

HEAT PUMPS SYSTEMS

Didactic material



From private dr. K.Jasiūnas archive

Earth energy using

- Using of earth energy is diverse:
 - centralized needs of homes and customers;
 - individual needs homes and customers.
- Environmentally friendly providing them for confort and quality live:
 - heating;
 - cooling (conditioning).
- Earth energy can be converted into:
 - heat;
 - electricity.



From private dr. K.Jasiūnas archive


Systems using of earth energy

Heating (cooling) from the ground (soil) - this is the process when the soil, surface of the water or in water volume stored heat (cold) is used for the heating (cooling).

- Those heating (cooling) systems are named:
 - **water – water** heating (cooling) systems
 - **ground – water** heating (cooling) systems

Systems deviding according recovering of heat

- Depending on how the heat is recovered can be divided into two systems:



- **low-temperature** heat can be used for land application of heat pumps: source - heat exchanger - heat pump - the user.



- **high-temperature** ground heat can be used directly over the heat exchangers: source - heat exchanger - the user.

Heat pumps using experiences in Lithuania

- The heat pumps are used in practice for more than 15 years in Lithuania.
- Ground soil heating system is already used in private homes.

Heat pumps using experiences in Lithuania

- Consumers has two different opinions:
 - ✓ welcomes low heating bills and they are not about the rising natural gas and fuels prices;
 - ✓ is invested and very disappointed – not enough heat or additional heat has to be extracted by an additional electric heating, which is quite expensive.

Heat pumps using experiences and mistakes

- It cost by design mistakes – by saving the investments, for the increasing of profit, selected to small capacity of heat pump;

Heat pumps using experiences and mistakes

- A common mistake theory is the choose and to install the heat pump, covering the building heat losses till -5°C outside temperature.

Heat pumps using experiences and mistakes

- The resulting heat loss is covered with an electric heating and economic idea of saving recourses collapses – in the days, when electric heating is used, it could be paid several times more for heating than it was calculating.

Heat pumps conditions of instalation in Lithuania

- When choosing land and place for using of earth energy primarily focuses on the natural conditions of the region.
- Lithuania is on the large earth's structure – East European platform, which in the western part of Lithuania, has a larger area average geothermal intensity.
- Large areas of stable parameters (mainly 40-50 mW/m² heat flux intensity).

Air-water heat pumps and operation modes

- Air-to-water heat pumps feature is that the cooling / heating energy required taking from the ambient air heat, which is constantly renovating and never ends.
- According compressor and used their power inversion there are two general air-to-water heat pumps type.

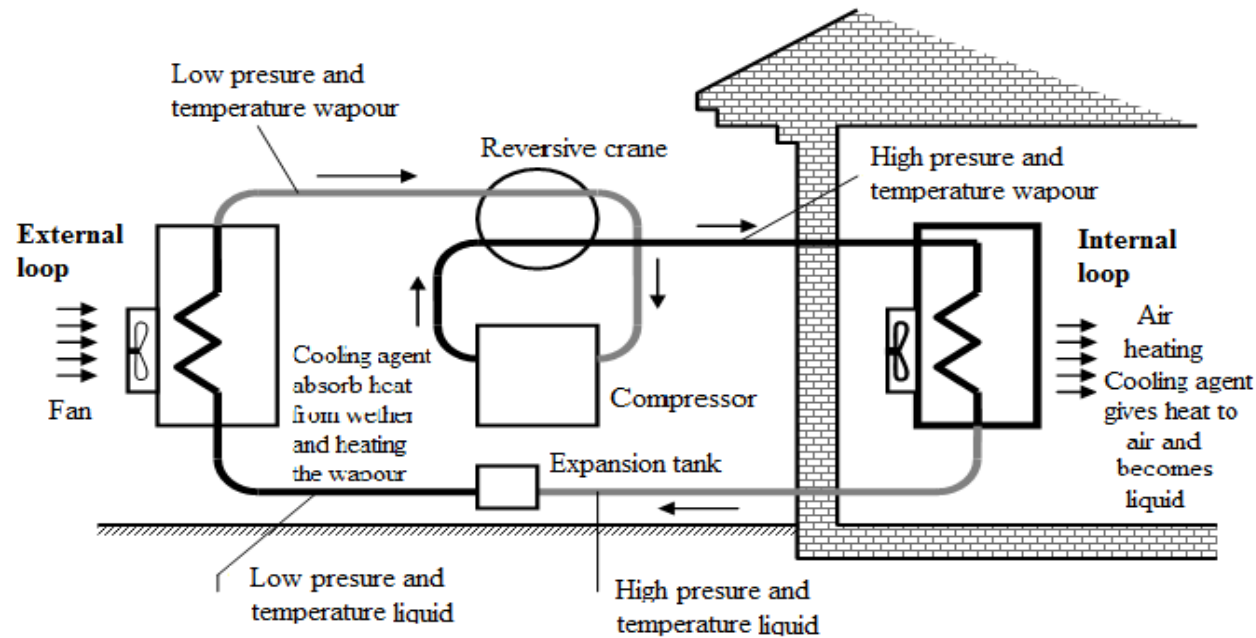
Air-water heat pumps and operation modes

