COMMENT ON THE ARTICLE "STEADY-STATE TEMPERATURE DURING TRANSPIRATION COOLING"*

V. L. Chumakov

Transpiration cooling, an effective method of ensuring thermal protection of surfaces, is used for cooling various structures exposed to high-temperature atmosphere. Therefore, it would be worthwhile to extend the results obtained by M. D. Mikhailov to the case where radiation constitutes an appreciable component of the total heat transfer in porous bodies at high temperatures and must be taken into account along with the heat transmitted from the hot surface by convection.

The appropriate boundary conditions for the dimensionless temperature function $\theta(\xi) = T/T_a$ are

$$\theta'_\xi = (g/\xi^\Gamma)(\theta - \theta_0),\ \xi = \xi_1, \tag{4'}$$

$$\theta'_\xi = \varphi\left[\theta(1)\right] = \mathrm{Bi}\left[1 - \theta(1)\right] + \mathrm{Sk}\left[1 - \theta^4(1)\right] - gK,\ \xi = 1. \tag{5'}$$

The general solution (7)-(9) to Eq. (1) is then expressed in terms of the function $\theta(1)$:

$$\theta(\xi) = \theta_0 + [\theta(1) - \theta_0] f_\Gamma(\xi), \tag{13}$$

where $\theta(1)$ is determined from the solution to the algebraic equation

$$\theta(1) = \theta_0 + \varphi\left[\theta(1)\right]/g. \tag{14}$$

From (13) and (14) follow, as a special case with $\mathrm{Sk} = 0$, the solutions (12) for the temperature $\theta = (T - T_0)/(T_a - T_0)$.

On the basis of formula (14), one can analyze how the magnitude of the radiative component of external heat transfer in a porous body affects the flow rate of coolant at a temperature θ_0 necessary to maintain a given temperature at the outside body surface with a fixed value of the Biot number. In this case the complex group g/Sk is a following function of $\theta(1)$ and of the complex group $p = \mathrm{Bi}/\mathrm{Sk}$:

$$g/\mathrm{Sk} = \{p\left[1 - \theta(1)\right] + 1 - \theta^4(1)\}/[\theta(1) - \theta_0],$$

and this relation is valid for a body with any value of the shape factor Γ.

In conclusion, we will point out a few noticed inadvertent misprints in the text of the subject article.

The term q_f/λ_{eq} in Eq. (1) must have the opposite sign. The differential term in condition (6) should be written $d\theta(1)/d\xi$, not $d\vartheta(1)/g\xi$. Solution (12) is shown in a form which may confuse the reader; it should have been written as

$$\theta = \frac{1 - Kg/\mathrm{Bi}}{1 + g/\mathrm{Bi}} f_\Gamma(\xi).$$

Reference [8] in the LITERATURE CITED should be, more precisely:

8. E. Meyer and J. G. Bartas, Jet Propulsion, 24, 336 (1954).

*M. D. Mikhailov, Inzhen. Fiz. Zh., 11, No. 2, 264 (1966).

Institute of Engineering Thermophysics, Academy of Sciences of the UkrSSR, Kiev. Translated from Inzhenerno-Fizicheskii Zhurnal, Vol. 24, No. 3, pp. 556-557, March, 1973.