

Research and development on the Advanced Humid Air Gas Turbine (AHAT) System

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Abstract

To prevent further increases in CO₂ emission and energy consumption, it is necessary to improve the thermal efficiency of thermal power generation systems. Operational flexibility such as a high start-up speed and a high load change ratio are also important for thermal power generation systems because the proportion of electric power generated by renewable energy is expected to increase in the future.

We have previously studied the advanced humid air gas turbine (AHAT) system that can fulfill the requirements of the latest thermal power generation systems such as higher thermal efficiency and operational flexibility.

The AHAT system is a newly developed gas turbine power generation system in which the water atomization cooling (WAC) system is substituted for the intercooler system of the HAT cycle. The HAT cycle was first proposed at the 1983 International Gas Turbine Congress held in Tokyo.

Since the HAT cycle was first proposed, many gas turbine systems using humidified air such as REVAP, TOPHAT, and WIWR as well as the AHAT system, all of which result in increased power and improved thermal efficiency, have been proposed. These systems that are regenerative cycle using humidified air can achieve higher thermal efficiency than gas turbine combined cycle power plant (GTCC) even though they do not require a steam turbine. An advantage of the AHAT system compared with the HAT cycle and other systems is that a heavy duty, single-shaft gas turbine, which is commonly used in thermal power plants, can be employed. The AHAT system can achieve the same thermal efficiency as the HAT cycle and other systems but at a lower pressure ratio.

The feasibility of the AHAT system as a power generating system has confirmed by the 3MW-class pilot plant. Moreover, various characteristics such as the effect of changes in ambient temperature, part-load characteristics, and start-up characteristics were clarified by analyzing the data obtained from the running tests.

The characteristics of the AHAT system and the outline of development project will be introduced in this presentation.