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Study on Optimization of Underground Water Source Heat Pump

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Abstract

Based on the study of groundwater source heat pump air conditioning system, the thermodynamic characteristics of the water source heat pump system are analyzed in detail. This paper analyzes the energy saving optimization of a new type of underground water source heat pump system, making the groundwater source heat pump system more efficient and energy saving. Based on the theory of thermal economics and quantitative analysis, five independent variables are selected as the variable parameters of the thermal economic analysis after designing the objective optimization function. The exergy efficiency under several variable values are discussed, and then a comparative analysis is carried out. Finally, the parameters of the traditional water source heat pump and the optimized new water source heat pump are compared through the experiment. We found that the compressor power consumption of traditional underground water source heat pump system is greater than that of the new underground water source heat pump system. The exergy efficiency of the new underground water source heat pump system is high and the annual total cost is low. So the water source heat pump system has higher exergy efficiency, better economic and better exergy efficiency after optimization design.

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Keywords: Underground water source heat pump; Objective optimization; Exergy efficiency

1. Main text

With the continuous improvement of people's living standards, the issue of energy and environmental harmony has become the focus of today's social and economic development. In the context of sustainable development, the

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use of underground water source heat pump air conditioning system is a major feature of today's air conditioning applications[1]. The energy saving effect of the ground water heat pump air conditioning system is obvious, and this type of air conditioning system has the advantages of small environmental pollution, meeting the requirements of cooling and heating, low investment and operation cost, simple operation of the system and high water temperature. What's more, It has high operating stability, and it is a new developing field in the environmental protection field.

At present, there are still a lot of immature places in the new type of ground water heat pump system, and there are many defects in the system operation standards and design capacity[2]. The cost of groundwater heat pump system is high, so it is necessary to match the ground water heat pump system reasonably. This will achieve greater use of results with smaller operating costs and improve the economic performance of ground water heat pump system as much as possible. This paper adopts the method of quantitative analysis. After the design objective optimization function, five independent variables are selected as the variable parameters of the thermal economic analysis. This paper discusses the exergy efficiency in several variable values and makes the comparative analysis. Finally, the high efficiency of the optimization method is verified by the unit experiment.

1.1. Thermal economics analysis

Thermal economics also called Exergy Economics, which is a combination of thermodynamic analysis theory and Economics [3]. In this paper, the superiority of the new underground water source heat pump air conditioning system is determined through comparison of exergy efficiency and other parameters. The largest energy consumption in China is building, which the largest is air-conditioning equipment. So the urgent need for researchers to solve the problem is to find a suitable analysis method to achieve the purpose of energy saving. At present, the energy analysis method, that is, the first law of thermodynamics is used to analyze the invariance of the total energy transfer process to find the loss of energy in order to take appropriate measures to improve energy utilization. The exergy analysis method combined with the second law of thermodynamics shows that the energy of the "quality", considering the energy available part and the part of the environment that cannot be utilized, can be judged more comprehensive[4]. Exergy efficiency refers to the thermodynamic process in the system or the equipment, which is the ratio of utilization or revenue exergy and payment or consumed exergy, general use ηe representation. It can quantitative calculate the energy balance, utilization and loss, and determine the effect of energy conversion and the effective use of the energy. It can analyze the rationality of energy utilization, and analyze the amount of loss and impacts of various factors, so as to find out the improvement measures and ways [5].

You can find the method of improving the utilization rate to save energy by using exergy analysis method, while the energy saving is not at the cost of economy depletion. Energy saving and economy should be taken into account in the sustainable development of air conditioning system, this paper is based on the basic research of thermal economics. The thermal economics take exergy efficiency as the objective function for optimization analysis, which to find the best way to save energy. At the same time, it combines the economy of the system, in order to find a more reasonable and effective method to analyze and optimize the groundwater source heat pump system. Bulleted lists may be included and should look like this:

1.2. Optimization objective

In scientific research, the research object is often complex, varied, and meaning broad. It refers to a set of mathematical formulas, logical rules and specific algorithms that reflect some of the major quantitative relationships of objects based on the observed phenomena and the practical experience of the study object. The object must be clearly studied before optimizing the design. The optimization model is established according to the goal to be achieved, including the objective function and restrictions.That is, the objective function and constraint equation expressed by mathematical formula, and then optimize the calculation and analysis of the results.

The water source heat pump uses the electric energy to drive the compressor, causes the working medium to reciprocate motion, repeats the physical phase change process, completes the vaporization endothermic and