RADIATION EFFECIENCY AND ECOLOGICAL SAFETY OF INFRARED METAL FOAM BURNERS WITH CERAMIC COATINGS

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Abstract: Experimental study to determine the influence of ceramic coatings on the process of burning natural gas and air mixtures on the surface of penetrating high-porous metal foam matrices in infrared burners were carried out. Multichamber detonation sprayer was used to deposit ceramic coatings made of Al_2O_3 and $ZrSiO_4$ powders on the surface of the burner matrix. It was discovered that the burner flame zone configuration changes drastically after the 200-micron fire-resistant ceramic coating is deposited on the surface of the matrix, as the flame zone moves deeper into the pores of the surface thus redistributing the energy coming from the burning of the gas mixture and increasing the working surface temperature by more than 20%. Energy emission from the surface of the matrix increases more than twofold while the temperature of the products of combustion and their energy goes down. As a result of energy thus redistributed due to the Al_2O_3 and $ZrSiO_4$ ceramic coating deposition, the radiation efficiency of the burner increases more than 2 times and the amount of toxic substances emitted decreases (carbon monoxide emission decreases by half, nitrogen oxides decrease by 10%–15%). At the same time, ceramic coatings ensure longer service time of the burner and allow reduction of the metal foam consumption.

Keywords: surface burning; radiation burner; permeable matrix; ceramic coating; burning limit

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References

1. Bryukhanov, O. N. 1977. Radiatsionno-konvektivnyy teploobmen pri szhiganii gaza v perforirovannykh sistemakh [Radiation and convective heat exchange with the combustion gas in perforated systems]. Leningrad: LGU. 238 p.
2. Shmelev, V. M. 2014. Osobennosti poverkhnostnogo goreniya na matritse iz penometalla s keramicheskim pokrytiem [Specific features of combustion on the surface of a foam metal matrix with ceramic coating]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 7:203–207.

3. Vasilik, N. Ya., Yu. N. Tyurin, and O. V. Kolisnichenko. 2014. Sposob detonatsionnogo gazodinamicheskogo uskoreniya poroshkov i ustroystvo dlya ego realizatsii [Method for detonation and gas-dynamic acceleration of powders and device for its implementation]. Patent RF No. 2506341.

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