Література.

1. Резцов В.Ф. Некоторые принципы синергетического анализа процессов преобразования энергии нетрадиционных и возобновляемых источников //Відновлювана енергетика. - 2005. - № 1. - С. 19 - 25.

2. ДСТУ 2837-94 (ГОСТ 3044-94) Перетворювачі термоелектричні. Номінальні статичні характеристики перетворення. Діє від 01.01.1997 р.

Авторська довідка.

1.Лухтан Тетяна Олександрівна, студентка, факультет ГРТБ, Національний університет харчових технологій, тел: 067-279-19-20.

2. Коломієць Дмитро Петрович, старший викладач, кафедра електротехніки, Національний університет харчових технологій, e-mail:kdp1210@i.ua.

3. Ковтун Світлана Іванівна, науковий співробітник, Інститут технічної теплофізики НАНУ, тел.. (044) 453-28-42, e-mail: teplomer@ukr.net

4. Воробйов Леонід Йосипович, к.т.н., с.н.с., провідний науковий співробітник, Інститут технічної теплофізики НАНУ, тел. (044) 453-28-42, e-mail:teplomer@ukr.net

Надійшла до редакції 14.05.2012
Надійшла після рецензування 16.05.2012

УДК 536.2: 536.08

UNIVERSAL TPC-INSTALLATION WITH THERMOELECTRIC CONVERTERS

O.G. Mazurenko, T.O. Roman, Z.A. Burova, L.V. Dekusha

Summary: *The article provides a description of the created ТФХ - installation with thermoelectric converters, given their technical and metrological characteristics, possibilities of application. Was used standard, according to DSTU, measuring transducers.*

Keywords: *Thermoelectric converters, thermal characteristics, coefficients of thermal conductivity and thermal resistance.*

Introduction. Universal TPC-installation on the basis of thermoelectric converters is designed for the study of the effective coefficients of thermal conductivity and thermal resistance of a wide range of samples of solid, granular and viscous materials. It can be implemented in the research and certification laboratories of various gala-sectors of the industry, including food, grain processing, construction, etc.

Methods of investigations. The installation is implemented symmetric scheme of the method of determining the coefficient of thermal conductivity of the materials with the use of primary thermoelectric converters of heat flow (thermometers) [1]. The essence of the method-do is to create a stationary heat flow through the flat sample, directed perpendicular to the face (the largest) surfaces.

The constructive solution of the installation measuring cell allows simultaneous testing of up to four samples empirical material, which significantly reduces the duration of the research and reduces measurement error.

Coefficient of thermal conductivity is determined by the results of measurements of the thickness of the sample, the difference of temperatures of the working surfaces and the surface density of a thermal stream, passing through the sample. Calculation of thermal resistance, R_T, $K \cdot m^2/W$, and the coefficient of thermoconductivity of the sample λ,), is performed by formulas:

$$R_T = \frac{2 \cdot (T_B - T_H)}{q_B + q_H} - R_K, \quad \text{and} \quad \lambda = \frac{h}{\frac{2 \cdot (T_B - T_H)}{(q_B + q_H)} - R_K},$$

where h – thickness of the sample, m; T_B - T_H – the difference of the values of temperature, accordingly, the upper and lower working behavior- surfaces of the sample, K; q_B and q_H - surface density of a thermal stream, passing, respectively, through the upper and the lower work surfaces of the sample, W/ m2; R_K - total contact thermal resistance between the surfaces of the sample and the converters of temperature of the heat meters blocks, $K \cdot m^2/W$.

Basic constructive scheme of installation is shown on Fig. 1.

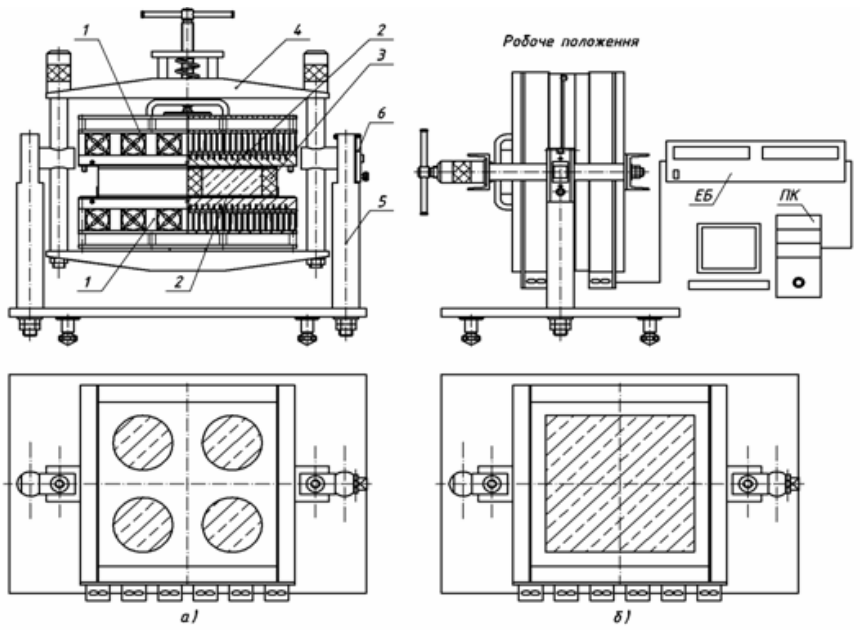

Fig.1. Basic constructive scheme of the universal installation for the study of four (a) and one (b) samples of material: *1 – thermo static blocks, 2 – thermo electric heat measuring blocks, 3 – inset, 4 – press mechanism, 5 –posts, 6 – fix mechanism, ЕБ – electron block, ПК – PC.*

Structurally installation is a collection of functionally united thermal unit (ТБ), in which placed samples of experimental material and provide the necessary temperature and heat mode and of the electronic unit (ЕБ) with built-in device of thermostating reference junctions of thermoelectric converters.

