

# Quadratic Thermal Convection in a Sutterby Nanofluid over an Inclined Plate with Higher Order Chemical Reaction: Irreversibility Assessment

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## 1. ABSTRACT

The present research paper deals with the entropy generation analysis of Sutterby nanofluid flow over an inclined plate in a non-Darcy porous medium along with quadratic convection and n-th order chemical reaction. The study is made for the two cases of Sutterby nanofluid as pseudoplastic and dilatant fluid. The formulated dimensional equation is transformed into non-dimensional one using suitable transformations. The results are visualized for pertinent parameters corresponding to the study and is numerically validated. The study is conducted to enumerate the significance of quadratic convective flow of Sutterby nanofluid.

**KEYWORDS:** Sutterby nanofluid, inclined plate, quadratic thermal convection, non-darcy porous medium.

## 2. INTRODUCTION

Over a decade, mixed convective boundary layer flow has received a special focus among numerous researchers due to its applications in various industrial fields. However, the surface temperature and ambient temperature need not be linear or in general it need not be small enough for the process to take place especially in some practical applications, such as solar collectors, higher temperature combustion reactors. In such situations, the nonlinear variation in temperature density relation yields a major impact on the characteristics of the fluid flow.[1] gave this nonlinear relation, which is mathematically described as follows,  $\Delta\rho = -\rho\gamma(T - T_s)^2$ . Later, this study was extended with different geometries and distinct situations. Ramreddy et al., [2] discussed the influence of non-linear Boussinesq approximation along an inclined plate.

### 3. MATHEMATICAL MODELING

The present investigation will be mathematically modeled by completing the following key sections [3].

- At first, the governing equations for radiating Sutterby fluid flow over an inclined plate are formulated.
- After that, the dimensionless form of the governing equations is obtained by applying the relevant similarity variables.
- Finally, the built-in MATLAB function Bvp4c will be implemented in solving the resultant equations and solutions will be visualized graphically.

### 4. RESULTS AND HIGHLIGHTS

The current study mathematically generated the numerical analysis on the flow of Sutterby nanofluid over an inclined plate. The significance of quadratic convection and  $n$ -th order chemical reactions are illustrated visually. The enumerated results are as follows:

- The inclination angle shows that the increase in the angle yields a decline in the fluid flow velocity.
- Increasing values of thermal convection parameter decreases the velocity profile.
- The increasing values of Brownian motion parameter increased the temperature profile.
- The present study will also be useful as the Shear-thickening fluids are widely used in the production of body armor and engineering applications such as machine bearings and dampening devices.

### REFERENCE

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