Air-water heat pumps operating system change the power depending on how much house needs heat. This is done by changing frequency of current, technology saves 20% heating cost

Air-water heat pumps and operation modes

Air-water heat pump system works at the maximum possible capacity, a microprocessor mode is calculated and extremely accurately between the electronic expansion valves to aid the effect of a heat pump turns off.

Heat pump systems “air-water” components and operation by heating mode



Gudžius, S.; Morkvėnas, A.; Studija hibridinių energijos šaltinių ir jų sistemų modeliai (Study of hybrid energy sources and models of the systems). KTU, 2009

Heat pump systems “air-water” components and operation by heating mode



- Outside loop near the building
- Loop located inside the building
- Ventilators
- Compressor
- Heat element with boiling agent
- Hydromodule
- Electrical or another additional heater

From private dr. K.Jasiūnas archive



Heat pumps selection and operation

The choice of a heat pump, it is necessary to take into account 3 key characteristics:

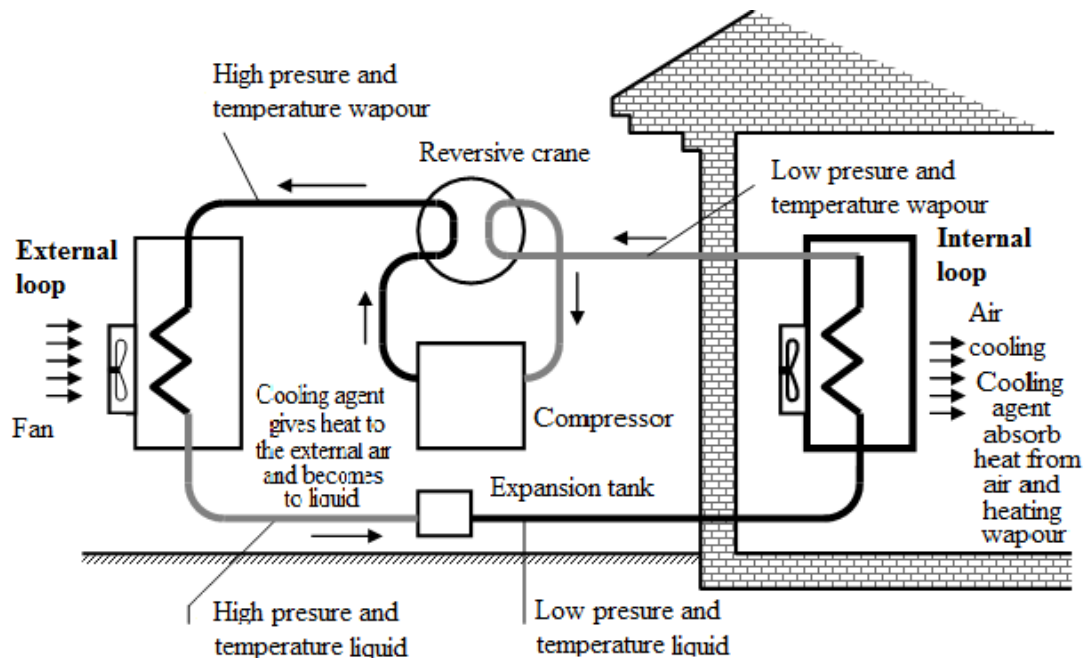
- energy efficiency;
- size;
- system components.

