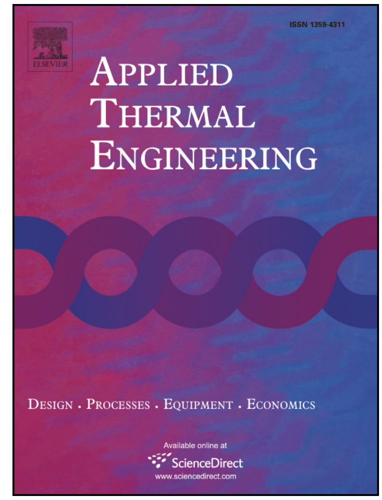

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Study on different heat supplementation strategies for a combined cooling, heating and power system

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Abstract: The small CCHP system is adopted by majority of office buildings and markets. The heat supplementation under partial load is a problem for CCHP systems. In this research, a partial load model of a combined cooling, heating and power (CCHP) system was established. The CCHP system's partial load analysis showed that the micro gas turbine (MGT) and the bottom absorption chiller were coupled by flue gas energy. Based on the coupling effects analysis, four different supplementary strategies (load adjustment method (LAM), mass flow first method (MFM), temperature first method (TFM) and maximum coefficient of performance (COP) method (MCOPM)) had been proposed and analyzed when flue gas heat was insufficient. The results showed that the CCHP system's supplemental fuels under MFM, TFM and MCOPM were all less than that under LAM. And the additional fuel under the TFM was the least among the four different strategies. The CCHP system's heating capacity under TFM was smaller than that under MFM and MCOPM, while the CCHP system's primary energy and exergy efficiencies under the TFM were larger than that under MFM and MCOPM, at the same cooling load, when supplement heat was needed. The CCHP system's total exergy destruction under TFM (106.236 kW) was smaller than that under the LAM (110.309 kW). So when the flue gas heat was insufficient, the TFM supplementation strategy was recommended.

Keywords: combined cooling, heating and power; coupling effect; heat supplementation strategies; partial load model; exergy efficiency;

Nomenclature

A (m2)	heat transfer area	**Greek letters**	
ABS	Absorber	Δt (K)	temperature difference
ARC	absorption refrigeration chiller	η	efficiency
Burner	burner	υ (m3·kg^{-1})	specific volume
CC	combustion chamber	ξ	concentration of the solution
CCHP	combined cooling, heating and power		
CMP	compressor	**Subscripts**	
CON	condenser	0	reference
COP	efficient of performance	1,2,3…	sub flows
DHW	domestic hot water	air	fresh air
EVA	evaporator	c	cooling load
Ex (kJ/kg)	exergy	cm	cooling capacity under the MFM
HPG	high pressure generator	ct	cooling capacity under the TFM
HTHE	high temperature heat exchanger	cur	current state
IHE	internal heat exchanger	e	electricity
LPG	low pressure generator	exh	exhaust gas