ANALYSIS OPERATING PROPERTIES OF HEAT PUMPS

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ABSTRACT

In this article is described model of heat pump designed at DEPE BUT in Brno. There're stated possibilities utilize of heat pump together with solar system and measured data evaluation that have been obtained by at working model heat pump.

1 INTRODUCTION

At the present time are in technical papers and between subject specialist, but and non-professional public too, is given to the head question about possibilities utilization heat pumps for systems heating, like compensation (alternative) present warm-water systems. Firms deal with heat pumps usually introduction very much "weighty arguments" for use heat pumps, but not always be theirs arguments well-founded practical findings.

On the Department of Power engineering BUT in Brno wage research work at the development division alternative power supply. In global of this research is process disertation work o the topic Utilize heat pumps at the systems accumulation of heat. Work is direction on examination possibilities cooperating heat pumps with solar systems, and on analyses running properties of the heat pump at changing running conditions.

Purposes of research is determine appreciate the heating factor of the heat pump at the dependence on changing conditions process during the day, and define temperature gradients and pressurized terms on the heat pump. Next load is suggest conditions cooperation heat pump together with active solar system, respectively that way, so as to have been reaching optimum heating factor near low input values (temperature) to the primary circle heat pump, and same have been executed trust economical claim to running whole system.

2 TECHNICAL CHARACTERISTICS OF THE HEAT PUMP

Heat pump which was designed at the Department of Power engineering BUT in Brno

works in the system air-air. Heat pump has been design by means of refrigerated components and it is composed from this basic parts:

- Compressor unit (compressor + condenser): KCHJ - CGP14TB3NR
- Evaporator: EVS 180
- Throttling valve: TMVX – R 134a

Like cooling medium has been used substance CH2F-CF3 / SUVA 134a, known under the name of R-134a.

2.1 COMPRESSOR UNIT – TECHNICAL PARAMETERS

Compressor		**Condenser**	
Displacement	14,17 cm^3	Condenser type	CU-AL
Bore/ Stroke	31,19/ 18,54 mm	Model	9T 3R
Motor type	CSIR	Evaporating	10 W
Voltage/ Frequency	220V/ 50Hz	Fan blade diameter	230 mm
Voltage range	187-264V		
Locked rotor curent	18,0 A		

2.2 EVAPORATOR & THROTTLING VALVE – TECHNICAL PARAMETERS

Evaporator EVS 180		**TMVX-00105**	
Nominal capacity	1,28 kW	Evaporating temperature	15…-30°C
Capacity	1,06 kW	Capillary	1,5 m
Air flow	870 m^3/h		
Air surface	5,3 m^2		
Number of fans	3 pc		

The EVS range has been specifically designed for smaller refrigerator aplications. In accordance to the room temperature this range is subdivided into two types:

- EVS, for higher temperatures (≥-12°C);
- EVS/B, for lower temperatures (≥-25°C).

The entire range is equipped with high efficiency coils made from special profile aluminium fins and copper tube, suitable for the new generation refrigerants.

3 DESCRIPTION OF SYSTEM DESIGN

Is generally general knowledge that heat pump and solar system can work as individual power sources. With development of heat pumps system air-air was appearance question of possibilities cooperation these two systems.

System with heat pump can work in two modes, namely in monovalent or bivalent. In monovalent shunting protection power needs have object only heat pump. In bivalent shunting is to heat pump addition helping source, which is exploitation in case, when media temperature at entry heat pump goes down below specific value (so-called bivalent temperature). When the temperature drop below point of bivalence is activate heat chamber solar collector and by the help of acumulation heat energy in this chamber is rising temperature at the input of heat pump.

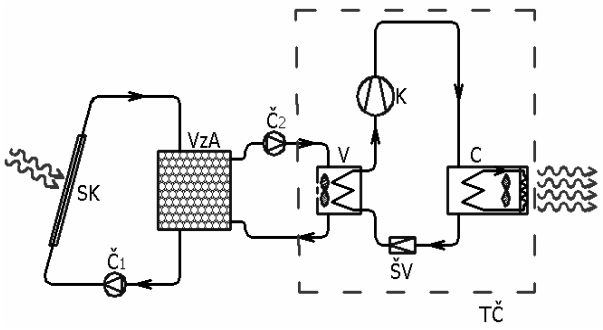

Fig. 1: *Technological diagram*

If we increase the air temperature at the input heat pump, we will attainment increasing heating factor of the whole system. For illustration is here state technological diagram on the figure 1.

