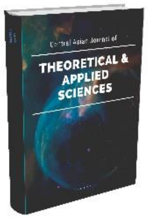

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Determination of Heat Pump Power Coefficient

Shairakhon Abdujalilova
Ferghana Polytechnic Institute

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Abstract: *The power factor of the heat pump varies depending on the temperature of the choke and condenser. By recording the measured power factor, it is determined what the boiling point depends on, and when estimating the power factor, the boiling point correlation is determined.*

Keywords: *heat pump, condenser, compressor, reservoir, temperature, boiling point, electric power, manometer, thermometer, power, evaporator, pressure, relay, expansion screw.*

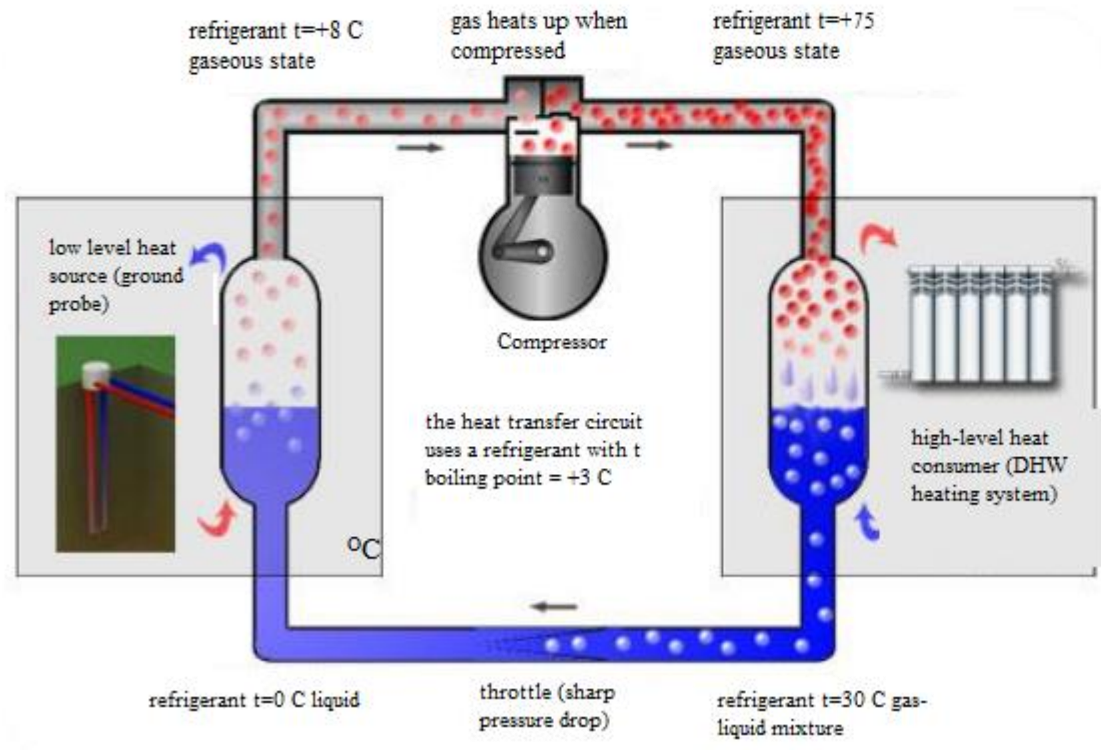
Introduction.

A heat pump is a compact, economical and environmentally friendly heating system that allows you to obtain heat for hot water supply and heating by transferring heat from a low-level source to a high-temperature heat carrier. There are different options for classifying heat pumps. According to their operational functions, pumps are divided into two main categories: Heat pumps are used only for heating or hot water supply, to provide a comfortable room temperature or to prepare domestic hot water. Heat pump systems installed for space heating, cooling, domestic hot water and sometimes exhaust air recovery. Water heating can be done either by extracting the superconducting heat of the supply gas from the compressor or by extracting the superheated heat and using the recovered heat from the condenser.

Methods. The efficiency of a particular source of heat energy is highly dependent on climatic conditions, especially the source of heat, atmospheric air. In fact, this type is better known as an air conditioner. There are tens of millions of such devices in hot countries. For northern countries, heating in winter is the most relevant.

The most common types of heat pumps:

- **Air to air:** They are the most available and the cheapest.
- **Air-water:** They are ideal for underfloor heating.
- **Water-air and water-water:** They absorb heat from water currents (nearby rivers or underground streams).
- **Land-air and land-water:** They are used in geothermal heating devices. They emit heat from the ground at a constant temperature.



The heat pump consists of:

1. Heat exchanger
2. Compressor
3. Heat exchanger for transferring heat from the internal circuit to the heating system
4. A gas shut-off device to reduce pressure
5. Salt water circuit and ground probe
6. Heating and water supply period

Figure 2. Heat pump device.

