Thermoeconomic Optimization of an Ice Thermal Storage System for Gas Turbine Inlet Cooling

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Abstract

The gas turbine power output and efficiency decrease with increasing ambient temperature. With compressor inlet air cooling the air density and mass flow rate as well as the gas turbine net power output increase. The inlet cooling techniques include vapor or absorption refrigeration systems, evaporative cooling systems and thermal energy storage systems (TES). In this paper the thermoeconomic analysis of ice (latent) thermal energy storage system for gas turbine inlet cooling application was performed. The optimum values of system design parameters were obtained using genetic algorithm optimization technique. The objective function included the capital and operational costs of the gas turbine, vapor compression refrigeration system, without (objective function I) and with (objective function II) corresponding cost due to the system exergy destruction. For gas turbines with net power output in the range of 25 to 100 MW, the inlet air cooling using a TES system increased the power output in the range of 3.9 to 25.7%, increased the efficiency in the range 2.1 to 5.2%, while increased the payback period from about 4 to 7.7 years.

Keywords: Thermoeconomic optimization, Inlet air cooling system, Thermal Energy Storage System

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