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COMMENTS ON "A GENERALIZED FOURIER AND FICK'S PERSPECTIVE FOR STRETCHING FLOW OF BURGERS FLUID WITH TEMPERATURE-DEPENDENT THERMAL CONDUCTIVITY"

by

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The equations of $\theta(\eta)$ and $\varphi(\eta)$ are not valid.

Waqas *et al*. [1] investigated mixed convection and heat generation characteristics in flow of Burgers fluid induced by moving surface with variable thermal conductivity as a function of temperature. The researchers introduced simultaneously the revised Fick-Fourier relations covering mass/heat paradoxes. They implemented boundary-layer concept to simplify the mathematical model of their physical problem. Waqas *et al*. [1] presented the equations of energy and concentration (eqs. (3) and (4) in ref. [1]) as:

$$u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}+\lambda_T\left[\begin{array}{c}u\frac{\partial u}{\partial x}\frac{\partial T}{\partial x}+v\frac{\partial v}{\partial y}\frac{\partial T}{\partial y}+v\frac{\partial u}{\partial y}\frac{\partial T}{\partial x}+2uv\frac{\partial^2 T}{\partial x\partial y}+u^2\frac{\partial^2 T}{\partial x^2}+\\ +v^2\frac{\partial^2 T}{\partial y^2}-\frac{Q}{\rho c_p}\left(u\frac{\partial T}{\partial x}+v\frac{\partial T}{\partial y}\right)\end{array}\right]= \tag{1}$$

$$=\frac{1}{\rho c_p}\frac{\partial}{\partial y}\left[K(T)\frac{\partial T}{\partial y}\right]+\frac{Q}{\rho c_p}(T-T_\infty)$$

$$u\frac{\partial C}{\partial x}+v\frac{\partial C}{\partial y}+\lambda_C\left(\begin{array}{c}u\frac{\partial u}{\partial x}\frac{\partial C}{\partial x}+v\frac{\partial v}{\partial y}\frac{\partial C}{\partial y}+v\frac{\partial u}{\partial y}\frac{\partial C}{\partial x}+\\ 2uv\frac{\partial^2 C}{\partial x\partial y}+u^2\frac{\partial^2 C}{\partial x^2}+v^2\frac{\partial^2 C}{\partial y^2}\end{array}\right)=D\frac{\partial^2 C}{\partial y^2} \tag{2}$$

From eqs. (1) and (2), temperature, *T*, and concentration, *C*, depend on *x, y*.

Waqas *et al*. [1] introduced the following variables to convert PDE into ODE (eq. (15) in ref. [1]):

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$$\eta = y\sqrt{\frac{c}{\nu}} \tag{3}$$

$$\theta(\eta) = \frac{T - T_\infty}{T_w - T_\infty} \tag{4}$$

$$\phi(\eta) = \frac{C - C_\infty}{C_w - C_\infty} \tag{5}$$

From eq. (3), the similarity variable, η, depends only on y. From eq. (4), the temperature $\theta(\eta)$ depends only on y while RHS $[T(x, y) - T_\infty]/(T_w - T_\infty)$ depends on x, y. Hence, there is no agreement between LHS and RHS so that eq. (4) is not valid. From eq. (5), the concentration $\varphi(\eta)$ depends only on y while RHS $[C(x, y) - C_\infty]/(C_w - C_\infty)$ depends on x, y. Hence, there is no agreement between LHS and RHS so that eq. (5) is not valid.

Pantokratoras [2-5] revealed the same errors. As shown by Pantokratoras [5], Minkowycz and Sparrow [6] defined the similarity variable (η) as:

$$\eta = \left[\frac{g\beta(T_w - T_\infty)}{4\nu^2}\right]^{1/4} \frac{y}{x^{1/4}} \tag{6}$$

to be compatible with their energy equation:

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \alpha\frac{\partial^2 T}{\partial y^2} \tag{7}$$

Recently, Awad [7] revealed the same errors.

Reference

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