Mathematical simulation of carbon material burnup in stationary high-pressure air flow

© V.V. Gorsky[1,2], A.V. Melkovskaya[2]

[1] JSC "MIC "NPO Mashinostroyenia", Reutov, 143966, Russia
[2] Bauman Moscow State Technical University, Moscow, 105005, Russia

Carbon materials are among the thermal-protective materials widely used in the products of aviation and space-rocket technology for the manufacture of high-temperature elements of the structures. The calculation of warm-up and burnup of materials of this class is inseparably linked with application of methods for calculating heating, warming up and burnup of structural elements made of these materials. That explains why it is necessary to perform appropriate computational and experimental studies. An analysis of the need of using strict physical and mathematical approaches to describe the processes occurring when a body of carbon material moves in a high-pressure oxidative gas flow was performed on the example of the motion of a blunted cone in a stationary air flow. The obtained computational study results are compared with published in the literature similar data corresponding to the application of approximate approaches used in practice. It was established that in the considered flight conditions the use of methods for solving the boundary layer equations and the model of ablation of carbon material, tested on experimental data, is associated with such a significant change in the body burnup shape, which is not possible to ignore in practice.

Keywords*: ablation, thermal protection, carbon materials, combustion products, oxidation, erosion, heat flux*

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Gorsky V.V. (b. 1939) Dr. Sc. (Eng.), Professor, Department of Computational Mathematics and Mathematical Physics, Bauman Moscow State Technical University. Chief Research Scientist, Division of Aerodynamics and Ballistics, JSC "MIC "NPO Mashinostroyenia". SPIN-код: 5981-1694, Scopus Author ID: 7006106052.

Melkovskaya A.V., student, Aerospace Faculty, Bauman Moscow State Technical University. SPIN-code: 9462-3277.