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The Determination of Emissivity T A Stationary Method

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I.INTRODUCTION

A review of methods for measuring the integral radiation characteristics of materials, carried out in the article and shows that there are the following tasks for creating simplified measurement methods [1-2].

II. MATERIALS AND METHODS

In the widely used "radiation method", it is necessary to measure three parameters - temperature and radiation flux density, as well as convective heat loss (if convective heat loss is excluded, as can be seen, it is necessary to measure two quantities). To exclude convective heat losses and the need to measure the radiation flux, a simplified non-stationary method for determining the integral emissivity (ε_T) was proposed in [3-4]. Where it was proposed to exclude convective heat losses by conducting an experiment simultaneously with two samples - one with a known ε_T, is the second working. Both methods were based on the fact that at the same temperatures and for the same temperature differences, both samples have the same convective heat loss. However, as is known for non-stationary methods, samples with the same dimensions and known thermo-physical characteristics (heat capacity, mass) are required, and it is also necessary to measure time. Both of these methods were proposed, but were not implemented, and the error assessment of these methods was not carried out.

The analysis showed that it is possible to develop the methods proposed above and to develop on this basis a stationary method - measuring the emissivity by equilibrium temperatures. A schematic of our stationary method is shown in Fig. 1. Its peculiarity is as follows. Two thin flat plates are taken, from one working material with a thickness of about 1-5 mm, and one of them is covered with soot. These samples, working and "black" are heated using a radiation source. The equilibrium temperatures of the samples are measured. Further, given that the temperature drops in the samples are small, less than 0.1 degrees, and also neglecting heat loss through the sides of the plates and heat loss through the support legs, we can write the following balance equations.

$$2_*\varepsilon_{1*}\sigma_*T^4 + 2_*\,\alpha_{K1*}(T-T_0) = \alpha_{1*}E_C + 2_*\varepsilon_{1*}\sigma_*T_\Pi{}^4 \qquad (1)$$

$$2_*\varepsilon_{2*}\sigma_*T_a{}^4 + 2_*\alpha_{K2*}(T_a-T_0) = \alpha_{2*}E_C + 2_*\varepsilon_{1*}\sigma_*T_\Pi{}^4 \qquad (2)$$

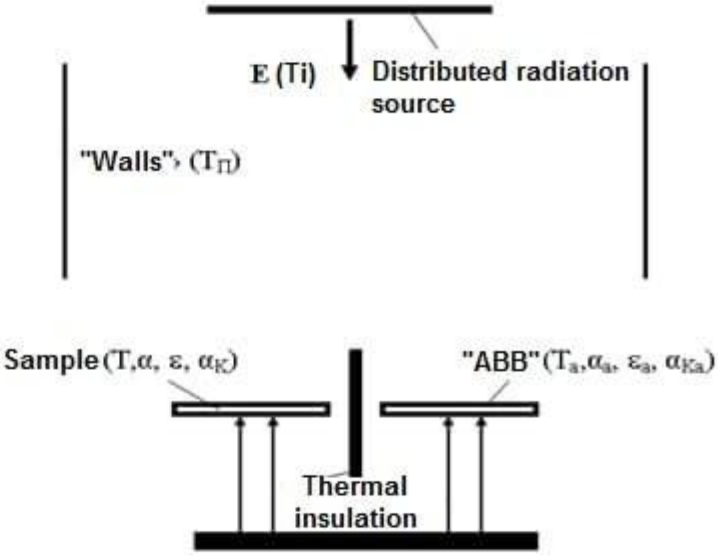

Figure: 1. Scheme for determining ε_T from equilibrium temperatures.

At source temperatures close to heating temperatures, it can also be assumed that

$$\alpha_1 = \varepsilon_1 \text{ and } \alpha_2 = \varepsilon_2 \qquad (3)$$

In these equations, the temperatures of the sample and the "ABB", the temperatures of the walls (measured), the ambient air temperature are known, the density of the incident radiation E is also measured, and the unknowns are the convective heat transfer coefficients α_{K1}, α_{K2}.

From equation (2) we determine the coefficient of convective heat transfer αK2. Let's find the connection between α_{K2} and α_{K1}. In general, the nature of convective heat transfer on both samples is the same (the same conditions), so the differences between them are due to the difference in the temperatures of the working sample and the “ABB”. The temperature dependence of the convective heat transfer coefficient for flat plates cooled from above is shown in Fig. 2.

