Principle and Characteristics of Heat Pump Air Conditioning System

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ABSTRACT

More and more attention has been paid to the heat pump technology in building energy efficiency. Based on the analysis of the principles and characteristics of air source heat pump, ground source heat pump and water source heat pump, this paper points out the problems and future in the development of heat pump technology in China.

HEAT PUMP AND BUILDING AIR CONDITIONING

The principle of heat pump

The heat pump (refrigerator) is a device which makes the heat flow from low temperature medium to high temperature medium. The working principle and process of the heat pump and refrigerator are identical. The difference between the name of the heat pump and the refrigerator only reflects the difference in the purpose of the application: if the main purpose of obtaining high temperature heat, it is generally referred to as the heat pump, otherwise known as the refrigerator.

Main features

The air-conditioning system of the construction should meet the general requirements of heating in the winter and cooling in the summer, which are two opposite requirements. The traditional air conditioning system usually needs to set up the cold source (refrigerator) and the heat source (boiler). The coal fired boiler is one of the major sources of air pollution. Small and medium sized coal-fired boilers have been phased out in the city. Boiler fuel oil and natural gas reduce the pollution of the atmosphere, but the emission of the greenhouse gas emissions (CO2) causes environmental problems, and the operation cost is very high. There must be a cold source (refrigerator) in the building air conditioning system, if it is in a mode of heat pump in winter, we can save the boiler and boiler room. This method not only saves a great investment, but also make us use the clean electric power which completely solves the problem of air pollution. In addition, the use of heat pump air conditioning system can also take into account the domestic hot water supply. Especially water can be heated by waste heat of refrigeration and it doesn’t need additional energy consumption.

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THE CLASSIFY OF HEAT PUMPS

Air source heat pump

The air source heat pump hot water unit is a new heating water device which can alternative hot water boiler. Compared with the traditional solar energy, air energy heat pump hot water unit can not only absorb the heat in the air, but also can absorb solar energy. It is a new hot water equipment which combines the advantages of an electric water heater and a solar water heater.

The technology of air source heat pump water heater is a kind of energy saving and environmental protection heating technology which is based on the principle of reverse Kano cycle. In the air source heat pump hot water system, the system can make the low temperature heat source become the high temperature heat source of the heat pump system, which can be used for heating or sanitary hot water. The efficiency of the whole heat collection system is much higher than that of the electric hot water unit (boiler), fuel oil and gas water heater.

Water source heat pump

Ground source heat pump air conditioning technology is also known as "ground air conditioning". It extracts groundwater and gives off heat in the heat pump. It belongs to the open source heat pump in the heat source. The promotion of this technology benefit obvious energy conservation and protection of the atmospheric environment, and it can promote the application of heat pump technology in the air conditioning. However, this underground water source heat pump technology also has obvious congenital defects. First of all, the way to extract groundwater need to have a rich groundwater as a prerequisite, if the groundwater level is low, the power consumption of the pump will greatly reduce the efficiency of the system. In addition, although the theoretical groundwater pumps back to the underground water layer, but in many geological conditions, the rate of irrigation is much lower than the rate of pumping, which results in the loss of groundwater resources. Even if it is possible to recharge all of the extracted groundwater, it is a difficult task to ensure that the aquifer is not contaminated. Water resources are the scarcest and the most valuable resources, any waste or pollution of water resources are absolutely not allowed. Therefore, we should adopt a cautious attitude towards the popularization of this technology.

VARIOUS TYPES OF HEAT PUMP FEATURES

Ground source heat pump

Wide Application

Ground source heat pump system can be used for heating and cooling, it can also provide domestic hot water. The system has many uses. It can replace two sets of equipment for boilers and air conditioners, especially for buildings with heating and cooling requirements at the same time. The ground source heat pump has obvious advantages. It not only saves a large amount of energy, but also can meet the requirements of heating, cooling and water supply, which reduces the initial investment
of the equipment. The ground source heat pump can be used in hotels, residential areas, apartments, factories, shopping malls, office buildings, schools and other buildings, small ground source heat pump is more suitable for residential heating and cooling [3].

Simple Maintenance

The ground source heat pump system moving parts are less than the conventional system, which reduce maintenance. The system is installed in the room, it exposed to wind, rain and other damage. So it has higher safety and longer life. It has a high degree of automatic control, and can be unattended.

Little Pollution

The ground source heat pump pollutant emissions reduce more than 38% than air source heat pump. Compared with the electric heating, the emissions of ground source heat pump reduce more than 70%. It really achieved the energy-saving emission reduction, which is to reduce energy waste and reduce emissions more.

Water source heat pump

High Efficiency and Energy Saving

Water source heat pump is the highest energy efficiency ratio (COP) in air conditioning system. The theoretical calculation can be up to 7, the actual operation is from 4 to 6. Water source heat pump unit can be used 12~22 degrees Celsius water in winter, the temperature of water is higher than the ambient air temperature, so the heat pump cycle evaporation temperature increase, energy efficiency is also increased. The water temperature in summer is 18~35 degrees Celsius, the water temperature is lower than the ambient air temperature, so the cooling effect is better than air cooling and cooling tower and it improves the operation efficiency of the unit.

Renewable Energy

Water source heat pump used solar energy resources in the earth water storage as a heat source and use low temperature water cooling after the earth natural water as cold source. It can use water, including groundwater or rivers, the surface of the part of the rivers and lakes and oceans. Soil and water is not only a huge solar collector, which collect 47% of the solar radiation energy, but also is a huge dynamic energy balance system, which keeps the relative balance of energy acceptance and divergence. This makes it possible to make use of the nearly limitless solar energy or energy stored in it. Therefore, the use of water source heat pump is a clean renewable energy technology.

Water Saving and Land Saving

The surface water is cold and heat source. Releasing heat or absorbing heat do not consume water resources and cause pollution; It eliminates the boiler room and ancillary coal yard, storage room, cooling tower and other facilities, The room area is much smaller than that of the conventional air conditioning system. It saves the building space and conducive to the appearance of the building.
CONCLUSION

As a new technology, heat pump system is in line with the trend of reducing emissions and developing low-carbon economy. In China in recent years, the technology has been rapid development, although there are still many problems, however, with the continuous development of technology and improvement of heat pump technology, it has more broad prospects for development in our country in the future.

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