EXPERIMENTAL WORKBENCH FOR STUDYING COMBUSTION IN POROUS MEDIA AND MICROCHANNELS

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Combustion in porous media has a number of practical applications in energetics and industry. Further progress in applications demands fundamental understanding of flame dynamics, flame instabilities, heat and mass transfer in porous media. However, observation and investigation of the flame behavior at the pore scale is hampered by the absence of the optical access due to the opaque of the porous media.

For studies of the flame inside porous media and meso-scale channels, we propose a novel concept of a single-layer experimental burner providing optical access to the reaction zone through quartz windows. The burner design is a set of shaped metal plates fastened with bolts. Functionally, the central plates are designed to set the shape of the channels (work area) (Fig. 1 a), while the outer plates hold quartz glasses and determine the external shape of the burner. Due to the simple design, it is easy to manufacture, assemble, upgrade and customize the burner.

Burner parts are made by laser cutting from sheet metal, which allows you to quickly manufacture and replace burner elements and change the channel configuration. Due to the high precision of laser cutting, manual finishing of the parts is not required. In the work area, one layer of the packed bed (Fig.1 b, c) or set of channels of different shapes. Burner design allow to install the shutters for thermal insulation of the work area (Fig.1 d).

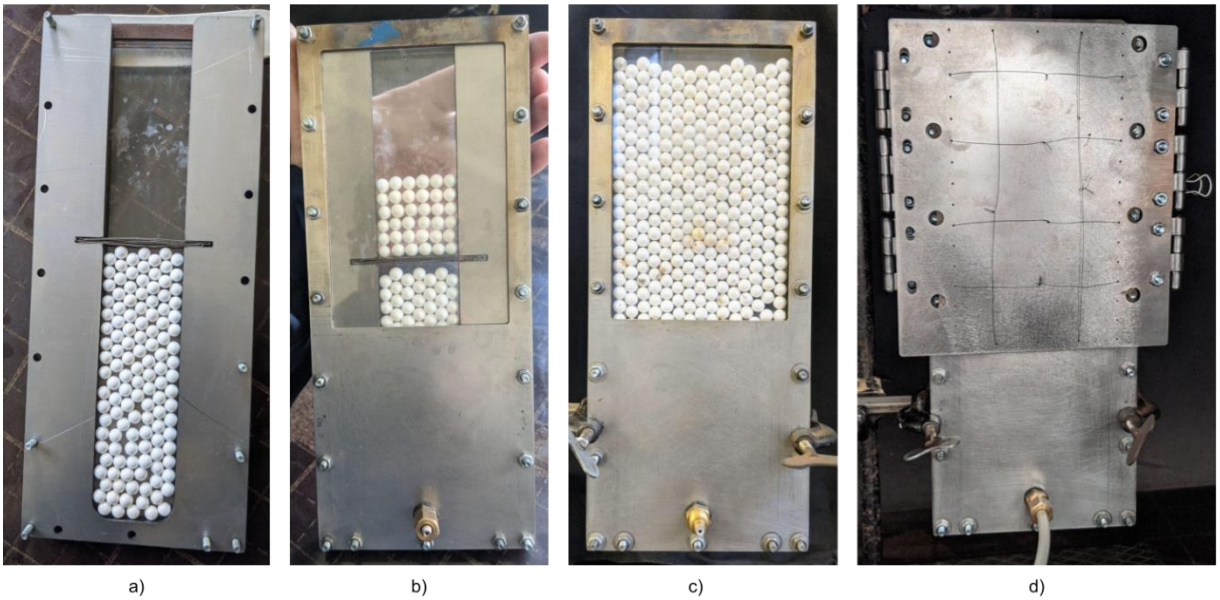

Fig.1. a) Workbench without top sheet (balls at the bottom of the burner serve for flow smoothing). b) 6x6 regularly packed bed. c) packed bed of spheres. d) workbench with heat insulating plates.

The burner was used and well proven in experimental studies of pore-scale flame dynamics in the one-layer packed bed [1]. Burner design allowed us to obtain high-speed records of the flame oscillations inside the pores as well as describe the features of the macroscopic flame behavior.

REFERENCES

[1] R. V. Fursenko, I. A. Yakovlev, E. S. Odintsov, S. D. Zambalov, S. S. Minaev, “Pore-scale flame dynamics in a one-layer porous burner,” Combustion and Flame, vol. 235, pp 111711, Jan. 2022, doi:10.1016/j.combustflame.2021.111711 .