessary to further improve energy efficiency, to use new energy sources and to use environmentally friendly energy to solve environmental pollution. At the same time, it is necessary to use and develop an engine that has excellent energy consumption efficiency and low exhaust gas emissions. The Stirling engine is an external combustion engine. With commonly used fuels such as gas and gasoline, it can use gas /liquid / solid fuel. Further, it can use sunlight with thermal energy, and characteristically has a variety of heat sources. The heat recovery function of a regenerator in the Stirling engine is theoretically close to the Carnot efficiency and it has the highest thermal efficiency because it is a closed-type system that does not discharge the working fluid to the outside. Unlike the internal combustion engine, it is characterized by low vibration, low noise and quietness because there is no explosion process, and it has recently received attention for its clean burning according to the combustion condition. Currently, the Stirling engine is being developed and commercialized for domestic and overseas use as a cogeneration system for a thermal power plant, a small home power generation system, and a Stirling freezer, and many patents have been filed. The operating principle of the Stirling engine utilizes the expansion / compression of the working fluid created by heating the expansion with an external heat source in a vessel made of a piston and cylinder sealed with a working fluid such as helium, air or hydrogen.

This study explains the construction and use of SAGE, a commercial analysis program used in the development of Stirling engines, and describes its applications. The free piston Stirling engine (FPSE), which is a type of Stirling engine, eliminates excessive mechanical parts to solve the disadvantages of conventional Stirling engines (weight, size, mechanical loss of connecting parts for reciprocating motion) and connecting springs to each piston vibration system. In this paper, we briefly describe the SAGE program and investigate the effect of numerical variations of the analytical elements (porosity, mesh diameter, regenerator diameter) of the regenerator on the performance of FPSE using the basic model embedded in the program.