4E analysis and Multi-objective Optimization of CCHP Using MOPSOA

Sepehr Sanaye[1] **Hassan Hajabdollahi**

Energy Systems Improvement Laboratory (ESIL)
School of Mechanical Engineering
Iran University of Science and Technology (IUST)

Abstract

Thermal modeling and optimal design of combined cooling, heating and power generation (CCHP) system are presented in this paper. Selecting the type and number of prime movers, their nominal power and operational strategy, the heating capacity of backup boiler and storage tank, the cooling capacity of electrical and absorption chillers as well as electric cooling ratio (the ratio of electrical chiller capacity to the demand cooling capacity) were considered as nine design parameters. Three types of prime movers including gas turbine, diesel engine, and gas engine were studied in this paper. Multi-objective particle swarm optimization algorithm (MOPSOA) was applied to obtain the maximum actual annual benefit (AAB) and exergy efficiency simultaneously. AAB included the Energy, Economy and Environmental (3E) parameters, therefore with adding Exergy parameters, *4E* analysis of CCHP system was performed. The CCHP system could run in two operation modes, named economical (EC) and electricity tracking (ET) modes. In the former case it was allowed to sell the excess electricity to the network and in the latter, it was not allowed to sell the excess electricity to the grid. It was observed that AAB for the gas engine was higher than two other cases in (EC) mode. In ET mode, the gas engine and gas turbine were more profitable. In addition the trends of optimum values of design parameters versus AAB and exergy efficiency in EC mode were investigated and the results were presented. Finally the results of applying the assumptions of constant and variable running load of prime movers during a year were compared.

Keywords: Combine cooling heat and power; Actual annual benefit; Exergy efficiency; MOPSOA

*Corresponding author: Sepehr Sanaye, Energy Systems Improvement Laboratory, School of Mechanical Engineering, Iran University of Science and Technology, Narmak, Tehran, Iran, 16844, Tel-Fax: +98-21-77240192
E-mail address: sepehr@iust.ac.ir