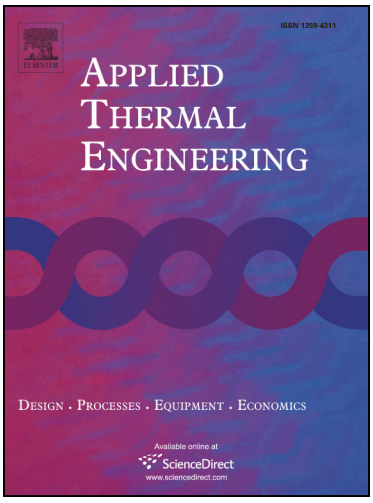

Heat transfer and thermal characteristics analysis of direct air-cooled combined heat and power plants under off-design conditions

Ningling Wang, Yumeng Zhang, Peng Fu, Pengpai Feng, Yongping Yang

PII: S1359-4311(16)33104-0
DOI: https://doi.org/10.1016/j.applthermaleng.2017.10.034
Reference: ATE 11232

To appear in: *Applied Thermal Engineering*

Received Date: 6 November 2016
Revised Date: 30 September 2017
Accepted Date: 6 October 2017

Please cite this article as: N. Wang, Y. Zhang, P. Fu, P. Feng, Y. Yang, Heat transfer and thermal characteristics analysis of direct air-cooled combined heat and power plants under off-design conditions, *Applied Thermal Engineering* (2017), doi: https://doi.org/10.1016/j.applthermaleng.2017.10.034

Heat transfer and thermal characteristics analysis of direct air-cooled combined heat and power plants under off-design conditions

Ningling Wang*, Yumeng Zhang, Peng Fu, Pengpai Feng and Yongping Yang†

National Thermal Power Engineering and Technology Research Center, North China Electric Power University, Beinong Road 2, Beijing 102206, China

Abstract:

The distributed energy systems and efficient utilization of traditional fossil fuel are confronting great opportunities under present energy framework in which coal power dominating and renewable energy emerging gradually. Heating technology, especially cogeneration of heat and power (CHP), has been increasingly concerned and rapidly developed in recent years. It is an effective way for direct air-cooled power units to cope with rigorous complex environmental conditions, decrease coal rate and pollutant emission. This paper analysed the heat transfer characteristics of heating network and air-cooled island and obtained the cold end parameters of steam turbine under off-design condition, which is used to stimulate the operation state combined with relative parameters. The heat transfer characteristics of air-cooled island under different operation mode of air-cooled fans was acquired by introducing heat transfer coefficient; the power consumption of air-cooled island and the net power output were calculated with the relationship between frequency and power, air-cooled based on which the optimal operation and regulation method were determined. The optimized operation mode of both heating system and air-cooled system were determined under different ambient temperature and regulation method. The result showed that a maximum 0.86g/kWh coal consumption reduction was reached in optimal fans operation mode, which meant the method scientifically supported the development of heating technology and further improved the processes of energy-saving and CO2 reduction.

Keywords:

Direct air-cooled, Heat supply, Energy saving, Collaborative optimization.

1. Introduction

Recently, fossil fuel shortages and the emission of greenhouse gases have produced a life-threatening challenge [1]. As a main fuel consumption sector, heating supply has large potential for energy conservation and emission reduction [2], especially through the introduction of combined heat and power (CHP), a reliable and environment-friendly technology with a history of over 100 years. Currently, heating supply technology has experienced three main generations (using steam, pressurised hot water over 100°C, pressurised hot water under 100°C as heat carrier, respectively), and the fourth generation technology, involving lower temperature level, will become mainstream technology in the near future [3], as studied by researchers [4].

CHP is an energy efficient and environmentally friendly way for energy conversion and utilization, especially when combines with the natural gas [5][6]. Researches are focusing on the old but vital technology from all over the world. To evaluate the energy conservation characteristics of CHP plants, a series of indicators have been proposed [7-11]. Meanwhile, to bring up the efficiency of CHP systems, a series of technical measures has been studied with respect to different system types and boundaries [12]. However, most of the recent published studies on CHP mainly focus on natural gas based small-scale tri-generation systems [5, 6, 13] and units combining CHP with wind power or solar power [14, 15]. Researches on solely conventional CHP with large-scale coal-fired

* Corresponding author. North China Electric Power University, epower2004@163.com

† Corresponding author. North China Electric Power University, yyp@ncepu.edu.cn