Comments on “Analysis of non-linear radiative stagnation point flow of Carreau fluid with homogeneous–heterogeneous reactions”

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Abstract

These commentaries show that the heat generation/absorption parameter (γ_1) is dimensionless only if the parameter (m) = 1, which means constant surface thickness. However, Hayat et al. (Microsyst Technol 25:1243–1250. <https://doi.org/10.1007/s00542-018-4157-y>, 2019) utilized $m < 1$ like $m = 0.5$ (shape with increasing thickness). For the motion type, $m = 0.5$ represents decelerated motion. In addition, Hayat et al. (2019) utilized $m > 1$ like $m = 1.5$ (shape with decreasing thickness). For the motion type, $m = 1.5$ represents accelerated motion. Thus, the heat generation/absorption parameter (γ_1) is dimensional.

Hayat et al. (2019) analyzed flow of stagnation point using Carreau fluid in the existence of homogeneous–heterogeneous reactions. In their analysis, Hayat et al. (2019) presented the energy equation (Eq. (5) in the paper) as:

$$u \frac{\partial T}{\partial x} + v \frac{\partial T}{\partial y} = \frac{k}{\rho c_p} \frac{\partial^2 T}{\partial y^2} - \frac{1}{(\rho c)_f} \frac{16\sigma^*}{3m^*} \frac{\partial}{\partial y} \left(T^3 \frac{\partial T}{\partial y} \right) + \frac{Q_0(T - T_\infty)}{\rho c_p} \quad (1)$$

From Eq. (1), every term on RHS must have the units of $K s^{-1}$. Thus, we have

$$[Q_0/\rho c_p] = s^{-1}$$

Also, Hayat et al. (2019) defined the heat generation/absorption parameter (γ_1) (below Eq. (22) in the paper) as:

$$\gamma_1 = \frac{Q_0}{\rho c_p U_0} \quad (2)$$

Hayat et al. (2019) defined the velocity, U_w as:

$$U_w = U_0(x + b_1)^m \quad (3)$$

From Eq. (3), the U_0 units are

$$[U_0] = m^{1-m} s^{-1}$$

Thus, we can find the units of γ_1 in Eq. (2) as:

$$[\gamma_1] = (s^{-1})/(m^{1-m} s^{-1}) = m^{m-1}$$

From the above, the heat generation/absorption parameter (γ_1) is dimensionless only if the parameter (m) = 1 that means constant surface thickness. However, Hayat et al. (2019) used $m < 1$ such as $m = 0.5$ in their 1st and 2nd tables (shape with increasing thickness). For the motion kind, $m = 0.5$ represents decelerated motion. Furthermore, Hayat et al. (2019) used $m > 1$ such as $m = 1.5$ in their 1st table (shape with decreasing thickness). For the motion kind, $m = 1.5$ represents accelerated motion.

Therefore, the heat generation/absorption parameter (γ_1) is dimensional not dimensionless as Hayat et al. (2019) claim.

Reference

Hayat T, Ullah I, Farooq M, Alsaedi A (2019) Analysis of non-linear radiative stagnation point flow of Carreau fluid with homogeneous–heterogeneous reactions. Microsyst Technol 25:1243–1250. <https://doi.org/10.1007/s00542-018-4157-y>

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