

Reflection of ground-source heat pump systems' application

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Abstract: Ground-source heat pump system is an air-conditioning form of energy efficient and environment protection. This article introduced the forms of ground-source heat pump systems, analyzed the problems of ground-source heat pump systems in application in China, and put forward the solutions to these problems.

Keywords: ground-source heat pump; system forms; problems; solution

1. Introduction

Ground-source heat pump (GSHP) is a form of effectively utilizing low potential terrestrial heat resources for heating and air conditioning, which have the characters of energy efficient, environment protection and low running cost. It is a sustainable energy using technique and has amplitude foreground. In the last few years, ground-source heat pump has been the research focus in the field of building energy efficient and heating, ventilation and air-conditioning (HVAC) fields in China and overseas. Ground-source heat pump have been launching into using gradually overseas especially in Europe. At present, our research on ground-source heat pump has just in stage of beginning. Although China has some practical applications, they lack of systemic summarize and analysis, we have not integral standard and criterion and have difficulty in popularization of GSHP. As people increasingly paying more and more attention on energy efficient and environment protection, ground-source heat pump will have more applications certainly in the future. The paper is based on the original intention to introduce the forms of GSHP systems, discuss the problems of GSHP systems in application in China, and put forward the solutions to these problems.

2. System forms of GSHP

GSHP can be divided into soil-source heat pump and water-source heat pump systems according to the form of heat resources, among which the latter can classified as underground water-source heat pump and surface water -source heat pump systems.

Water-source heat pump systems have some

limitations on water temperature. In winter, water temperature should above 15°C, or else, in case of freezing auxiliary heaters should be added to the system to supply energy to the system. In summer, water temperature should below 35°C, or else, energy removal equipment(for example cooling tower) should discharge redundant heat to outside environment. At the same time, water-source heat pump systems have some requirements on water quality. A series of environment and ecological problems caused by using underground water and surface water limit the application of water-source heat pump systems. At present, GSHP systems largely indicate soil-source heat pump systems.

GSHP systems include two parts, which are under-ground and aboveground part. Under-ground part is the core of ground heat pump system. According to the kind of heat exchanger, ground heat pump systems can be classified as direct and indirect system. In the indirect system, inside of embedded heat exchanger is refrigerant carrying medium (generally is water). Comparing to direct system, indirect system reduces the quantity of refrigerant and saves the installation of refrigerate pipeline. Direct system embeds evaporator spiral

Underground directly, which have low original investment, adapt to mini-residential heat-pump system. According to the shape of heat-exchangers, it can classified as horizontal and vertical heat -exchangers, the fore can classified as one layer, double layer and spire, adapt to open circumstance; the latter can classified as U and cannula, adapt to denseness circumstance.

Above-ground parts of ground-source heat pump

systems conclude fan coil unit system, floor heating system, central air conditioning system and traditional heating and air conditioning system.

3 Problems of GSHP system in application

3.1 Technological problems

Ground-source heat pump exchange energy between soils and embedded heat exchangers. How to strengthen the performance of embedded heat-exchangers is the key problem that ground-source heat pump technique should account for. There are a lot of factors that influence the performance of heat-exchanger, mainly include thermal physical properties of soil, geometry and dimension of embedded heat-exchangers, pipe material, distance between pipes and layout of embedded pipes, etc. It is impossible to accurately know the influence mechanism about such influence factors and to determine the optimal design parameters of embedded heat-exchangers. So, how to generally taking into account these influence factors, how to optimize the geometry and dimension of embedded heat-exchangers turn into the key portion among technique problem of embedded heat-exchangers.

Ground-source heat pump system behaves good when first run, but, along with the cumulation of running time, heat pump efficiency decade, which mean that capacity of heat-transfer weaken as running time cumulate. How to considering such factor in design is an urgent task.

How to solve the balance of input energy and output heat energy, how to realize the reasonable matching between on-ground and under-ground part and how to realize intellective circulation are pressing problem to solve.

Considering environment protection and corruption, it is very important to develop and search reasonable heat-pump circulating medium and carrying medium. In the aspect of construction and installation, it is urgent to figure out how to secure the quality of embedded heat-exchanger, how to secure safety of it and to realize zero-maintain and how to form the standard and criterion on construction and installation.

3.2 financial problems

Ground-source heat pump system is a energy saving but higher first investment system, but we are lack of authoritative material and data about that. When comparing ground-source heat pump system with

traditional heating and air conditioning systems, we put more attention on economy cost than environment cost (not economizing environment cost), just confining on first investment and recycling period, lacking of systematic technique and finance analysis in using cycle. The correctness of such valuation needs further argumentation. So, the advantage of ground-source heat pump system hasn't been embodied fully, having no attractions to the investors. The investment towards the system is little, so financial problem is very strict.

Though, ground-source heat pump system is a higher first investment system, it's running cost is low. When using reasonable investment and benefit analysis, it is more attractive towards investors. But investment Channel in our country is not straightway, the source of construction is short, fund mechanism need to be completed.

Furthermore, we are in developing country, financial obstacle is inevitable, lacking of the research fund, integration fund, the fund of constructing demonstrating engineering, and alteration fund in old buildings. In order to strengthen ability of technique faculty, we are lack of corresponding cultivating fund and information spreading fund. Fund obstacle is a core in the popularization of ground-source heat pump system.

3.3 other problems

Popularization of ground-source heat pump is not only technique problem. Ground-source heat pump system is a new form of energy-saving system, which can't depart from government lead and impulsion. At present our country is short of corresponding supervise organization and policy to inspire and standardize the construction of ground-source heat pump system. Technique and management faculty are not competent. The faculty majoring in HVAC hasn't grasped the character and key-technique. The management institution of building energy efficient, the building owner, manufacturer and public know little of ground-source heat pump system. All above problem limit the application of ground-source heat pump systems.

4. Solutions

According to the above problem, the solutions can be found from the following aspects.

Strengthen the research on ground-source heat pump system. We should organize expert specially investigating the system, pressing to constructing the

regulations of ground-source heat pump systems. Due to the complexity of it, we should carrying out systematic study avoid of repetition research and lay emphases on

Carry on Technique integration and formation. At the same time, we should reinforce the research and exploitation, cooperating with the application of research achievement.

Strengthen the cultivation of the faculty. Training the group of management and technique, developing the relative technique cultivation, writing and publishing ground-source heat pump technique material, along with forming the policy and code of ground-source heat pump, breading the channel of investment and financing, constructing demonstrating project, constructing the communicating flat roof to promoting the popularization and application widely.

Excavating the channel of investment and financing. In virtue of inspiring policy, breading the channel of construction investment, sounding the channel of investment and financing and relative market mechanism, inspiring manufacturer and owner to

investing more towards ground-source heat pump systems.

5. Conclusion

Ground-source heat pump systems have the character of energy saving、environment reserving and low running cost. It is a sustainable energy utilizing technique. But at present, we have the obstacle in technique, capital and capability. By quickening the research and exploitation of ground-source heat pump technique and the product, strengthening the capacity cultivation, excavating the channel of investment and financing, ground-source heat pump systems will have more capacious foreground in application and popularization.

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