Heat pumps selection and operation

System efficiency factor indicates how many kWh of heat carried by the heat pump by consuming one kWh of electricity. At 10 ° C external temperature, the heat pumps efficiency factor will be 3.3.

It means that 3.3 kWh of heat is transferred while using 1 kWh of electricity. Heat pump efficiency decreases with decreasing ambient temperatures, as the heat from the colder weather is more difficult to hold.

Heat pump systems “air-water” operation by cooling mode



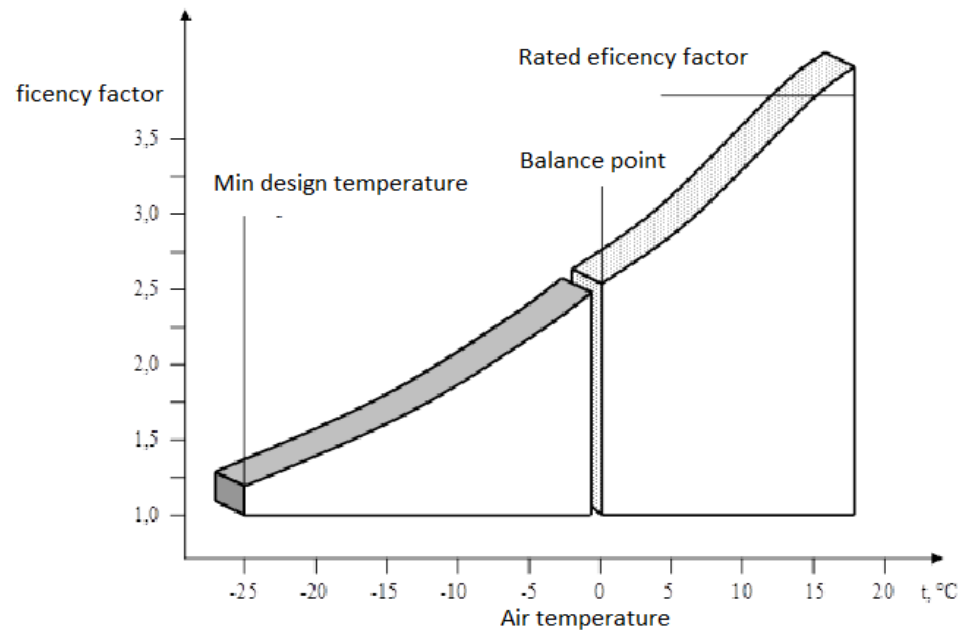
Gudžius, S.; Morkvėnas, A.; Studija hibridinių energijos šaltinių ir jų sistemų modeliai (Study of hybrid energy sources and models of the systems). KTU, 2009



Typical air-water heat pump performance characteristics



From private dr. K.Jasiūnas archive



Gudžius, S.; Morkvėnas, A.; Studija hibridinių energijos šaltinių ir jų sistemų modeliai (Study of hybrid energy sources and models of the systems). KTU, 2009

Evaporator or condenser temperature variation influence

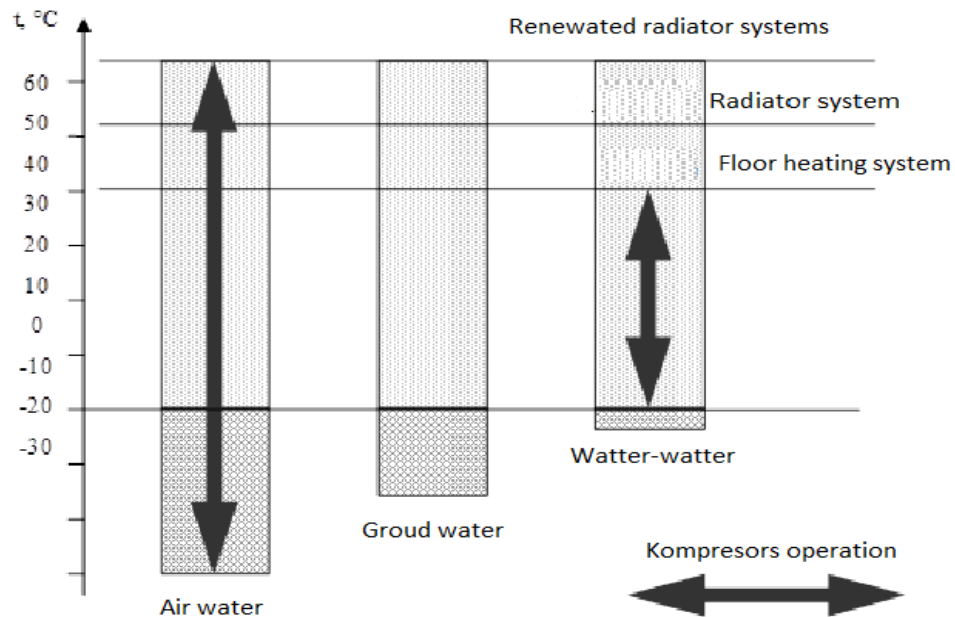
- Evaporator or condenser temperature variation greatly influence the efficiency of the compressor. Temperature influence the density of the agent and a pressure difference between the high and low pressure zones.
- Evaporator temperature is determined by its warming environment.

