

EXPERIMENTAL STUDIES OF THE INFRARED BURNER AT HIGH VALUES OF SPECIFIC COMBUSTION POWER

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Abstract: Experimental studies of the combustion process of natural gas–air mixtures are carried out in the infrared (IR) burner device operating in the forced surface combustion (FSC) mode near the surface of a system of plates made of a heat-resistant metal alloy (Cr 25%, Al 6%, and Fe — base). Burner design and FSC mode made it possible to implement a stable surface combustion mode in the range of specific combustion power values from 900 to 5800 kW/m² per unit cross-sectional area of the gas stream. The burner power varied in the range of 10.7 to 24 kW. The dimensions of the burner radiating plate system are: width 72 mm; length 90 mm; and height 110 mm. The concentration of nitrogen oxides in the combustion products does not exceed 11 ppm, the concentration of carbon monoxide does not exceed 10 ppm at the values of the air-to-fuel equivalence ratio of 1.5, and the power does not exceed 20 kW. The maximum temperature of the outer surface of the radiating plates is 1280 °C.

Keywords: surface combustion; radiation burner

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Figure Captions

Figure 1 Schematic of the experimental apparatus: 1 — stainless steel tube; 2 — system for mixing and supply of fuel components (natural gas and air) based on the radial fan NRG 137; 3 — gas mixture flow distributor; 4 — heat-resistant ceramic plate; 5 — system of alloy plates (Cr 25%, Al 6%, Fe — base); 6 — gas meter Metrix G6; 7 — air flow meter AGAT G 25; 8 — thermocouple; 9 — convertor; 10 — gas analyzer; and 11 — IR pyrometer

Figure 2 Photograph of the layout of the IR burner operating in the FSC mode. Combustion power is 20 kW; concentration of natural gas in the initial mixture is 6.54%; air-to-fuel equivalence ratio is 1.5; concentration of carbon monoxide in the combustion products is 8 ppm; and concentration of nitrogen oxides is 10.5 ppm

Figure 3 Distribution of specific burning power across the burner slots depending on the distance to the center at different values of the total burning power: 1 — 24 kW; 2 — 20; 3 — 18; 4 — 13.8; and 5 — 10.7 kW

Figure 4 Schematic of the cross section of the IR burner and the supply tube for a mixture of air and natural gas. Dimensions are in millimeters

Figure 5 Surface temperature vs. the burner power: 1 — surface temperature of the supply tube near the top edge; 2 — surface temperature of the radiating burner plates in the center of the surface formed by the lateral edges of the plates at a distance of 40 mm from the bottom edge; and 3 — temperature of the radiating plates surface in the center of the upper edge of the IR burner

Figure 6 Concentration of toxic components in combustion products for different values of the combustion power density: 1 — carbon monoxide; and 2 — nitrogen oxides

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