Installation of a heat pump in conjunction with a solar collector

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1. General Information

Heat pump - a device for transfer of thermal energy from the source of low grade heat (low temperature) to the consumer (heat medium) at a higher temperature. Thermodynamically similar to a heat pump chiller. However, if the chiller main goal is to produce a cold heat through selection of any volume evaporator and the condenser provides heat discharge into the environment, the reverse pattern of the heat pump. Condenser is the heat exchanger, the heat released to the consumer, and the evaporator - heat exchanger, dispose of low-grade heat.

2. Sources of low potential energy

Heat pump for energy derived from the low temperature heat source. Heat, energy, and economic characteristics of heat pumps are closely linked to the characteristics of the sources from which pumps take heat. The ideal heat source should provide a stable high temperature during the heating season, not to be corrosive and polluting, have favorable thermal characteristics, we do not require significant investment and maintenance costs. In most cases, the available heat source is a key factor in determining the performance of the heat pump.

As a heat source in small systems based on heat pumps are widely used outdoor and exhaust air, soil and underground water, for high power systems are used sea, lake and river water, geothermal springs and groundwater.

2.1 Air

Outside air, being completely free and available, is the most preferred source of heat. Nevertheless, heat pumps, air applying it are seasonal load factor is lower on average by 10-30% as compared to water heat pump. This is due to the following circumstances:

• rapid decline in power and performance with the fall of the external temperature;

• a relatively large difference between evaporation and condensation temperatures during winter minimum temperature, which reduces the overall efficiency of the process;

• energy consumption for defrosting the evaporator battery and operation of the respective fans.

In hot and humid climate on the surface of the evaporator in the range of 0 to 6 ° C Mist is formed that leads to a reduction in performance and capacity of the heat pump. LeAnn reduces the area of the free surface and prevents the passage of air. As a consequence, reduced

evaporation temperature, which in turn helps build-up of frost and further steady decline in performance up to a possible unit shutdown due to tripping of the low-pressure control probe, before it will be removed icing.

Thawing is accomplished by inversion of the battery cooling cycle or otherwise, although less effective ways.

Power consumption tends to increase. The overall coefficient of performance COP decreases with increasing frequency thawing. Use of special control system providing on-demand defrost (t. E. When it is in fact necessary), instead of intermittent, can significantly improve the overall efficiency.

Another source of heat in the residential and commercial and administrative structures - discharged ventilation air. The heat pump recovers the heat from the exhaust air and provides hot water or warm air for space heating. In this case, however, requires constant ventilation during the heating season, or even a whole year, if provided air conditioning facilities in the summer. There are devices in which a constructive initially incorporated the use of ventilation and exhaust and outside air. In some cases, heat pumps, air discharged applying used in combination with recuperators "air-to-air."

Air as a universal coolant used in large plants year-round conditioning. It has a low heat transfer coefficient, so to reduce the surface of the evaporator is necessary to reduce the boiling point of the working fluid, thereby decreasing the degree of perfection teplonanosnoy installation. These tests such installations using air as a heat source, indicate that the average ratio during the heating season m is not more than 2 - 2.5. During periods of peak t. E. Sporadically low outdoor temperatures, include replacement heaters. The best way to combat it is with frost automatic defrosting conducted periodically.

2.2 Water

The most appropriate use of warm water waste industrial enterprises, including circulating water and thermal power plants. In addition, also used in the natural hot springs resort area.

Due to the high costs of urban water use uneconomical. However, the sources of water from a relatively deep layers of soil, having a temperature close to the average, provide a higher conversion ratio m in comparison with air.

Groundwater is in many places, they are sufficiently stable in the temperature range from 4 to 10 ° C. To use water as a heat source are used mainly open systems: underground water is pumped out and supplied to a heat exchanger system unit, where the water contained in the portion shown in its heat. The water thus cooled is discharged to the drainage well or surface water. Open systems require very careful design in order to prevent problems with frost, corrosion and

accumulation of sediments.

The big drawback of heat pumps working on subsoil waters, is the high cost of installation of water intake. Moreover, it should take into account requirements, sometimes very hard, local governments in the organization of wastewater.

River and lake water from a theoretical point of view it is a very attractive source of heat, but it has one major flaw - the extremely low temperatures in winter (it can be close to 0 ° C). If you use the water of rivers, lakes and seas, in winter it can freeze on the walls of the evaporator. For this reason, special attention is required when designing the system to prevent freezing of the evaporator.

Seawater appears in some cases a great heat source, and is used mainly in medium and large systems. At a depth of 25 to 50 m sea water has a constant temperature in the range of 5 to 8 ° C. As a rule, the problems with ice formation does not occur, since the freezing point is from -2 to -10 ° C. It is possible to use as a direct expansion system, and systems with brine. It is important to only use heat exchangers and pumps, resistant to corrosion and prevent buildup of organic nature in the water intake pipe, heat exchangers, evaporators.

Groundwater characterized by relatively high and stable temperature throughout the year. The main limitations there may be transportation distance and actual resources, the amount of which may vary. Examples of possible sources of heat carriers in this category can be considered groundwater at sites sewer (wastewater treatment and other water courses), industrial sewers, drains areas of industrial cooling condensers or energy production.

2.3. Ground

The most effective but also the most expensive schemes involve the collection of heat from the soil, whose temperature does not change during the year at a depth of several meters, making installation almost regardless of the weather. According to 2006 units half Sweden, Finland 50000, was established in Norway in the year 70 000. When used as a source of heat energy conduit soil in which circulates antifreeze buried in the ground to 30-50 cm below the frost line to the region. In practice, the 0.7 - 1.2 meters. The minimum recommended distance between the producers of sewer pipes - 1.5 meters, minimum - 1.2. It does not require drilling, but require more extensive ground work for a large area, and the pipeline is more susceptible to the risk of damage. Efficiency is the same as in the removal of heat from the wellbore. Special soil preparation is required. But it is advisable to use the site with moist soil, if it is dry, it is necessary to make a long circuit. Approximate value of thermal power per 1 m of pipeline: clay - 50-60 W in the sand - 30-40 W for the temperate latitudes, in the north of the value is less. Thus, for the installation of heat pump capacity of 10 kW required ground contour length of 350-450

m, which is required for laying land area of about 400 square meters (20x20 m). With the proper calculation circuit has little effect on vegetation.

3. Description of the installation

In training workshops installed heat pump brand WATERKOTTE DS 5027 Ai with a heat output of 26 kW (Figure 2). According to the passport 6 is an efficiency factor at low potential source of 10 degrees and an outlet temperature from the heat pump 35 degrees. When a potential source of low temperature of 0 degrees and an outlet temperature of 35 degrees of the heat pump efficiency coefficient is 4.8.

Fig. 2 heat pump WATERKOTTE DS 5027 Ai

Circuit, extracts the heat of ground laid in the basement at a depth of 2.5 meters on the level of the floor (Figure 3). Due to the fact that the heat flow from the lower basement, paved preheating circuit powered by a central heating system. But there is a major drawback of this

scheme: in the summer time when no heating circuit is not heated. Accordingly, there is no possibility to conduct laboratory tests.

Fig. 3 The circuit extracts the heat from the low potential source

As a consumer of thermal energy used radiators. To solve the problem year-round heating basement decision in the absence of central heating to heat using solar collectors. In this regard, in a room with a heat pump is moved from a storage tank of solar collectors. Later in the autumn months, when there is no central heating will be possible to heat the classroom with the help of the heat pump.