2022 8th International Conference
on Energy Efficiency and Agricultural Engineering
EE&AE 2022

30th June - 2nd July 2022, Ruse, Bulgaria

Use of Thermoelectric Cooler as Humidity Regulator

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GOAL OF THE STUDY

The Peltier thermoelectric modules are used basically for cooling or heating of comparatively small air volumes or objects. The aim of the present paper is to present an uncommon possibility to use Peltier modules as regulators of the relative humidity in closed compartments. A realization of the thermoelectric system for control and maintenance of constant temperature in small close compartment is shown.

METHODOLOGY OF THE INVESTIGATION

The thermoelectric system (TES) for thermostatting of a closed compartment provides opportunity for gradual regulation and maintenance of constant temperature and humidity within the compartment. Generally, TES consists of three parts:

— thermally insulated chamber with thermoelectric pump;

— thermoregulator;

— humidity regulator within the thermally insulated chamber.

The two-position thermoregulator was realized on the basis of microcontroller PIC 16F873A-I/SP. In the main cycle of the program, the desired temperature is set and the two-position algorithm of the thermoregulator is realized, the switch-on period of the heater is about 1 s which prolongs its service life.

The block diagram of the TES thermoregulatory is shown in Fig. 1.

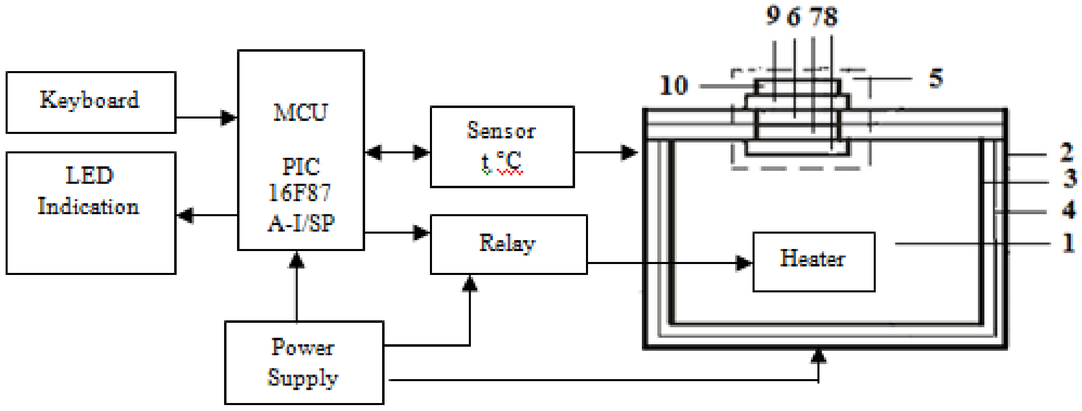

Fig. 1. Two-position thermoregulatory of the thermoelectric system.

ACKNOWLEDGMENT

The studies were carried out with the financial support of the CoC “QUASAR” – project № BG05M2OP001-1.002-0006.

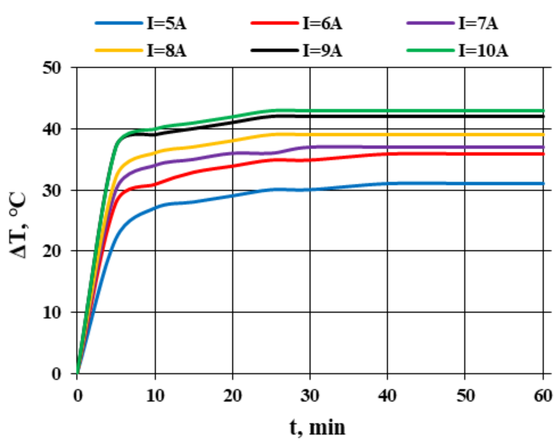

Fig. 2. Dependence of the temperature difference ΔT on measurement duration t under constant supply current I – $\Delta T = f(t)$, $I = const.$

MAIN RESULTS FROM THE STUDY

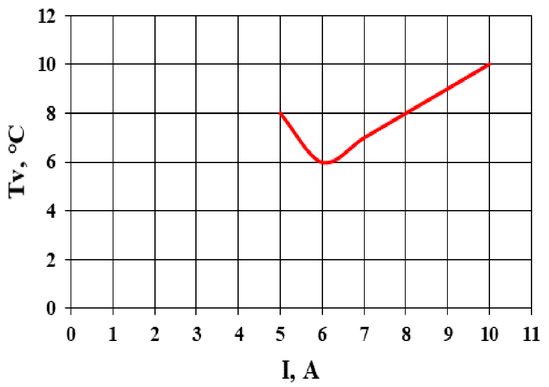

Fig. 3. Dependence of the temperature in the cooled chamber T_V on the current I through TEP: $T_V = f(I)$.

The family of plots shown in Fig. 2 indicates that the temperature difference ΔT between the sides of the thermoelectric pump increases with the increase of the input current I. At current $I = 10A$, the maximal temperature difference was observed $\Delta T_{max} = 43\ °C$.

The plot in Fig. 3 indicates that the optimal current I_{opt} trough the thermoelectric pump is $I_{opt} = 6A$. At this value of the current, the temperature of the cold heat sink – $T_c = -9\ °C$, while the temperature in the cooled compartment is $T_V = 6\ °C$.

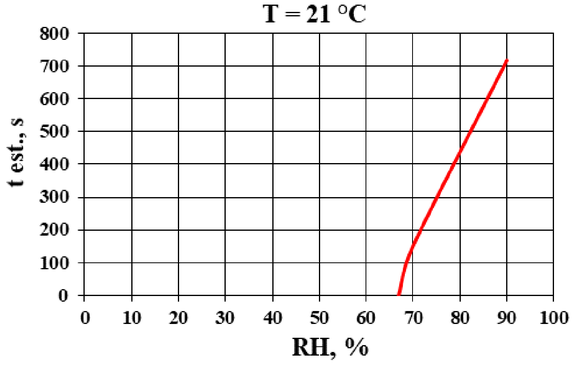

Fig. 4. Dependence of the settling time on the preset relative humidity:

$t = f(RH)$, $T = const.$

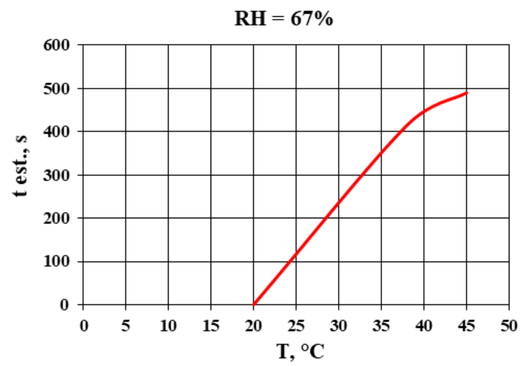

Fig. 5. Dependence of the settling time on the prset temperature:

$t = f(T)$, $RH = const.$

CONCLUSIONS

An idea is suggested for using a thermoelectric cooler as regulator of the relative humidity of the air. A thermoelectric system is realized with processor control and opportunity for gradual regulation of the temperature and the humidity in a thermally insulated chamber.

The following conclusions can be made according the experimental results obtained:

• TES ensures precise maintenance of the relative humidity and the temperature in a closed compartment. Such TES could be implemented in microgermination farm, as incubator, for growing mushroom mycelium, etc.

• The Thermoelectric cooler can successfully be used (in cooling mode) as an efficient regulator of the relative humidity of the air.