EXPERIMENTAL AND THEORETICAL STUDIES
OF THE METHANE OXIDATION PRODUCTS COMPOSITION
IN THE MATRIX CONVERTERS

V. I. Savchenko¹, O. V. Shapovalova², A. V. Nikitin¹-², I. V. Sedov¹, and V. S. Arutyunov¹-²

¹Institute of Problems of Chemical Physics, Russian Academy of Sciences, 1 Acad. Semenov Av., Chernogolovka, Moscow Region 142432, Russian Federation
²N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation

Abstract: The calculation of the equilibrium distribution of reaction products for the system \( \text{CH}_4 + 2\alpha \text{O}_2 \rightarrow \text{Products} \) at \( 0.25 < \alpha < 0.5 \) and temperature 900–1473 K, where \( \alpha \) is the oxidant-to-fuel equivalence ratio was performed. Based on the thermodynamic calculations at temperatures from 1000 to 1200 K, a substantial change in the yield of the reaction products was shown associated with the appearance of C\(_s\) (“s” stands for “solid”) in this temperature range. Temperature limits were established for the domain where the transition to the equilibrium of the system with the synthesis gas formation accompanied by soot formation. Based on the experimental data on the H\(_2\)/CO ratio achieved in the matrix converter for different values of \( \alpha \), the formulae were derived that satisfactorily describe the oxidation products yield (per mole of methane converted). These formulae are useful for engineering design and subsequent calculations based on macrokinetic models, as well as for the analysis of the effect of process parameters on the characteristics of the synthesis gas production in matrix converters.

Keywords: methane; synthesis gas; hydrogen; matrix conversion; soot formation

References

Contributors

Savchenko Valery I. (b. 1941) — Doctor of Science in chemistry, professor, leading research scientist, Institute of Problems of Chemical Physics, Russian Academy of Sciences, 1 Acad. Semenov Av., Chernogolovka, Moscow Region 142432, Russian Federation; vsavch@icp.ac.ru

Shapovalova Oksana V. (b. 1987) — Candidate of Science in chemistry, senior research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; shapovalova.oksana@gmail.com

Nikitin Aleksey V. (b. 1988) — Candidate of Science in chemistry, research scientist, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; engineer, Institute of Problems of Chemical Physics, Russian Academy of Sciences, 1 Acad. Semenov Av., Chernogolovka, Moscow Region 142432, Russian Federation; nik@icp.ac.ru

Sedov Igor V. (b. 1983) — Candidate of Science in chemistry, head of department, Institute of Problems of Chemical...
Physics, Russian Academy of Sciences, 1 Acad. Semenov Av., Chernogolovka, Moscow Region 142432, Russian Federation; isedov@icp.ac.ru

Arutyunov Vladimir S. (b. 1946) — Doctor of Science in chemistry, professor, head of laboratory, N. N. Semenov Institute of Chemical Physics, Russian Academy of Sciences, 4 Kosygin Str., Moscow 119991, Russian Federation; head of laboratory, Institute of Problems of Chemical Physics, Russian Academy of Sciences, 1 Acad. Semenov Av., Chernogolovka, Moscow Region 142432, Russian Federation; arutyunov@chph.ras.ru