INFRARED BURNER DEVICE WITH HIGH SPECIFIC POWER

N. Ya. Vasilik and V. M. Shmelev

N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation

Abstract: Experimental studies of the combustion of mixtures of natural gas with air over the surface of a flat permeable ceramic matrix of Fiberfrax soft heat-resistant heat-insulating material in an infrared burner have been carried out. A system of regenerative elements has been used in the burner design. Introduction of recuperative elements made of a heat-resistant metal alloy into the burner design has allowed a steady surface burning regime to be realized on the matrix surface and at a high flow rate in the surface layers of the gas–air mixture flowing around the recuperative elements surface. The surface temperature of recuperators of Fehral plates of the $Cr_{25}Al_6$ brand reached 1400 °C that made it possible to increase the value of the radiation flux density compared to burning devices with ordinary metal and ceramic matrices. The steady mode of surface burning was realized in the range of significantly higher values of the specific power of burning compared to the conventional permeable matrix, namely, from 980 to 2250 kW/m^2. The concentration of nitrogen oxides in the combustion products did not exceed the NOx values in the combustion products for metal permeable matrices with recuperation elements, and the concentration of carbon monoxide was 2 to 3 times lower.

Keywords: surface combustion; radiation burners; permeable ceramic material

DOI: 10.30826/CE19120105

Acknowledgments

The work is completed in 2018 due to a grant from the Institute of Chemical Physics of the Russian Academy of Sciences on the performance of the state task on the topic 44.8 “Fundamental study of the processes of transformation of energy-intensive materials and the development of scientific bases of management of these processes” (number of state registration of AAAA-A17-117040610346-5).

References

1. Brjuhanov, O. N. 1977. *Radiatsionno-konvektivnyy teploobmen pri szhiganii gaza v perforirovannykh sistemakh* [Radiative-convective heat transfer when burning gas in perforated systems]. Leningrad: LSU. 238 p.
2. Shmelev, V. 2014. Surface burning on a foam metal matrix with the ceramic coating. *Combust. Sci. Technol.* 186:943–952. doi: 10.1080/00102202.2014.890601.
3. Vasilik, N. Ya., and V. M. Shmelev. 2015. Radiatsionnyy koeffitsient poleznogo deystviya i ekologichnost’ infrakrasnykh gorelok s matritsami iz penometalla s keramicheskimi pokrytiyami [Radiation efficiency and ecological safety of infrared metal foam burners with ceramic coatings]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 8(1):63–70.
4. Vasilik, N. Ya., and V. M. Shmelev. 2017. Gorenie smesey prirodnogo gaza s vozdukhom na poverkhnosti rekuperatsionnoy matritsy [Burning mixtures of natural gas with air on the surface of the heat recuperating matrix]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 10(2):4–8.
5. Skachkov, O. A, O. N. Makarevich, S. V. Pozharov, and Yu. N. Demin. 2010. Sposob polucheniya poroshka dispersno-uprochnennoy ferritnoy stali [Method of obtaining a powder of dispersed-strengthened ferritic steel]. Patent RF No. 2460611.
6. Shmelev, V. M. 2008. Infrakrasnaya gorelka s ob”emnoy matritsey [Infrared burner with bulk matrix]. *Gas Industry Russia* 5:74–79.
7. Shmelev, V. M. 2007. Infrakrasnaya gorelka s ob’emnym izluchatelem dlya bytovoy gazovoy plity [Infrared burner with a volumetric radiator for a household gas stove]. *Gas Industry Russia* 11:79–81.
8. Vasilik, N. Ya., A. V. Porsin, and V. M. Shmelev. 2018. Infrakrasnoe gorelochnoe ustroystvo s kataliticheskim radiatsionnym ekranom [Infrared burning devices with the catalytic radiation screen]. *Goren. Vzryv (Mosk.) — Combustion and Explosion* 11(2):51–55.

Received January 22, 2019

Contributors

Vasilik Nikolay Ya. (b. 1946) — Candidate of Science in physics and mathematics, leading research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; vasnja@mail.ru

Shmelev Vladimir M. (b. 1940) — Doctor of Science in physics and mathematics, head of laboratory, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; shmelev.05@mail.ru