MEASUREMENTS OF EMISSIONS FOR LPG COMBUSTION WITHIN A POROUS CYLINDRICAL BURNERS [1]

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This study has been motivated by the experimental research findings on temperature and radiative characteristics of cylindrical Ni-Al alloy burners operated in the internal combustion mode [1] that reveal a significant improvement in the radiation efficiency. It can be expected that in this combustion mode the flue gases will be characterized by low CO/NO_X concentrations. A cylindrical or spherical axis-symmetrical configuration provides natural stabilization of the combustion front inside the porous burner due to a decrease in the filtration speed with the radius growth. Therefore, the size of the burner pore channels can be optimized for low CO/NO_X emissions. The objective of this study is to experimentally study the effects of burner pores structure on environmental characteristics for LPG combustion.

The cylindrical burners with equal overall porosity of 55% but different structure parameters have been studied: the average size of the frame elements is 600, 1000 and 1350 μm respectively. The burners are made in the form of hollow cylinders with a hemispherical head, the diameter of 48 mm, total length of 76 mm, and the wall thickness of 8.5 mm [1]. The LPG of the following composition has been used as a fuel: methane 10.67 vol.%, ethane 13.82 vol.%, propane 61.66 vol.%, the rest (carbon dioxide, butane, pentane) – 13.83 vol.%; the low heat value is H_i = 80.60 kJ/nl. Three firing rates were analyzed F_R = 160, 260 and 420 kW/m^2. The cylindrical burner were fixed in a housing equipped with a flow distributor. The *Polar* gas analyzer equipped with a *BOP-1* dehydration unit (*Promekopribor*, Russia) was used to measure the concentration of CO/NO_X in the flue gases. In order to avoid a premix of air to the combustion products, the burner was placed inside a quartz tube with a diameter of 90 mm and a length of 500 mm.

It has been found that the porous structure of the burner significantly determines CO emission: the larger are the structural elements of the material, the lower is CO concentration in the flue gases (fig 1, *a*-*c*). It has been also established that as the firing rate increases, the CO emission decreases. Thus, at air-fuel equivalence ratio $\alpha \approx 1.2$, the CO concentration decreases from 50-100 ppm at 160 kW/m^2 to 5-10 ppm at 420 kW/m^2.

It has been established that with a decrease in the equivalence ratio, the NO_X concentration in the combustion products is significantly reduced, while the NO_X emission is practically independent of the firing rate and porous structure of the burner. As shown in Fig.1d, at $\alpha \approx 1.1$ the NO_X concentration is about 40 ppm, at $\alpha > 1.3$ $NO_X < 20$ ppm is provided. Thus, the obtained results testify to the relevance of studied burners for the development of environmentally friendly heat engineering equipment.

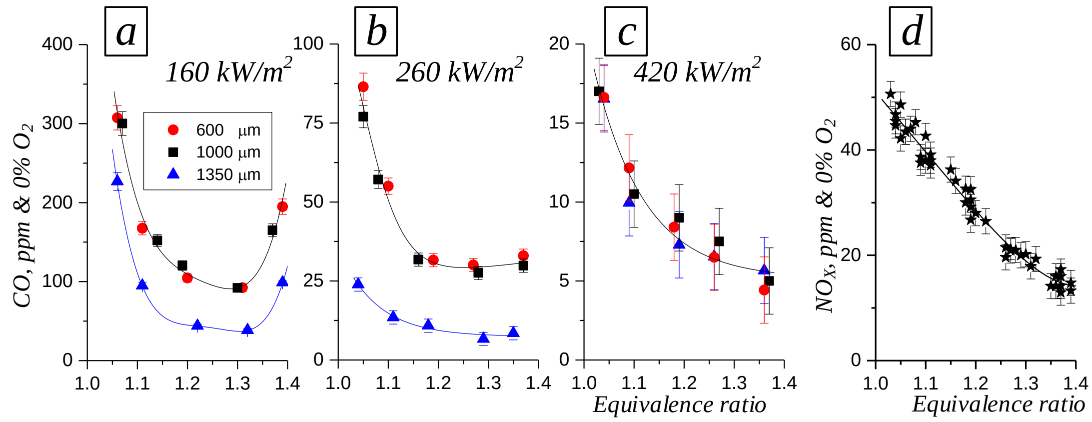

Fig. 1. Experimental dependences of CO (a-c) and NO_X (d) concentration on air-fuel equivalence ratio

REFERENCES

[1] *Fursenko R., Maznoy A., Odintsov E., Kirdyashkin A., Minaev S., Sudarshan K. // International Journal of Heat and Mass Transfer. – 2016. – 98. – 277-284.*

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