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Study on Simulation Performance of Solar Energy and Gas Heat Pump for Heating Supply

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Abstract

This paper introduces a new system named solar energy and gas heat pump, based on the solar heat pump system driven by electricity. The study established the models of the system according to the using of TRNSYS and SIMULINK. This paper mainly studies on the performance parameters of the new system, such as evaporation temperature, COP and heating capacity. At the same time, the paper makes a comparison of COP and PER between gas heat pump and solar energy heat pump, solar energy and gas heat pump. The results show that the evaporating temperature increases by 0.84℃ when the thermal storage tank temperature increases by 1℃ and the condensing temperature increases by 1.46℃ when the condenser inlet temperature increases by 1℃. The COP of the new system can reach 4.76 and the primary energy ratio of the system is up to 1.96, which is superior to the other two systems obviously.

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Keywords: Solar gas heat pump; Running mode; Simulation performance; Primary energy ratio

1. Introduction

With the developing of production and the improving of live, the consumption of energy increases greatly. The development and utilization of new energy is an urgent problem to be solved. Natural gas is one of the cleanest energy in the world which has an amazing reserves, and the rational development and utilization has attract the attentions of many countries in the world. The solar energy and gas heat pump is an air conditioning device which uses the solar energy as the heating source and the gas engine as the driving source and recover waste heat of the engine [1].

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The research of electricity driven solar energy heat pump has a long history and Jodan and Therkeld firstly proposed the idea in the early 1950s.The study of solar energy heat pump started rather late in our country, but we have achieved a lot in theoretical and experimental research in recent years. Yuhui Kuang established the experimental prototype of direct expansion solar assisted heat pump, the prototype uses the bare format solar collector as the evaporator section, and Kuang tested the heat performance under the indoor source. The result show that the average power of water heating is 1.04KW and the average COP of heat pump is 4.18. At the same time, the research study on the variation rule of evaporation temperature and water heating power and COP of heat pump with the solar radiation and running time and proposed some measures to improve the COP of the heat pump.

The research of gas heat pump technology begin in 1940s, and B.A.Z proposed the idea to drive the heat pump by gas engine in 1947, who is a famous expert in the former Soviet Union. Shigang Zhang, a famous professor of Tianjin University, studied on the performance of gas heat pump in standard conditions by simulation software. The results show that the primary energy utilization of gas heat pump was superior to other air conditioning devices, and the system has a favorable capacity adjusting ability and excellent part load performance [2].

This paper presents a new system, named solar energy and gas heat pump. Firstly, not only can the system overcome the disadvantage of large energy consumption and low efficiency, but also the system solve the problem of defrosting in winter. Secondly, comparing with the single solar energy heat pump, the COP of the heating system can be improved any further and the solar collector area can be reduced due to the waste heat recovery. At the same time, the solar energy and gas heat pump can be used in night or cloud day normally. So the system is affected little by the weather outside, which can save the cost to installing auxiliary heating device.

2. Methods

2.1. The principle of the system

The principle of solar energy and gas heat pump is shown in figure 1.The water completed heat exchange with the water to water heat exchanger firstly flow into the condenser to absorbing heat. Then, the outlet water of condenser flow into the cylinder cooler for heat exchanging, and the outlet water of cylinder cooler flow into the exhaust heat recovery device for heat exchanging. Lastly, the circulating water flow in the water-water heat exchange, transferring the heat to heat users. At the same time, the system connects with the city heating network, which can ensuring heating demand in extreme cold weather. The heat storage tank can ensure the temperature of water flowing into evaporator changes between 10-30℃.So the system can guarantee the stability and reliability of heating [3].