Operation temperatures of heating systems

Heating system	Require water temperature, °C	Condensation temperature by condenser agent, °C
Floor	from +25 till +35	from +30 till +40
Radiator low temperature	from +35 till +50	from +40 till +55
Radiator high temperature	from +45 till +60	from +50 till +65

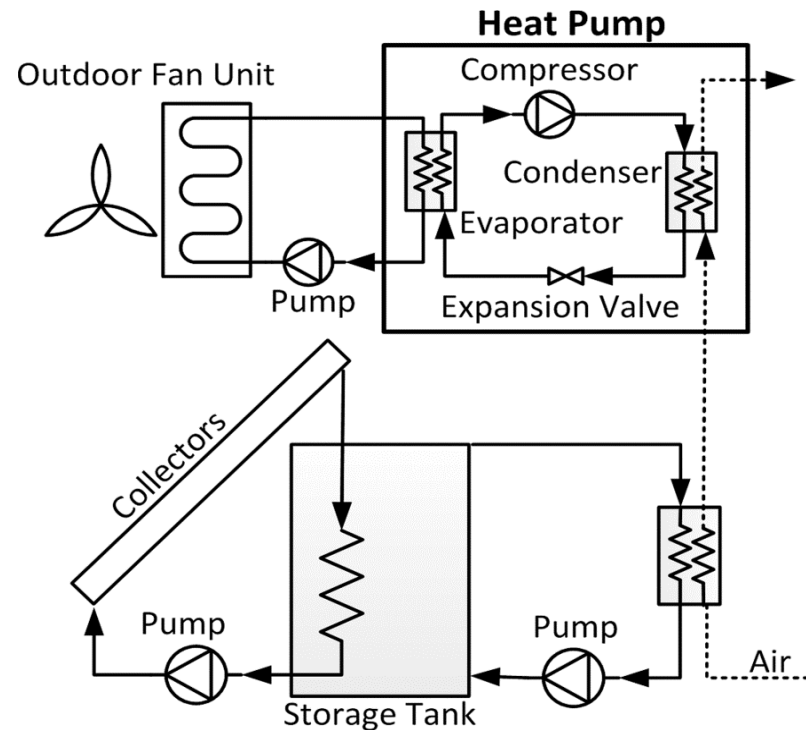
Gudžius, S.; Morkvėnas, A.; Studija hibridinių energijos šaltinių ir jų sistemų modeliai (Study of hybrid energy sources and models of the systems). KTU, 2009

Temperature of the different heating systems



Gudžius, S.; Morkvėnas, A.; Studija hibridinių energijos šaltinių ir jų sistemų modeliai (Study of hybrid energy sources and models of the systems). KTU, 2009

