УДК 124.568

А.А Насибян, студент гр. ЭТ–192 (БГТУ)
Е. А Беловодский, ст. препод (БГТУ)
г. Белгород

HEAT PUMP TECHNOLOGIES OF HEAT PRODUCTION

A heat pump is a device that provides heat energy from a source of heat to a destination called a "heat sink". Heat pumps are designed to move thermal energy opposite to the direction of spontaneous heat flow by absorbing heat from a cold space and release it to a warmer one, and vice-versa. A heat pump uses some amount of external power to accomplish the work of transferring energy from the heat source to the heat sink. Heat pumps are integral to an air conditioning system, transferring heat from one environment to another via a refrigerant. They can transfer heat from a cool space to a warm space, against the natural direction of flow, or they can enhance the natural flow of heat from a warm area to a cool one. Heat pumps also offer a cost-effective heating

Solution - and air source heat pumps are recognised as a renewable heat technology [2].

This is well documented now, but basically there are a number of heat sources used by heat pumps and these, in simplest terms, can be defined as air, ground and liquid.

Air Source Heat Pumps Obtain their heat from the ambient air, using a fan unit located outside the building. The pump converts heat from the air into more useful energy through a heat exchanger similar to ground source heat pumps. Residential air source heat pumps can save more than 2 tonnes of carbon a year, emitting up to 20% less than gas boilers and up to 70% less than electric systems. As well as being used to heat in winter, some heat pumps can be reversed to cool in the summer, when the unit takes heat

1. Out of the indoor air and releases it outside. Water Source Heat Pumps. Water source heat pumps are much rarer. These pumps can be both open-loop or closed-loop, utilising the
2. Heat from a pond, lake, river, stream, or other body of water to provide heating for nearby homes.

In these types of pumps, the water is drawn into the pump's heat exchanger, where the heat is extracted and the water is returned to the source.

When used in relatively shallow waters they can be subject to seasonal temperature fluctuations and may suffer a loss of efficiency during cold weather [2].

A geothermal heat pump or ground source heat pump (GSHP) uses the earth as a heat source (in the winter) or a heat sink (in the summer). This design takes advantage of

The moderate temperatures in the ground to boost efficiency and reduce the operational costs of heating and cooling systems, and may be combined with solar heating to form a geosolar system with even greater efficiency. Ground source heat pumps harvest heat absorbed at the Earth's surface from solar energy. The temperature in the ground below 6 meters (20 ft) is roughly equal to the mean annual air temperature at that latitude at the surface [1].

Open-Loop GSHP with coefficients of performance (CoPs) of up to 5.0, open-loop GSHPs offer an environmentally friendly source of heating with significantly lower running costs than a conventional heating system. As underground water temperatures remain constant throughout the year, an open-loop system can maintain high efficiency all year.

Open-loop systems remove heat from ground water, usually abstracted via a borehole into an aquifer. The water is then pumped through the heat pump where the exchanger takes the low grade heat from the fluid and concentrates it to a higher temperature, cooling the borehole water from approximately 110°C to 5°C. This heat is then raised in temperature and delivered to the domestic hot water system and/or the space heating system. The water is then returned to the ground where it immediately begins to regain heat from the earth.

These systems are considered 'non-consumptive' when the same volume of water is returned to the same aquifer from which it was extracted. Occasionally the water is used for other purposes, for example it can be filtered for domestic consumption before being discharged or used for garden irrigation and other 'grey water' uses. In such cases it is classified as 'consumptive'. On this basis open-loop systems should only be installed in areas where there is sufficient groundwater available.

Closed-Loop GSHP. Similar to open-loop systems, closed-loop GSHPs obtain their heat energy through pipes buried in the ground. However instead of circulating ground water, these schemes consist of a closed pipe system filled with thermal transfer fluid in the form of an anti-freeze solution. The fluid absorbs heat from the ground which is then passed through the heat exchanger as it travels around the pipe. A key benefit of these systems is that they can be installed virtually anywhere.

The geothermal pump systems reach fairly high coefficient of performance (CoP), 3-6, on the coldest of winter nights, compared to 1.75-2.5 for air-source heat pumps on cool days. Ground source heat pumps (GSHPs) are among the most energy efficient technologies for providing HVAC and water heating [2]. Actual CoP of a geothermal system which includes the power required to circulate the fluid hrough the underground tubes can be lower than 2. 5. The setup costs are higher than for conventional systems, but the difference is usually returned in energy savings in 3 to 10 years. System life is estimated at 25 years for inside components and 50+ years for the ground loop. Heat pump technologies of heat production for municipal services successfully applied in the world allow saving substantially expensive and scarce organic fuel, reducing pollution of the environment, improving social conditions of life and work of population and have all opportunities for large-scale introduction in Ukraine. However, taking into account that Ukraine has no domestic manufacture of heat pump equipment available to modern world requirements, it practically has no its own investigations in optimal design and selection of efficient operating regimes. Problems connected with peculiarities of practical introduction of heat pump technologies are of current importance [1].

References

1. Ю.Н.Малахатка, Г.Н. Тарасова, Вестник Белгородского государственного технологического университета им. В.Г. Шухова, №4 (2012) "О возможности использования пыли производства строительных материалов для очистки сточных вод от ионов тяжёлых металлов".
2. М.Н.Спирин, Вестник Белгородского государственного технологического университета им. В.Г. Шухова, №5 (2014) "Очистка маслосодержащих сточных вод отходами производства сахара".

Информация об авторах:

Насибян Альберт Артурович, студент гр. ЭТ–192, БГТУ, 308012, г. Белгород, ул. Костюкова, д. 46, nasibyan_albert@mail.ru

Беловодский Евгений Алексеевич, ст.препод., БГТУ, 308012, г. Белгород, ул. Костюкова, д.46, BelovodEvg@yandex.ru