Note: SK - solar collector, VzA - air accumulator, V - evaporator, K - compressor, C - condenser, ŠV - throttling valve, $Č_{1,2}$ - circulating pump, TČ - heat pump.

Idea cooperation of active solar system and heat pump is found on these presumptions:

- collector efficiency and heat quantity obtained from collector system depend on temperature warmed-up media (see. Fig. 1 – Efficiency of a solar collector on its mean temperature) efficiency and heat quantity increases with this temperature degreases,
- if is this extracting heat use as a source for HP, its temperature may be lower than temperature for heating or preparing of a hot water.

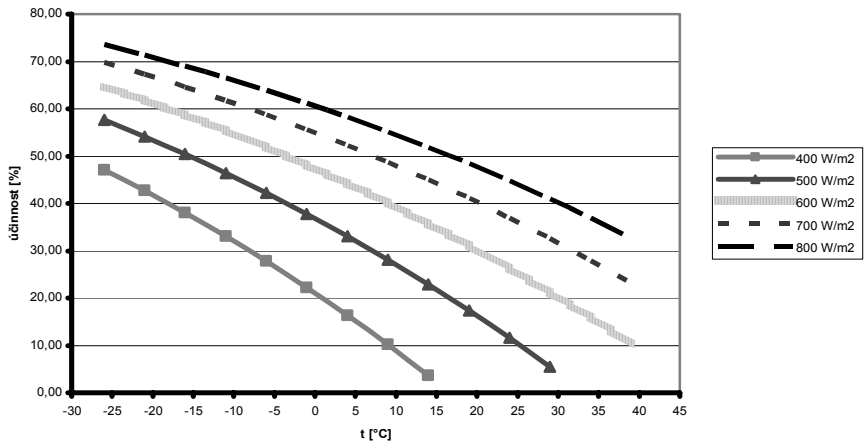

Fig. 2: *Efficiency of a solar collector on its mean temperature*

According to height presentation wil be in heating season heighten how amount of heat adventitious from collector system, so firstly heat quantity obtained by heat pump, owing to exercise drive energy.

4 ANALYSIS AND GRAPHICS PROCESSING OF MEASURED VALUES

Principal aim of measuring on this system has been definition curve heating factor on input temperature to the heat pump and successive determination dependency between input pressure and temperature at entry and between temperature at output and output pressure. Individual dependencies they are displayed on fig. no. 2, 3, and 4.

