

DEVELOPMENT OF A VORTEX DEVICE FOR THE TGU MODEL HEAT GENERATOR AND PLANNING OF RESEARCH TASKS

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Abstract

The article presents information on the proposal of a vortex device designed to ensure a uniform distribution, along the entire length of the body, of the temperature generated by combustion products in the TGU model heat generator developed at the "Scientific Research Institute of Fiber Crops", with the aim of increasing its heat generation efficiency, and on the determination of the research direction.

Keywords: Heat generator, combustion product, temperature, device, efficiency, research.

Introduction

Scientific research is continuing to increase the heat generation efficiency of the TGU model heat generator developed at the Scientific Research Institute of Fiber Crops.

The scheme of the proposed heat generator is shown in Figure 1.

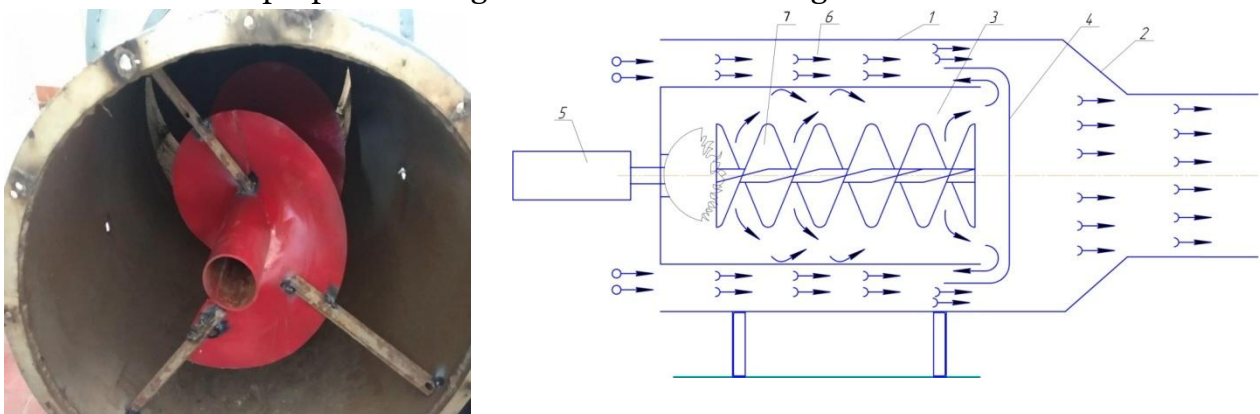


Figure 1. The process of mounting the screw guide in the combustion chamber of the heat generator (left), the scheme of the proposed heat generator (right)

The heat generator consists of a combustion chamber 3 with a burner 5 and a deflector 4 located along the axis of a cylindrical body 1 having a confuser-type outlet section 2. A heat exchanger 6 is located between body 1 and combustion chamber 3. A screw guide 7 is additionally installed in the combustion chamber of the proposed heat generator.

The heat generator operates as follows.

Combustion products enter combustion chamber 3 at a certain velocity through automatic burner 5. The screw guide (vortex) 7 located in the combustion chamber helps to change the direction of movement of the combustion products (shown by the arrows), as a result of which the wall of combustion chamber 3 is heated uniformly along its entire length and perimeter. This increases the efficiency of heat transfer from the heated wall of the combustion chamber to the air passing through heat exchanger 6.

A scientific research study was conducted to develop and investigate the technological process of the proposed heat generator and the screw guide that ensures more uniform distribution of combustion products onto the chamber walls.

According to the experimental data obtained, as the diameter of the screw devices installed in the combustion chamber of the heat generator increased from 250 mm to 400 mm, the uniformity of directing the temperature generated by the combustion products of the gas in the combustion chamber toward its outer cylindrical body increased, while the calculated standard deviation and coefficients of variation decreased [1, 2, 3].

Based on the results of the experiments conducted using mathematical planning of experiments, it was determined that the screw device installed in the combustion chamber of the heat generator should have a diameter of 400 mm, a pitch of 225 mm, and a length of 660 mm [4].

However, it should be noted that the efficiency of the screw device installed in the combustion chamber of the heat generator in rotating the drying agent in the form of a vortex was not high.

Therefore, savings in natural gas consumption used for cotton drying of up to 8% for higher grades and 13% for lower grades were achieved only.

Therefore, it was concluded that there are opportunities to further increase the efficiency of rotating the drying agent in the form of a vortex in the combustion chamber of the heat generator. To achieve the stated objective, a technical proposal was developed for the development of the curved-blade device for rotating the drying agent in the form of a vortex, shown in Figure 2.

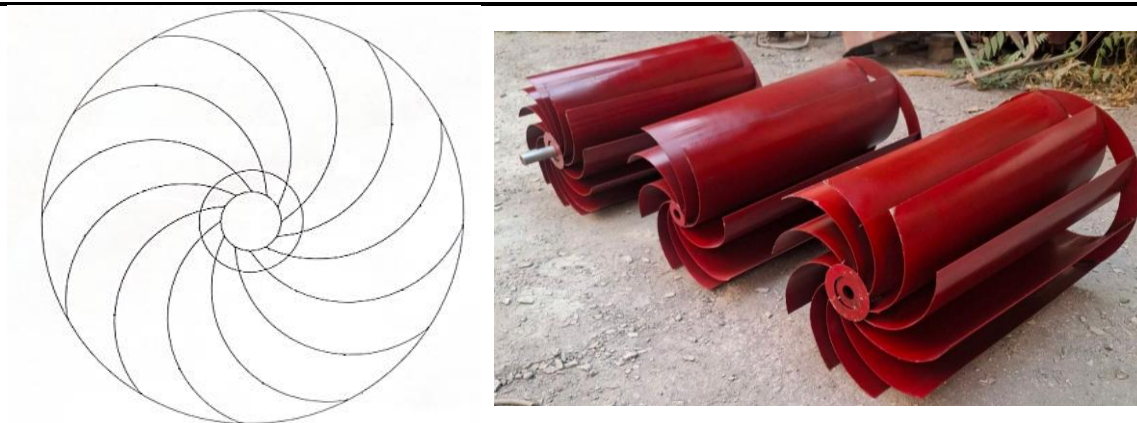


Figure 2. Scheme of the curved-blade device for rotating the drying agent in the form of a vortex (left), appearance of the manufactured versions of the devices (right)

According to the results of previously conducted experiments, the diameter of the device for rotating combustion products in the form of a vortex in the heat generator chamber was taken as 400 mm and its length as 600 mm.

The vortex rotating device was also designed to be installed in a housing bearing and to rotate freely on the shaft. All of these measures are expected to contribute to increasing the efficiency of uniform distribution of the temperature generated by the combustion products along the entire length of the heat generator body.

To achieve the stated objective, the following tasks were defined:

1. To study the physical and mechanical properties of combustion products as the research object.
2. To substantiate the technology, developed design, main parameters, and operating modes of the proposed heat generator, and to conduct theoretical and experimental studies to ensure increased technological efficiency of the guide for improving the uniformity of combustion-product distribution over the walls of the combustion chamber.
3. To substantiate the main indicators of the proposed heat generator design under production conditions and determine its energy and technical performance indicators.
4. To manufacture a prototype of the proposed heat generator with substantiated main parameters, conduct tests under production conditions, perform an economic evaluation, and introduce it into production.

References

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