CRYSTALLIZATION HEAT UTILIZATION IN BUILDING HEATING

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Abstract. Crystallization of water creates problems in almost all the heat pumps, because of they should be avoided. However, its use in the right place, create new possibilities of heat pumps for use in problem areas.

Practical study is based on the heating, cooling machines and thermodynamic basis. To check the theoretical result of the process computer modeling was used.

Keywords: crystalization, heat, water, specific heat of melting.

Introduction

In ancient times, the only form of heating was a bonfire. Nowadays, in order to obtain the heat is very much different heating solutions. However, there are places where there are various restrictions on the heating installation.

The most comfortable is electric heating, but a large proportion lack the necessary of electrical power for this. Therefore, in addition to the need for other sources of heat, they can be both fossil and renewable.

In recent years heat pumps have become popular. Almost every place can find the most appropriate source of heat. Usually it is water, soil or air.

All types of problems can cause water to crystalization a layer of insulation. This in turn impairs heat conduct and heat pump efficiency decrease.

It would be useful to turn this lack of advantage. This means putting water crystallizing and benefit from the heat of crystallization together.

Studies are used to drinking water and estimates included in the price together with the disposal.

The aim of the study is to investigate and evaluate the parameters of water crystalization process.

Materials and Methods

Before the study various calculations were carried out.

Calculations were performed on the insulation house with a total area of 100 m ^{2,} assuming that the heating season is 210 days a year. Consumed water tariff was taken together with the charges for sewerage.

Due to the fact that including of many factors and many sizes are varied computer program was used in Matlab & Simulink.

Studies were used to drinking water from the tap. Water temperatures during the day is not constant, due to changes depending on several factors. Groundwater during the temperature changes very minimal and an average of about +8 ° C. However, the multi-family homes reached a temperature of +18 ° C. Warm water or warm air are often near existing water mains in warm water, not enough insulated.

More efficient heat pumps are considered to be operating in the flow mode, as the heat source is cooled by only a few degrees. The heat source is used with the possible high temperatures, the equipment efficiency is easily detectable. Such equipment fairly easy to calculate the necessary heat quantity necessary capacity and dimensions.

If the heat source is used for drinking water, it cooled the maximum amount, because otherwise, its use would be very costly and ineffective. Water specific heat varies with temperature, normally used for calculation rounded value 4190 J / kg * K. Compared with other potential sources of heat that is quite a lot. However, the biggest amount of heat can be obtained from the phase transition. Water specific heat of crystallization is 3.4 * 10 ^{5} J / kg. So crystallization of 1 kg of water can get about 80 times more heat than the cooling water for 1kg of 1 ° C.

Water crystallization does not take place simultaneously throughout the volume, until all the water is crystallized, a part of the ice is already cooled several degrees below the melting temperature. Therefore, the calculation should also include an ice specific heat 2100 J / kg * K. (http://en.wikipedia.org/wiki/Specific_heat_capacity, 12.03.2010)

It is known that water evaporates at all state under heat of evaporation, however, the calculations were not taken into account because the system is contracted and the water is condensed again. Heat balance in this case close to zero.

If the water is fully crystallized, it can not skip the flow mode, as crystalline substances, flowability is very bad. This in turn enables the plant to use it as a design element. Building and design of various equipment and containers in which water is crystallized. Another view of the

heat source with a lower temperature, the equipment efficiency also decreases, because the need for more work.

The COP for a heat pump in a heating application, with steady-state operation, is:

$$COP_{\text{heating}} = \frac{\Delta Q_{\text{hot}}}{\Delta A} \leq \frac{T_{\text{hot}}}{T_{\text{hot}} - T_{\text{cool}}}$$

where

- ΔQ_{hot} is the amount of heat delivered to a hot reservoir at temperature T_{hot} ,
- ΔA is the compressor's dissipated work.
- All temperatures are absolute temperatures usually measured in kelvins (K). (http://en.wikipedia.org/wiki/Heat_pump, 12.03.2010.)

The study was set up the device to ensure the crystallization and thermal measurement. The temperature measurements were used for many basic data loggers: Pico TC - 08, and ADC - 11.

Results and Discussion

Currently, in Latvia the cheapest heating used is firewood. To 100 m^2 insulation housing costs are 150 - 200 Ls per year, depending on the price of firewood (firewood with a moisture of 25%, the boiler efficiency of 75%). Expensive, but would also be convenient for heating is electrical energy (the former with the house would cost around 1250 Ls, assuming that the boiler efficiency is 95%). Using heat pumps heating costs could be from 260 to 600 Ls, depending on the type of heat pump, heat source and type of heating system type. (http://gribumaju.lv/?id=171, 12. 03.2010.)

Using water crystalization, costs depend mainly on water rates and charges for ice utilization (sewage charges) If the reclamation of water and ice should be free of charge heating costs would be about 400 per year, but if water and ice reclamation would be relatively high, such as the 3 Ls / m^3, the heating costs will rise to 800 per year.

If you could make ice not stick to freeze the surface, it might look better on disposal options.

To create a specific form crystals we can use ones which can make the crystallization with embryos. It would also allow crystallization to occur from the middle. (Nohara, LB, 2006.)

Because of the fact that the heat of crystallization is significantly higher than the specific heat, and then the heat storage facility would be appropriate to use it. For amorphous substances there is not a specific melting temperature and the phase transition can not accumulate a large amount of heat.

Temperature of water crystalization can be increased by increasing both the pressure and the addition of chemicals. Hot ice is possible to obtain squeezing water to 1.1 GPa, however, following pressure at home would be very difficult to obtain. (http://www.answers.com/topic/ice, 12.03.2010.) Another option is to use sodium acetate, the solution crystallizes at +58 °C (http://en.wikipedia.org/wiki/Sodium_acetate, 12.03.2010.)

Conclusions

1. Drinking water for the coolant is advantageous if it could be crystallized in order to use the heat of crystallization.
2. To reduce the required compressor power it is required to establish a thermal energy storage system.
3. Ice is not recommended for cooling to lower temperatures, it reduces system efficiency.
4. Experiments results certainly differ from the estimation obtained on drinking water, depending on the quantity of impurities and changes in heat capacity, as well as the crystallization temperature.

References

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