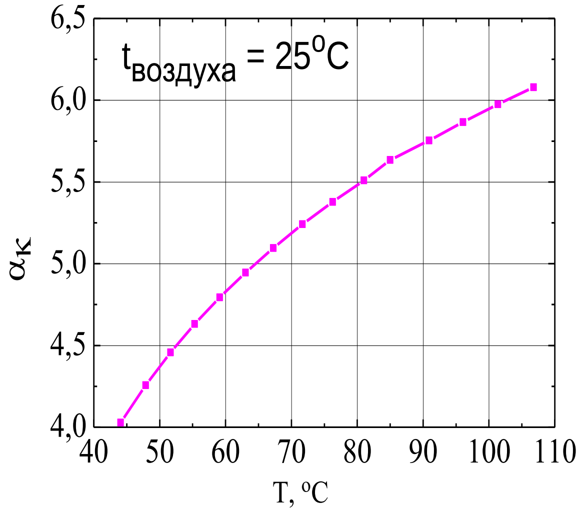

Fig. 2. Dependence of the coefficient of natural convective heat transfer from the temperature of a flat plate cooled from above.

As shown by preliminary experiments, the difference between the temperatures of the working sample and the "ABB" is at the level of 10-150, while as follows from Fig.2. The difference between α_{K2} and α_{K1} does not exceed 5%. It can be assumed that $\alpha_{K1} = \alpha_{K2}$. Then, determining α_{K2} from (2) and substituting instead of α_{K1} from (1), we determine the emissivity of the sample. Note that in the case of forced convection, the heat transfer coefficient does not depend on the temperature of the samples, but depends only on the temperature of the ambient air.

Let us estimate the main components of the relative error of the method δ. They are made up of the following random errors:

The error in the assumption of low heat loss from the side surface is - $\delta_S = 100\% *(S_Б/(2*S) = 100\%$, which at $r_S = 30mm$ and $h = 2mm$ is equal to $\delta_S = 100\% (h/r_S) = 100*0.033 = 3.3\%$;

The error in determining the temperatures of the sample and "ABB" by thermocouples – $\delta_{TO} = 100\% *(0.5/90) = 0.6\%$;

The error in determining the density of the incident flow –$\delta_{ПАД}$ 5% (according to the passport);

The error in determining the ambient air temperature - $\delta_B = 100\% *(0.2/25) = 0.8\%$;

The error in the assumption that $\alpha_{K1} = \alpha_{K2}$ in the case of natural convection is –$\delta_{\alpha K} = 5\%$, in the case of forced convection $\delta_{\alpha K} = 0\%$;

The error in determining the temperature of the "walls"- $\delta_{CT} = 100\%*(0.5/30) – 1.7\%$;

The total relative error δ will be determined by the formula [5].

$$\delta = (\delta_S^2 + \delta_{TO}^2 + \delta_{ТАЧТ}^2 + \delta_{ПАД}^2 + \delta_B^2 + \delta_{\alpha K}^2 + \delta_{CT}^2)^{0.5} = 8\% \qquad (4)$$

Consequently, for almost all bodies it is possible to determine the integral emissivity and the selectivity parameter to solar radiation from its equilibrium temperature, and since the equilibrium temperatures of the gray and black bodies are the same, a blackened working sample can be used as a gray body.

Figure 3 shows a diagram of an installation for measuring emissivity, where: 1 - sample –ε_T, which must be determined; 2 - “black” sample with known ε_T; 3 - type XA thermocouples; 4 - switch; 5 - voltmeter; 6 - thermometer; 7 - sensor for measuring the radiation flux, type FOA 022, 8 - distributed radiation source, 9 - standard actinometer for measuring direct solar radiation with an automatic tracking system for the Sun.

