Interaction between chemical species and generalized Fourier's law on 3D flow of Carreau fluid with variable thermal conductivity and heat sink/source: A numerical approach

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Interaction between chemical species and generalized Fourier's law on 3D flow of Carreau fluid with variable thermal conductivity and heat sink/source: A numerical approach

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Abstract: This paper deals with three-dimensional (3D) flow of a Carreau liquid by utilizing the impact of heterogeneous-homogeneous reactions towards the bidirectional stretched surface. The heat transfer mechanism is conceded out in the apparition of improved heat conduction relation. This occurrence is documented upon the notion of generalized Fourier's law that contributes by the thermal relaxation. Additionally, temperature dependent thermal conductivity with heat sink/source are accounted. On utilization of a suitable conversions a system of nonlinear ODEs is attained and then inferred numerically via bvp4c approach. The delineations of velocities, temperature and concentration fields corresponding to the numerous somatic parameters are scrutinized explicitly. The impact of local Weissenberg number We_1 on $f'(\eta)$ and We_2 on $g'(\eta)$ are same for (n=0.5 and 1.5). Furthermore, our inspection spectacles that the concentration of the Carreau liquid decays as the heterogeneous-homogeneous reaction (k_2, k_1) parameters boost up. It is also remarkable that for shear thinning $(n < 1)$ liquid the influence of local Weissenberg numbers (We_1, We_2) are absolutely contradictory as associated with the case of shear thickening $(n > 1)$ liquid. For authentication of numerical outcomes is prepared via benchmarking with formerly itemized limiting cases and we pledge a marvelous communication with these results. Additionally, graphically assessment is also presented between numerically (bvp4c) and analytically (HAM) techniques with tremendous settlement.

Keywords: 3D Carreau liquid, Variable thermal conductivity, Cattaneo–Christov heat conduction relation, Heat sink/source, Homogeneous-Heterogeneous reactions.

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