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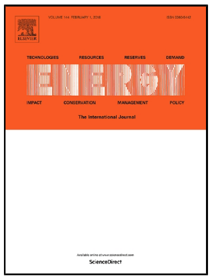

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Thermodynamic performance of Cycle Combined Large temperature drop Heat Exchange process： Theoretical Models and Advanced Process

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Abstract： High-temperature-drop heat exchange technology, which can be realized by the proper configuration of heat-driven heat pump cycles, is an important solution for the Large-scale District Heating project. Cycle combined heat exchange process model is a theoretical standard for the analysis of High-temperature-drop heat exchange process, the thermodynamic performance and the heat-work conversion relationship of the this kind of process need to be researched to approach the theoretical optimal heat exchange effect. In this paper, with the analytical method, the thermodynamic performance including the medium temperature variation, useful work transmission, operation efficiency and heat exchange effect. Various values of heat engine high-grade temperature, heat exchange efficiency and endo-irreversibility factor are considered to analyze their effects on the outlet temperature lift/drop. The quantity and location of the exergy destruction distribution is also researched. Moreover, the relation between the heat exchange effect and the distribution of the exergy loss is researched, by which the advanced process model is proposed. With re-distribution of the exergy destruction, the advanced process has a promoted heat exchange effect compared with the original one. The result and conclusion of the this paper will offer a guidance principle for the component configuration of the practical application.

keywords： Cycle combined heat exchange process, Theoretical model, Thermodynamic performance analysis, Exergy destruction analysis

1. Introduction

In the urbanization process of China, heating network construction and reconstruction are the key points to ensure residential living standard and people living quality improvement. In related technology field, Large-scale District Heating (DH) system plays a dominant role as its energy conservation features and greenhouse-gas reduction [1]. In recent years, the main focus of researches and development in DH system have been placed on network heating capacity expansion and pollution control [2]. For the first aspect, one effective way to improve the primary circuit heating capacity is to increase the heating medium temperature drop. As to the second aspect, the heating sources (such as thermal power plants and boiler plants) are relocated far away from the urban center or the presidential areas, and the long distance heating supply technology is applied. By enlarging the temperature variation range of the primary heat medium, the decreased flow rate would lead to low construction cost and supplying energy consumption [3].

Therefore, it is essential to propose a high effective heat exchange system, of which the heat exchange medium has a larger temperature variation to enhance the heat exchanged amount with constant medium flow rate. However, in the secondary circuit, considering the heating effect of the end user terminals, the temperature variation of the secondary water should be constrained (e.g. 85℃/60℃ for heating radiator system, 60℃/45℃ for floor heating