ЕБ contains the means of control of thermal regimes - electronic controllers of type RT-0102 and give the experimental conditions and modes of installation, regulation and control of operating parameters, reception and processing of primary measuring information and transfer it using the serial interfaces RS-485/RS-232 interface to a personal computer (PC) for further processing by the appropriate specialized program. Software for PC works with Windows XP and above and is intended for reception of the information from the ЕБ in all modes of operation, calculation and display values of measured variables and writes data to document in a file on a disk.

The main elements of the ТБ are the upper and lower blocks thermostat-1, which are identical in structure and consist of an electric heater and radiator, which is a set of plates with relevant ribs. Keeping of warmth is the convective by blowing air with the help of the blocks of the six ventilators, established in the general block. Thermostat blocks 1 equipped with heat measuring blocks 2, each of which represents a plate in the amount of 300x300 mm, containing five primary converters of heat flow with diameter 100 mm with built-in converters of temperature.

Between heat measuring blocks 2 set fire tab 3, which is intended for placing a prototypes and performed with heat insulating material to exclude the influence of external factors on the thermal field samples. The form and the sizes of the tab 3 corresponds to heat measuring blocks 2 and executed in the form of plates 300x300 mm of a thickness not less than 20 mm. Depending on the type of research material it can contain four holes heat measuring 100 mm (Fig. 1, a) or one hole 250x250 mm (Fig. 1, b). Here is the same, in assembled condition between the upper and lower blocks thermostat is formed one or four measuring cells, which are intended for accommodation of the samples of the experimental material and provision of the required thermal and temperature regimes.

Thermostat blocks 1 with the established between them the tab 3 and experienced samples placed in press unit 4, which is a framework on guide racks 5 and is intended for fix prototypes and minimize the contact resistances between them and heat measuring blocks in the measuring cell. The effort is specified by means of a screw mechanism with the power spring. In the study of granular materials the design is turning to 90 degrees and set in the operating position (vertical), locking it with fix mechanism 6. When the temperature modes of research below room ones, ТБ placed in the climate camera. At temperatures above room, ТБ equip with block of the active thermal side insulation (on figure not shown).

The scope of measuring equipment installation includes primary converters of heat flow (ТПТП) and of temperature (ТПТ), assembled in heat measuring blocks 2.

As ТПТП applied thermoelectric bimetallic converters of heat flow, which has been performed according to DSTU 3756-98 (GOST 30619-98), as the type of auxiliary wall with built-in converters of temperature, which are non-standard means of measuring the surface density of the heat flow and temperature.

As ТПТ, designed for temperature measuring and control various aspects of the installation, used thermoelectric temperature converters (thermocouples) typeТХК, manufactured according to DSTU 2837-94 (GOST 3044-94).

The electric connection of the ТБ and ЕБ is carried out with the help of connecting cables that connect to the appropriate connectors on the toolbars ЕБ.

Results and discussion.

The main technical characteristics of the installation:

• Range of values of coefficients of thermal conductivity, which are measured, from 0.03 to 3.0 W/(m•K);

• Limits of tolerable basic relative measurement error of the coefficient of thermal

• Range of values operating temperature of the samples from minus 20°C till 130°C;
• overall dimensions of the samples from Ø 100 mm up to 250x250 mm, a thickness of not less than 20 mm;
• The number of samples investigated at the same time, the solid - 1 PC., bulk and pasty - 4 PCs.;
• It is also possible definition of the capacity of heat and warmth of hydration of binding materials, for example, multi-component mixtures.

CONCLUSIONS. This setting is a multi-function device that allows you to carry out research not only thermal characteristics, but also to observe the condition of the thermal processes in the samples of different materials in the real time.

Literature.

1. Theoretical bases of calculation and design of facilities for the determination of the thermal conductivity. NDR report (final)/ Institute of technical Thermophysics of the NAS of Ukraine. - № of state registration 0101U002314. - Kyiv, 2003. - 176 p.

2. DSTU 3756-98 (GOST 30619-98). Energy saving. Converters of heat flow thermo electric for general purpose. General technical conditions.

3. DSTU 2837-94 (GOST 3044-94). Thermoelectric converters. The nominal static characteristics of conversion.

Авторська довідка.

1. Мазуренко Олександр Григорович, д.т.н., професор, зав. кафедри, кафедра електротехніки, Національний університет харчових технологій, тел. (044) 278-94-78.

2. Роман Тетяна Олександрівна, інженер, кафедра електротехніки, Національний університет харчових технологій, тел. (044) 278-92-31.

3. Бурова Зінаїда Андріївна, науковий співробітник, Інститут технічної теплофізики НАНУ, тел. (044) 453-28-42, e-mail: teplomer@ukr.net

4. Декуша Леонід Васильович, к.т.н., с.н.с., завідувач відділу, Інститут технічної теплофізики НАНУ, тел. (044) 453-28-42, e-mail: teplomer@ukr.net

Надійшла до редакції 14.05.2012
Надійшла після рецензування 18.05.2012