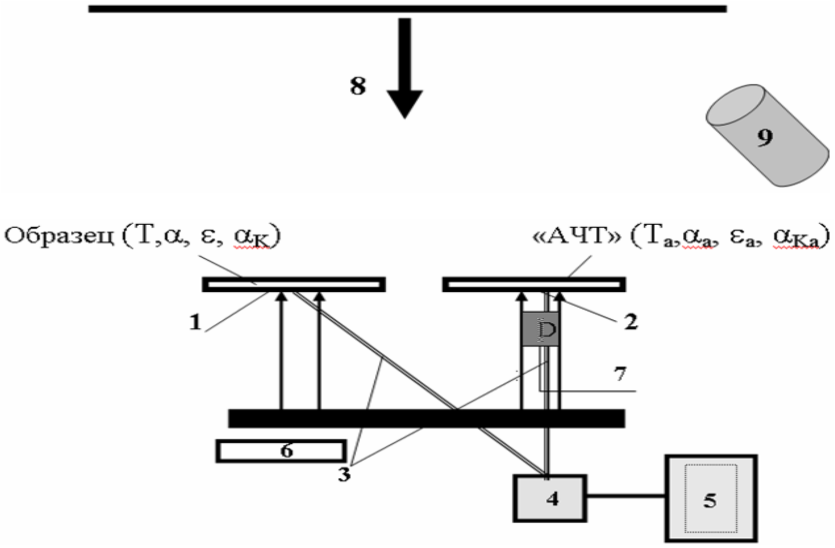

Fig. 3. Installation diagram for determining the emissivity

When developing the experimental setup, the requirements of the developed technique were taken into account (see [1]) - ensuring a uniform flux on the samples, the possibility of excluding the influence of residual radiation from the source on the samples after it is turned off (when the samples reach an equilibrium temperature), this was the reason for the use of quartz halogen lamps , the maximum possible elimination of heat leakage through the sample holders (needle supports for samples), as well as ensuring the possibility of fulfilling the conditions of equality of the emissivity and absorption capacity of the material during measurements (due to a change in the temperature of the radiation source). A general view of the experimental setup for measuring the emissivity ε_T of various opaque materials is shown in Fig. 4.

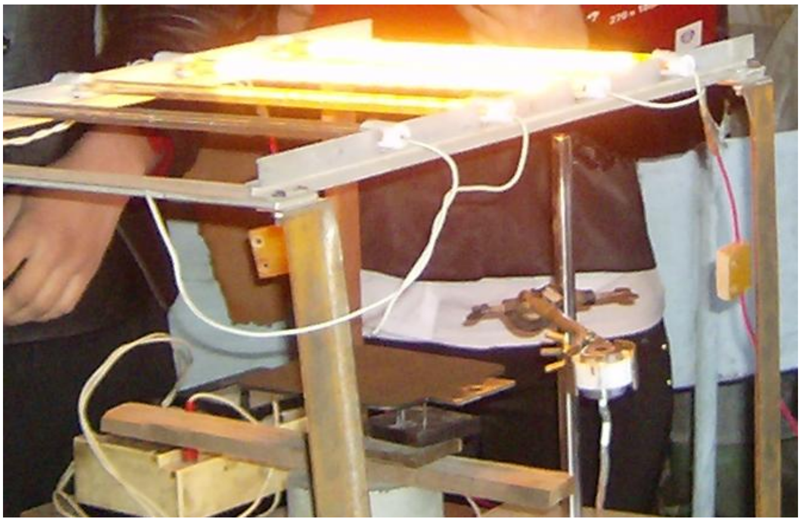

Fig. 4. An experimental setup for determining the emissivity.

The procedure for the experimental determination of ε_T by the method developed above was as follows. Two plates (working and "black") with thermocouples preliminarily fixed on their lower side are placed on the support legs of the installation. Then the source is turned on and when the samples reach equilibrium temperatures, the source is turned off. Based on the data obtained,convective heat transfer coefficient for a black sample.

$$\alpha_K = [\varepsilon_{T.\text{АЧТ}} * (E_C - 2 * \sigma * (T_{\text{АЧТ}}^4 - T_B^4))] / [2 * (T_{\text{АЧТ}} - T_B)] \quad (5)$$

Working material emissivity

$$\varepsilon_{T.\text{ОБР}} = [2 * \alpha_K * (T_{\text{ОБР}} - T_0)] / (E_C - 2 * \sigma * (T_{\text{ОБР}}^4 - T_B^4) \quad (6)$$

III. CONCLUSION

To check the experimental setup and refine the technique, we first measured ε_T of various materials with known ε_T copper and aluminum plates. It was obtained for a copper plate $\varepsilon_T = 0.44$, and for an aluminum plate $\varepsilon_T = 0.32$. These data, with an error of 8% to 15%, agree with those given in the literature [2-4]. Large deviations of the ε_T values were due to the fact that real plates were used in the experiment, and which were not specially processed. Further, after working out the method, the emissivity of some widely used materials was investigated - paints (white, red, green, blue, black and gray enamels) and building materials (gypsum, chamotte, limestone). The purpose of these studies was to determine in the subsequent their absorbency to solar radiation.