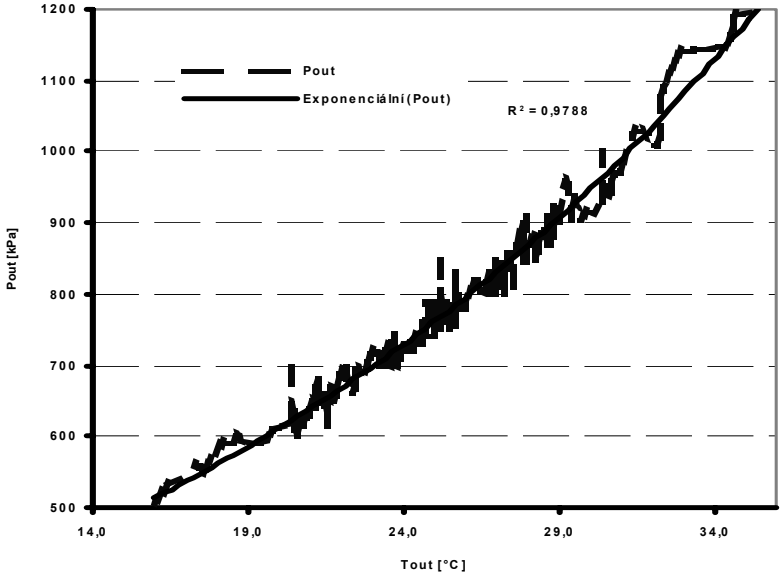

Fig. 3: *Dependence of Pout = f (Tout)*

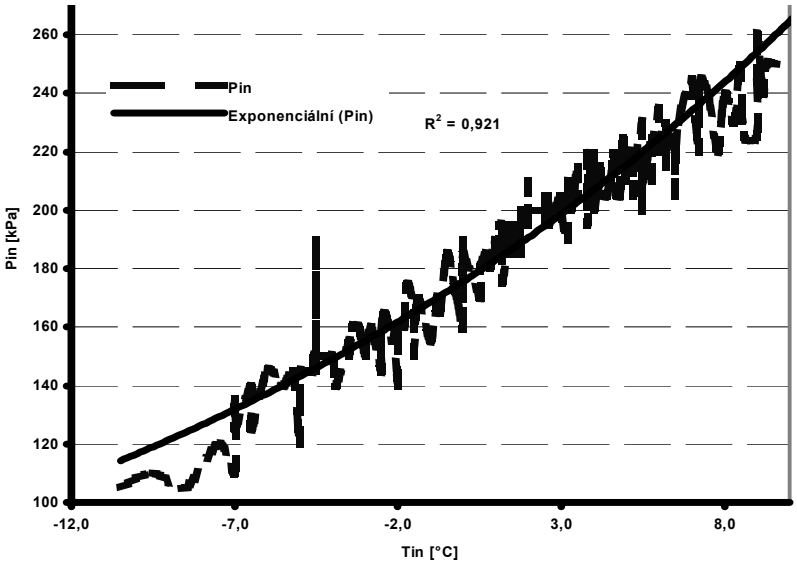

Fig. 4: *Dependence of Pin = f (Tin)*

From figures is noticeable dependence between of temperature at the input to the HP and pressure on the input and between temperatures at the output fro HP and output pressure. Dependence heating factor at the input temperature is partially interference of temperature in the room. Air from the room is exploitation to extracting temperature steam refrigerant on condenser, and same work on the compressor. The higher temperature in the room, the more

is warming-up compressor and thereby rise temperature at the output heat pump. From this resulting, that heating factor isn't in this case dependent only at input and output temperature heat pump, but the temperature of room influences him. It is possible tell, that for objective determination heating factor of the heat pump air-air, will be on account of energy flow at the system. This however presuming exact terms determination air flow at the input and output of heat pump. Measuring of the air flow will be realized by the help of Prandt's tube.

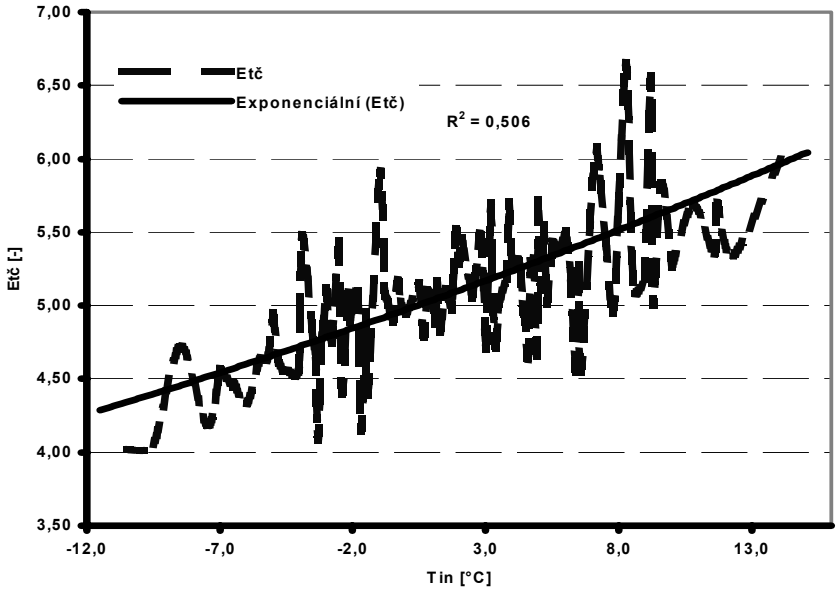

Fig. 5: *Dependence of heating factor on the input temperature – Etc = f (Tin)*

5 CONCLUSION

Idea of utilization heat pumps at the systems accumulation heat provide other possibilities more effectively utilization low-potential energy for purposes heating. Cooperation heat pumps with solar systems are once of possibilities how we can obtain more effectivity. Measured values reflect us that with increasing temperature at the input heat pump, increases heating factor of the system too. This fact confirmation us, that research with idea of reheating input media by the help of warmth from solar system is the right way.

ACKNOWLEDGEMENTS

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