Vaporizer. The evaporator is made of copper in the form of a spiral. It extracts heat from the surrounding air or ambient fluid. In the evaporator, the liquid refrigerant is under low pressure, the corresponding boiling temperature is much lower than the temperature of the air or liquid surrounding the evaporator (according to the prevailing low pressure, the liquid evaporates down to -10 °C). The cooling agent is forced to vaporize, physically this can only happen when heat is absorbed. This heat is taken from the environment (air or water).

Compressor. The compressor consists of a compressor driven by electric current (230V). The nominal power of the compressor is 110 Watts. It draws in the cold, gaseous refrigerant from the evaporator through the suction pipe and compresses it until high pressure builds up, so the temperature in the condenser rises to 50 °C. The condenser transfers heat to the water in the tank. The heat contained in the steam (refrigerant) is now: 2 parts of ambient energy + 1 part of electrical energy = 3 parts of energy for heating.

Condenser. The condenser is made of copper pipe in the form of a spiral. It transfers heat to the surrounding fluid. In the condenser, the boiling vapor of the cooling agent condenses on the inner walls of the pipes under the influence of relatively cold liquid in the environment. During the pouring process, the condensing steam releases heat and this heat heats the water in the reservoir.

Expansion valve. The expansion valve discharges the liquefied refrigerant and returns it to the evaporator through the super-liquid pipeline.

Low/high pressure relay. The low/high pressure relay is set at the factory and shuts down the device at a given maximum pressure. After the minimum pressure is reached as a result of the stop, the device starts automatically.

Low pressure manometer Low pressure manometer from 1 bar to 9 bar, built-in temperature scale from -60^{o}C to 39^{o}C

High pressure manometer High pressure manometer from 1 bar to 24 bar, built-in temperature scale from 60^{o}C to 77^{o}C

Dryer. The dryer is designed to filter the refrigerant from remaining gas bubbles, water residues and impurities before it enters the expansion valve. Acids formed as a result of the separation of oils and coolant (due to high operating pressure) are also chemically bonded.

The system is very efficient due to excellent energy performance and very low consumption.

RESULT AND DISCUSSION. 10 l of water is poured into the reservoir (evaporator / condenser capacity) (filling height equal to 10 l - 210 mm).

(The tightness of the water taps is taken into account. Water is filled into the sink sleeves of the thermometers (heat transfer). Thermometers are installed in the sink sleeves. The water temperature and corresponding pressure in the reservoirs are recorded in the record of measurements.

1. The following sequence is followed when performing the experimental work.
2. The heat pump is turned on.
3. The following are measured every 2 minutes and reported in the report:

- electric power;
- the temperature of the water in the tanks shown in the thermometers;
- pressure indicated on manometers.

4. The measurement results are recorded.
5. The power factor for the total measurement time is calculated using formula (1) for the power factor.
6. $\varepsilon = \frac{Q_{Ab}}{Q_{Zu}}$ (1)
7. Then the power factor is calculated for each step.
8. Average value for consumed electricity $W = 4186 \frac{KJ}{kg \cdot K}$ is taken as.

$$\varepsilon = \frac{m \cdot (\vartheta_{oxiri} - \vartheta_{boshi})}{Q \cdot t_{min} \cdot 60} \quad (3)$$

9. The power factor t_{min} - t_{start} is calculated for some stages of measurement and the results are included in the report.

$$\varepsilon = \frac{10 \cdot (38,5 - 17,9) \cdot 4186}{222 \cdot 32 \cdot 60} = 2,02$$

Temperatures are measured in digital thermometers.

t [min]	W_{el} [Vt]	ϑ_{steam} [^{O}C]	P_{steam} [bar]	ϑ_{kon} [^{O}C]	P_{kond} [bar]	ε
0	0	10,4	3,4	17,9	4,2	-
2	225	10,3	2,0	19,2	6,5	2,02
4	237	9,8	1,7	21,0	6,7	2,34
6	222	8,6	1,6	22,5	7,5	2,35
8	211	6,8	1,5	24,3	8,0	2,49
10	211	5,1	1,3	25,3	8,3	2,33
12	208	3,6	1,5	26,5	9,0	2,28
14	216	3,4	1,6	27,5	9,4	2,19
16	223	2,7	1,6	29,1	9,9	2,23
18	224	1,9	1,6	30,4	10,4	2,21
20	224	1,8	1,6	32,1	10,8	2,25
22	224	1,0	1,55	33,5	11,5	2,24
24	225	0,6	1,55	34,9	12,0	2,24
26	226	0,6	1,55	36,1	12,6	2,21
28	226	0,6	1,5	37,5	13,4	1,62
30	223	0,6	1,4	37,8	13,8	2,09
32	227	0,6	1,5	38,5	14,2	2,02

Calculations were found based on the above formula, and the results were shown in Table 1.

Conclusion: The system is very efficient due to excellent energy performance and very low consumption. The power factor of the heat pump varies depending on the temperature of the evaporator and the condenser. The cooling agent continues to draw energy from the water. This phenomenon is called enthalpy of solidification. This does not cause a further decrease in temperature, where the energy is taken from the water and this process continues until the water turns into a solid state (freezes) (the pressure relay switches off before this process starts).

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