INFLUENCE OF THERMOPHYSICAL PROPERTIES OF THE CHANNEL WALL MATERIAL AND INITIAL GAS MIXTURE TEMPERATURE ON THE COMBUSTION PROCESS IN A SLOT BURNER CHANNEL

N. Ya. Vasilik[1], A. A. Belyaev[1], A. V. Arutyunov[1,2], A. A. Mikhailov[1], A. D. Starostin[1], and V. S. Arutyunov[1,2,3,4]

[1]N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow, 119991, Russian Federation

[2]Gubkin Russian State University of Oil and Gas University, 65 Leninsky Prosp., Moscow 119991, Russian Federation

[3]Federal Research Center for Problems of Chemical Physics and Medical Chemistry of the Russian Academy of Sciences, 1 Acad. N. N. Semenov Prosp., Chernogolovka 142432, Moscow Region, Russian Federation

[4]Faculty of Fundamental Physical and Chemical Engineering, Lomonosov Moscow State University, Leninskie Gory, Moscow 119991, GSP-1, Russian Federation

Abstract: The study analyzes the influence of the thermophysical properties of channel wall materials, alongside the inlet velocity and temperature of a gas mixture, on combustion characteristics within a slot channel under contact with a surface made of material with high thermal conductivity. Numerical simulations were conducted using a two-dimensional mathematical model for three channel wall materials: fechral (kanthal), molybdenum, and quartz. A lean mixture of methane and air was used as a combustible mixture (fuel-to-air equivalence ratio 0.67). Stable combustion regimes were obtained only in channels made of fechral and molybdenum. Replacing fechral as a channel wall material with molybdenum, which has a higher thermal conductivity, leads to a shift of the combustion zone towards the channel inlet. An increase in the velocity of the gas mixture at the entrance to the channel from 150 to 286.5 cm/s at a constant initial temperature (300 and 573 K) leads to a shift of the combustion zone toward the channel exit and an increase in the concentration of carbon monoxide in the combustion products. An increase in the temperature of the gas mixture at the channel entrance from 300 to 573 K at a constant speed of 150 cm/s leads to a shift of the combustion zone toward the channel entrance and a decrease in the concentration of carbon monoxide in the combustion products.

Keywords: combustion in a slot channel; surface ignition; flame front; fechral; molybdenum; quartz; mathematical modeling

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Figure Captions

Figure 1 Schematic of the slot burner channel

Figure 2 Plate surface temperature (*1*) and temperature of gas along the x-axis parallel to the channel axis at various distances ξ from the plate surface: *2* — 0.085 cm; *3* — 0.17; and *4* — 0.28 cm. Material of the plate — fechral (solid curves) and molybdenum (dash-dotted curves); $T_0 = 300$ K; and $u_0 = 150$ cm/s

Figure 3 Dependence of the flame front coordinate x_F on the distance from the channel wall. Material of the plate — fechral (*1*) and molybdenum (*2*); $T_0 = 300$ K; and $u_0 = 150$ cm/s

Figure 4 Plate surface temperature (*1*) and temperature of gas along the x-axis parallel to the channel axis at various distances ξ from the plate surface: *2* — 0.085 cm; *3* — 0.17; and *4* — 0.28 cm. Solid curves — $u_0 = 150$ cm/s, dash-dotted curves — $u_0 = 250$ cm/s; and $T_0 = 300$ K. Material of the plate — fechral

Figure 5 Plate surface temperature of a slotted channel made of fechral (*1*) and temperature of gas mixture along the x-axis parallel to the channel axis at various distances ξ from the plate surface: *2* — 0.085 cm; *3* — 0.17; and *4* — 0.28 cm. Solid curves — $T_0 = 300$ K; dash-dotted curves — $T_0 = 573$ K; and $u_0 = 150$ cm/s

Figure 6 Dependence of the distance from the channel entrance to the flame front x_F on the transverse coordinate ξ and temperature of gas mixture at the channel inlet: *1* — 300 K; and *2* — 573 K. Material of the plate — fechral; and $u_0 = 150$ cm/s

Figure 7 Plate surface temperature (*1*) and gas temperature along the x-axis parallel to the channel axis at different distances ξ from the plate surface: *2* — 0.085 cm; *3* — 0.17; and *4* — 0.28 cm. Solid curves — $T_0 = 300$ K and $u_0 = 150$ cm/s; and dash-dotted curves — $T_0 = 573$ K and $u_0 = 286.5$ см/с. Material of the plate — fechral

Table Captions

Table 1 Thermophysical properties of molybdenum at different temperatures

Table 2 Calculated values of CO concentration in combustion products at the outlet of the slot burner channel with fechral plates

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Contributors

Vasilik Nikolay Ya. (b. 1946) — Candidate of Science in physics and mathematics, research scientist, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; mr.vasilik@internet.ru

Belyaev Andrey A. (b. 1954) — Candidate of Science in physics and mathematics, leading research scientist, N. N. Semenov Federal Research Center for Chemical Physics of Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; belyaevIHF@yandex.ru

Arutyunov Artem V. (b. 1994) — Candidate of Science in physics and mathematics, research scientist, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; associate professor, Gubkin Russian State University of Oil and Gas University, 65 Leninsky Prosp., Moscow 119991, Russian Federation; ya.tarutyunov@yandex.ru

Mikhailov Andrey A. (b. 1990) — graduate student, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; shedani0@yahoo.com

Starostin Aleksey D. (b. 2000) — graduate student, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; SALD.2000@mail.ru

Arutyunov Vladimir S. (b. 1946) — Doctor of Science in chemistry, professor, chief research scientist, N. N. Semenov Federal Research Center for Chemical Physics of the Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; chief research scientist, Federal Research Center for Problems of Chemical Physics and Medical Chemistry of the Russian Academy of Sciences, 1 Acad. N. N. Semenov Prosp., Chernogolovka 142432, Moscow Region, Russian Federation; professor, Gubkin Russian State University of Oil and Gas University, 65 Leninsky Prosp., Moscow 119991, Russian Federation; professor, Faculty of Fundamental Physical and Chemical Engineering, Lomonosov Moscow State University, Leninskie Gory, Moscow 119991, GSP-1, Russian Federation; v_arutyunov@mail.ru