Research Article

Improving the Environmental Safety of Combustion Products in the Development of Designs of Magnetic-Electric Activators for Industrial Gas Combustion

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Abstract. The aim of this research was to examine the combustion process of the magnetic-electric activation of hydrocarbon-containing waste gases for heat generation. A method for analyzing the composition of the gases was also developed.

Keywords: industrial gas combustion, magnetic-electric activation, heat generation

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Dates
Published 13 January 2022

Publishing services provided by Knowledge E

Selection and Peer-review under the responsibility of the 8th Scientific and Practical Conference Conference Committee.

1. Introduction

The theoretical justification of the physicochemical nature and energy efficiency of the limiting intensification and completeness of the combustion process of exhaust hydrocarbon-containing exhaust gases by preliminary preparation by means of ionizing activation of separate flows of combustible gases and air (oxidizing agent) by magnetic and electromagnetic fields, followed by their rapid vortex mixing to form a homogeneous activated air fuel, is presented. mixtures, then by accelerated ignition, accompanying the process with direct Exposure to these fields and the flame itself. A model and scientifically based principles of structural and technical design are presented for studying a new method of organizing the combustion process with preliminary ionizing electromagnetic preparation of hydrocarbon-containing gases and air mixture before burning. The results of studies confirming the validity of the developed hypothesis are presented[1].

2. Methodology

In accordance with the formulated strategy and the main research task, a systematic analysis of the modern theoretical base on the problem of gas combustion processes activation under the magnetic and electromagnetic fields influence was carried out.The effective result was achieved by changing the way of preparation of gaseous fuel and air before being fed to the fuel-burning device. For this purpose, gaseous fuel and air are activated in electromagnetic ionizers of gaseous fuel and air installed on the gas fuel supply pipelines and the air supply pipeline to the fuel-burning device simultaneously by a corona electric discharge and a magnetic field.

Various voltages are applied to the cleats of the electrodes of the gas fuel and air ionizers, which are regulated during the formation of crown discharges, respectively, in the gas fuel and air ionizers, from the condition for obtaining the maximum ionization currents, and as a result, the temperature in the fuel-burning device, from the condition for obtaining the maximum ionization currents of the flame, and the temperature in the fuel-burning device, simultaneously, the activation of gaseous fuel and air before being fed to the fuel-burning device is carried out by creating a magnetic field in the fuel and air ionizers by magnetic systems [2].

The proposed scheme and method for gaseous fuel and air preparing before feeding to the combustion device has the following main features that allow to achieve the best activation of combustion processes in the combustion devices.

1. The value of the voltage generated by high voltage sources at the terminals of the spark gap electrodes in the gas fuel and air ionizers is carried out using a control processor connected to the sensor of the ionization of flame.

2. The device for gaseous fuel and air preparing before being fed to the fuel-burning device is made in the form of a block-modular installation.

3. The parameters of crown discharges created in electromagnetic gaseous fuel and air ionizers are regulated by changing the voltage at the terminals of the electrodes of the dischargers to obtain the maximum ionization current, and consequently, the temperature on the burners of the fuel-burning device.

4. On the pipeline along the flow of gaseous fuel after the air ionizer, the flow regulators connected to the processor are installed.

5. The supply of ionized fuel and air to the fuel-burning device is carried out by means of flow regulators for the supply of gaseous fuel and air, respectively, to change the operating mode of the fuel-burning device using the processor.