Hybrid solar – heat pump system



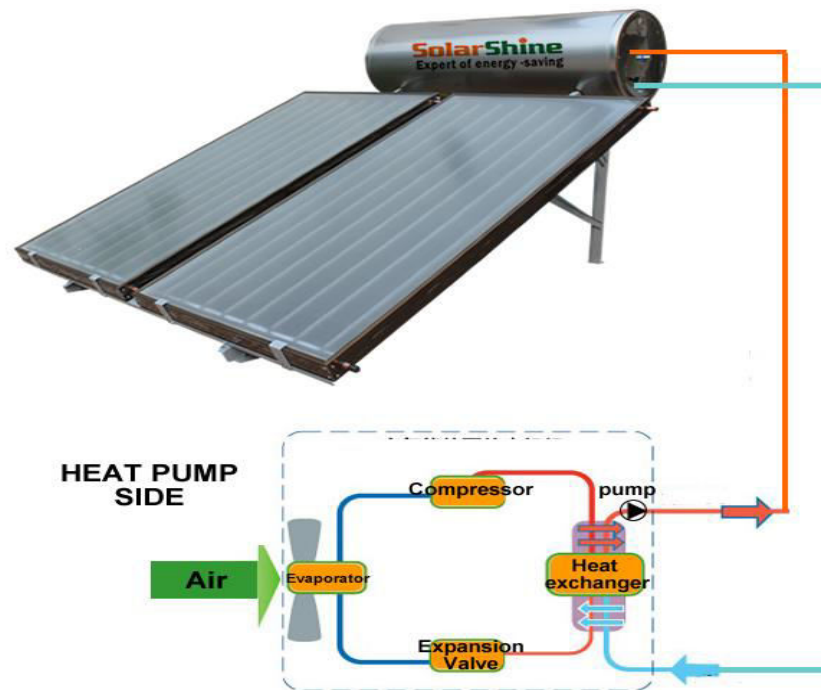
http://solarenergyengineering.asmedigitalcollection.asme.org/data/journals/jseedo/930211/sol_136_04_041013_f005.png

Contact

VIPSKILLS Project Coordinator:

vipskills[at]pb.edu.pl

Hybrid solar and heat pump systems diagram



https://www.alibaba.com/product-detail/Supply-hybrid-solar-and-heat-pump_60478315828.html

Heat pumps advantages compared with solar collectors

Easier installation;

The heat pump operates at night;

The heat pump produces more heat during the day;

Four persons house annually consumes much power at home with solar collectors;

Commercial buildings may be joining ducts of air conditioning system, thereby improving the efficiency;

Power consumption graph is continuous, unlike heating systems with solar collectors.



Heat pumps disadvantages compared with solar collectors

Heat pump
consumes power
constantly

Has rotating parts

Use a cooling
agent

Heat pumps more
expensive than
solar collector

Possible noise of
compressor



References

1. Adomavičius, V. Mažosios atsinaujinančiųjų išteklių energijos sistemos (Small renewable energy systems). Kaunas: Technologija, 2013;
2. Petrauskas, G.; Adomavičius, V. Saulės energijos naudojimas elektrai gaminti (Using of solar energy for electricity generation). Kaunas: Technologija, 2012;
3. Petrauskas, G.; Adomavičius, V. Vėjo energijos naudojimas elektrai gaminti (Using of wind energy for electricity generation). Kaunas: Technologija, 2012;
4. Tushar, K.; Ghosh,.; Mark A. Prelas. Energy Resources and Systems. London: Springer, 2011;
5. Gudžius, S.; Morkvėnas, A.; Studija hibridinių energijos šaltinių ir jų sistemų modeliai (Study of hybrid energy sources and models of the systems). Kauno technologijos universitetas, Elektros ir valdymo inžinerijos fakultetas, Elektros sistemų katedra, 2009;
6. <http://www.solarwhiz.com.au/air-conditioning/energy-efficient/> ;
7. http://solarenergyengineering.asmedigitalcollection.asme.org/data/journals/jseedo/930211/sol_136_04_041013_f005.png;

The presentation is available on license
Creative Commons Attribution-ShareAlike 4



Kęstutis Jasiūnas
Vilnius College of Technologies and Design

EN	<p>This project has been funded with support from the European Commission. This publication [communication] reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.</p>
PL	<p>Publikacja została zrealizowana przy wsparciu finansowym Komisji Europejskiej. Publikacja odzwierciedla jedynie stanowisko jej autorów i Komisja Europejska oraz Narodowa Agencja Programu Erasmus+ nie ponoszą odpowiedzialności za jej zawartość merytoryczną.</p>
ES	<p>El presente proyecto ha sido financiado con el apoyo de la Comisión Europea. Esta publicación (comunicación) es responsabilidad exclusiva de su autor. La Comisión no es responsable del uso que pueda hacerse de la información aquí difundida.</p>
LT	<p>Šis projektas finansuojamas remiant Europos Komisijai. Šis leidinys [pranešimas] atspindi tik autoriaus požiūrį, todėl Komisija negali būti laikoma atsakinga už bet kokį jame pateikiamos informacijos naudojimą.</p>