REFERENCES

1. Abdurakhmanov A., Turaeva U.F., Klychev Sh.I. Method for determining the integral emissivity of solar receivers. // Solar technology, 2009. - №4. - p. 62-64.
2. Mikheev M.A., Mikheeva I.M. Heat Transfer Basics. - M .: Energy, 1977 .-p. 344
3. Sparrow EM, Sess RD, Heat transfer by radiation. - M .: Energy, 1977 .-p.294
4. Heat power engineering and heat engineering, General questions, book 1, Handbook ed. Grigorieva V.A., Zorina V.M., - M .: Energoizdat, 1987 .-p.455
5. Kakhhorov S.K., Zhuraev A.R. Method of application of virtual stands in teaching subjects of electrical engineering, radio engineering and electronics // LXII International correspondence scientific and practical conference “International scientific review of the problems and prospects of modern science and education” (Boston. USA. September 22-23). 2019. - P. 44-47.
6. S.K. Kakhkhorov, Yu. Yu. Zhamilov “Opportunities for the formation of students' competence in alternative energy with the use of teaching software” European science 2020. No 2 (51). Part II. -FROM. 61-64.
7. Kulieva Sh.Kh., Rasulova Z.D. Innovative activity of a teacher in education // Young scientist. T. 112, No. 8, 2016, S. 978-979.
8. Umarov S.Kh., Khamroev R.R. Formation of innovative technologies in Central Asia and their importance in the process of modern managers of medical universities. Tibbiyotda yangi kun. (New Day in Medicine). 2 (30/2). 2020, pp. 90 - 92.
9. Umarov S.X., Nuritdinov Zh. Zh. Ashurov, F. K. Khallokov. Resistivity and Tensoresistive Characteristics of $TlInSe_2$ - $CuInSe_2$ Solid Solutions. Technical Physics, 2019,Vol.64, №2, pp. 183 – 186.
10. Umarov S.Kh., Nuritdinov I., Ashurov Zh. Zh., Khallokov FK Resistivity and tensoresistive characteristics of crystals of solid solutions of the TlInSe2 - CuInSe2 system. Technical Physics, 2019, vol. 89, issue 2, pp. 214 - 217.

11. Umarov S.X., Ashurov J. J., Khodzhaev U. U., Narzullaeva Z. M., Kurbonov B. S., Namozov I. U. **Influence of impurities on the electrophysical and strain-resistive properties of $TlInSe_2$ crystals.** Тиббиётда янги кун. (New Day in Medicine). 2(30/2). 2020.C.78 – 81.
12. Umarov S.X., Ashurov J. J., Khodzhaev U. U., Narzullaeva Z. M., Kurbonov B. S., Namozov I. U. **Effect of temperature and impurities of group iv elements on the electrophysical and strain - resistive properties of $TlInSe_2$ crystals.** Тиббиётда янги кун. (New Day in Medicine). 2(30/2). 2020.C.19 – 23.
13. M.F. Atoyeva. Interdisciplinary relations in physics course at specialized secondary education. The Way of Science. – Volgograd, 2016. – №9 (31). – P.22-24.
14. M.F. Atoyeva. The significance of periodicity at teaching physics. The Way of Science. – Volgograd, 2016. – № 10 (32). – P.62-64.
15. Атоева М.Ф. Эффективность обучения электродинамике на основе технологии периодичности. The Way of Science. – Volgograd, 2016. – № 10 (32). – P.65-66.
16. M.F. Atoyeva. Use of Periodicity in Teaching Physics. Eastern European Scientific Journal. – Düsseldorf-Germany, 2017. № 4. –P. 35-39.
17. M.F. Atoyeva. Didactic foundations of inter-media relations in the training of university students. International Scientific Journal. **Theoretical & Applied Science. p-ISSN:** 2308-4944 (print) **e-ISSN:** 2409-0085 (online). **Year:** 2020 **Issue:** 06 **Volume:** 86, P. 124.
18. M.F. Atoyeva, R. Safarova. Pedagogical integration as a means of forming professionally important qualities among students of a medical university. Academicia. ISSN: 2249-7137 Vol. 10, Issue 8, August 2020. Impact Factor: SJIF 2020 = 7.13 ACADEMICIA: An International Multidisciplinary Research Journal https://saarj.comэ.
19. M.F. Atoyeva. Pedagogical Tests As An Element Of Types Of Pedagogical Technologies. The American Journal of Applied Sciences, 2(09), (TAJAS) SJIF-5.276 DOI-10.37547/tajas Volume 2 Issue 9, 19.09.2020. ISSN 2689-09. 92 **The USA Journals, USA** www.usajournalshub.com/index.php/tajas 164-169. Имп.**5.2.**
20. Farkhodovna, A. M. (2020). The problems of preparing students for the use of school physical experiment in the context of specialized education at secondary schools. European Journal of Research and Reflection in Educational Sciences, 8 (9), 164-167.
21. Saidov S.O., Fayzieva Kh. A., Yuldosheva N. B. Atoyeva M.F. The Elements Of Organization Of The Educational Process On The Basis Of New Pedagogical Technologies. The American Journal of Applied Sciences, 2(09), (TAJAS) SJIF-5.276 DOI-10.37547/tajas Volume 2 Issue 9, 19.09.2020. ISSN 2689-09.92 **The USA Journals, USA** www.usajournalshub.com/index.php/tajas 164- 169. **Имп.5.2.**
22. Atoeva Mehriniso Farhodovna, Arabov Jasur Olimboevich, Kobilov Bakhtiyor Badriddinovich. (2020). Innovative Pedogogical Technologies For Training The Course Of Physics. The American Journal of Interdisciplinary Innovations and Research, 2(12), 82-91.