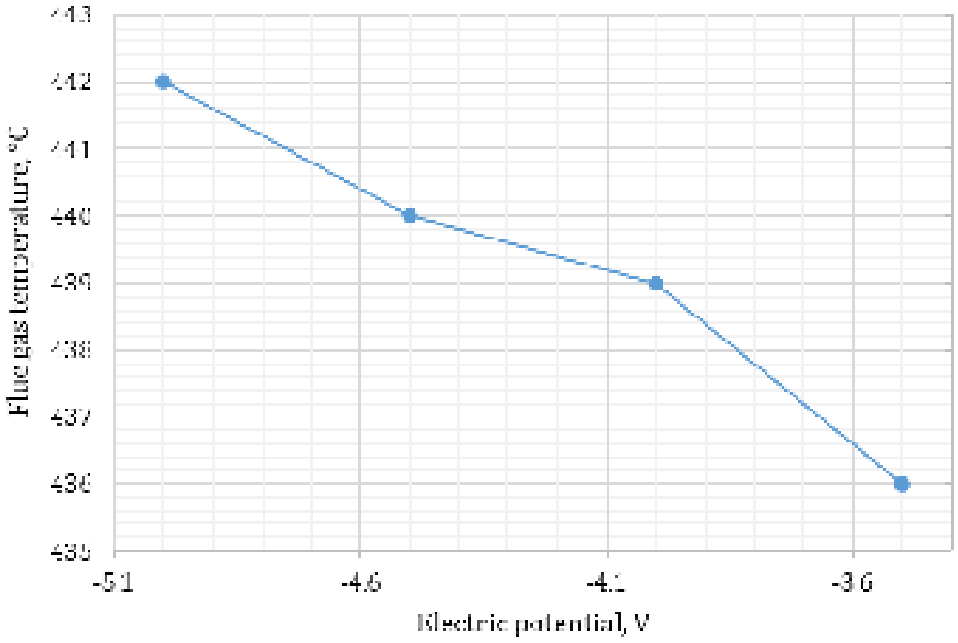

Figure 1: The change of temperature of combustion products when applying an electric field to the flame.

6. Combustion of the ionized fuel-air mixture in the fuel-burning device is carried out by means of a turbulent type burner.

At the same time, Coulomb forces of repulsion begin to act instantly in the entire volume at any point of the burner device, intensively stirring the combustible mixture. Due to the temperature increase and the simultaneous torch burning its luminosity is greatly enhanced. Heating of the working surface already occurs due to radiation not only in the infrared, but also in the visible and ultraviolet spectrum [3].

3. Experimental

The result is a change of physical and chemical fuel-air mixture properties, which improves the gaseous fuel processing efficiency and fuel economy while reducing harmful emissions of combustion products of gaseous fuels (products of incomplete combustion – CO) of various energy devices in the surrounding. Intensification occurs and the combustion process energy resource efficiency increases. The temperature of the flame and exhaust gases increases, and the amount of carbon monoxide decreases (Figures 1 and 2).

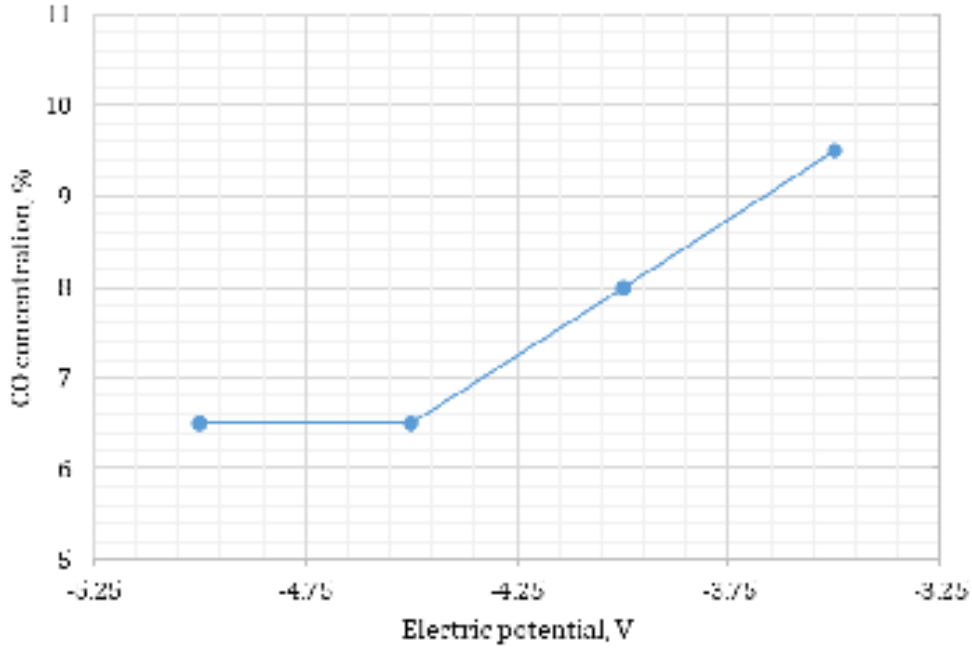

Figure 2: Changes in carbon monoxide emissions from the voltage at the electrodes.

Analysis of the results of waste gas carbonaceous combustion magneto-electric activation studies for heat generation revealed the basic and important laws of waste gas carbonaceous combustion magneto-electric activation for heat generation.

4. Conclusion

The basic and important laws of waste gas carbonaceous combustion magneto-electric activation for heat generation was revealed.Based on the obtained research results, a new method for activating gas-air mixtures to increase the specific useful thermal power (heat release) of fuel-burning devices has been developed.

5. Acknowledgement

This study was carried out in the framework of the grant RFBRN° 18-29-24220.

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