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Impact of chemical reaction, thermal radiation and porosity on free convection Carreau fluid flow towards a stretching cylinder

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Abstract:
Understanding fluid flow, heat, and mass transfer over a stretching cylinder is essential in ascertaining the quality of wire coating and coper thinning. This study looks at the influence of the heat source, thermal radiation, chemical reaction, and natural convection of Carreau fluid flows over a vertical stretching cylinder immersed in a porous medium. Suitable similarity variables are applied to convert the partial governing equations arising in fluid flows, heat, and mass transfer into ordinary differential equations. The optimal homotopy analysis method is then utilized to solve the transformed highly nonlinear governing equations. The impacts of the relevant parameters such as the Weissenberg number, porosity, heat source parameter, radiative number, chemical reaction parameter, mixed convection parameter, and curvature parameter on the dimensionless velocity, temperature, and concentration distribution as well as for the skin friction, Nusselt number, and Sherwood number are discussed through graphs and tables. It is observed that the velocity shows an opposite behavior as compared to temperature, and concentration in shear-thinning, $n<1$, and shear-thickening, $n\geq1$, fluid for an increment of the Weissenberg number. Additionally, the thickness of the momentum, thermal, and concentration boundary layer is enhanced by the curvature of the cylinder.