

Provision of Investment in Improving the Efficiency of Alternative Energy

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ABSTRACT

Thermal power plants (HPS) play an important role in the electric energy of the world and our country, but their efficiency is relatively low (up to 45%) even in the most modern devices.

Nevertheless, the method of converting thermal energy first into mechanical energy, then into electrical energy, i.e. thermal power plants, is still leading in the production of electricity, and it is expected to remain so in the next few decades [1]. In recent years, the use of hybrid technologies in increasing the efficiency of thermal power plants (for example, combining the heat energy of heliotechnical devices directly with the technological devices of thermal power plants) gives good results from the technical and economic point of view. Based on the above, in this article, the characteristics of anisotropy of thermodynamic parameters (pressure and temperature) in the process of convection heat exchange in devices operating on natural gas fuel are studied. Because it is precisely the change in pressure and temperature that causes convective processes during the combustion process and the transfer of heat to the working environment. In hybrid thermal power plants, it is assumed to transfer the working air stream heated by heliothermic method to the combustion chamber in an active or passive form, or to use the hot air stream from the technological devices, and this raises the issue of researching the thermodynamic parameters of the gaseous environment and its management. These issues are mainly assessed by the thermal conductivity and conductivity properties of the medium. In this case, the pressure and temperature of the working environment play an important role in the energy efficiency of the hybrid technology. In classical thermodynamics, the heat transfer process is theoretically considered as the amount of heat transferred from one isothermal surface to another isothermal surface, and this amount depends on the surfaces of heat exchange and the temperature difference. The amount of heat transferred is expressed by Fourier's law [2]

$$q = - \lambda \text{ grad } T \quad (1)$$

where λ is the heat transfer coefficient, which for its constant value is the amount of heat that

passed from the thickness DL through the surface S during the time interval Dt

(2)

It can be seen from the equation (2) that the accuracy of the λ -coefficient plays a key role in the calculation of the heat transfer process. In the second place, it is important how to choose the thickness of the layer from which the temperature gradients are obtained. Determining the temperature in these layers and the surface through which the current passes is not a problem if the temperature isotropic dimension is known. But the dynamics of the parameter λ and the characteristic dimensions of the temperature gradient in different directions in relation to the heat flow are very complex and are determined by the characteristics of pressure and temperature in specific conditions and the types of heat exchange processes (free convection, forced flow, radiation, etc.). Based on this, experimental determination of the λ parameter and temperature isotropic dimensions in the heat transfer (heat transfer and vice versa) thermal insulation issues has an important practical feature.

In the experiment, the dimensions of pressure and temperature homogeneity in the turbulent flow created in the heated air environment were studied using the wavefront distortions of the optical beam with a flat front passing through this environment. The air layer is 1 m long and 12 cm in diameter, and a convective flow is generated through a glass pipe with an electric heater inside. As a result of a laser beam with a flat front passing through the studied air layer and coherently combining it with the second beam (Michelson interferometer), an interference pattern (speckle pattern) randomly changing with time in the plane perpendicular to the direction of propagation of the beam is formed.

The mechanism of formation of random speckle scenes is shown in Fig. 1b. The wavefront of the laser beam is initially flat and is subjected to random fluctuations in pressure and temperature after passing through a heated and continuously convective medium (inside the tube). Such fluctuations are called turbulence in atmospheric optics, whose characteristic dimensions $R(T,P)$ are random and turn the direction of propagation of the beam to random angles (beams 1 and 11 in Fig. 1b). If the medium were quiet, the beam would propagate along a straight line (beam 2 in Figure 1b), and its wavefront would be flat.

It is possible to study the distribution of speckles on the cross-section of the beam by photographing the resulting scene. The characteristic sizes of the speckles provide information about changes in temperature and pressure, depending on the homogeneity of the optical refractive index of the medium

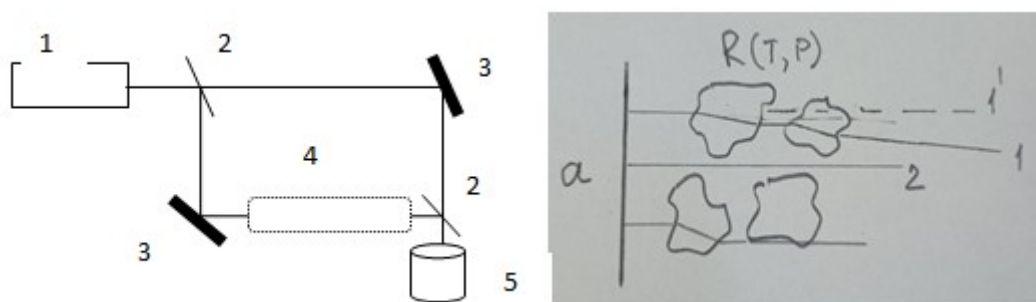


Fig. 1-a. Experiment scheme: 1-laser and optical collimator, 2-semi-transparent mirrors, 3-reflecting mirrors, 4-heated glass tube, 5-camera lens. Figure 1b. Mechanism of formation of speckle structures.

The results show that the characteristic mean sizes of the recorded speckle patterns increase with increasing temperature. In turn, in order to determine the influence of weight and Archimedean forces on the convection processes, as well as on the isotropic dimensions of pressure and temperature, experiments were conducted for points located in the horizontal and vertical points

of the glass tube. But the characteristic dimensions of speckle images were recorded in these halls at the level of statistical errors. In our opinion, the turbulence indicator of the atmosphere should be stronger to spread this light. For this, it is necessary to create a strongly heated and forced flow environment.

In short, it is possible to study the thermodynamic parameters of the environment by recording the distortion of the wavefronts of optical rays. To determine quantitative relationships, it is necessary to measure the time and spatial distribution of the light intensity level in the speckle image. Also, since the characteristic dimensions of the homogeneity of the ambient temperature and pressure are very small, theoretical considerations and boundary conditions for the turbulent flow of gases in this process are not appropriate here.

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