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A STUDY OF HEAT TRANSFER IN POROUS MEDIA ON A STRETCHING SHEET

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ABSTRACT

In this research work is focused an analysis of heat transfer in porus media on a stretching sheet. The flow is uniform as this stretching sheet the problem involves varying velocity along the sheet and therefore Blasius approach would be wrong. So the leading equations utilized in this analysis would be valid only for very low Euler number. ANSYS CFX software program is implemented for the CFD process. For this two dimensional problem of five transport derivations (Continuity, X-momentum, Y-momentum, Thermal energy and Concentration with reaction sink term) are considered. In CFD all these kind of transport derivations have been solved using Finite Volume Method. The output obtained for gases with the result of Prandtl number of 0.71 for more than a few values of constraint of temperature, velocity vector and concentration.

Keywords: heat transfer, ANSYS, Finite Volume Method and velocity vector
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1. INTRODUCTION

The flow during porous media has fundamentally important in sevaral applications in the several domain such as Science & Humanities and Mechanical as well as Automobile Engineering Sectors. Nakayama [2] examined reclining system in porous media applications. Kafoussias focused the Heat transfers over the porous media as well as their applications [3]. Raptis discussed [4] the impact of rotating fluid free temperature change and mass transfer flow on porous medium. Singh [5,6]has examined vertical plate in the effect of rotation on the hydro magnetic free temperature change flow of viscous and electrically conducting fluid. Nanousis [7] has discussed the thermal diffusion effect using laplace transformation in MHD free temperature change and also mass transfer flow in a rotating fluid. Chandran [8] has

focused an unlimiteded vertical plate of rotating system with angular velocity vector, heat implementing viscous fluid.

Alam [9] discussed in the thermal diffusion of the impact of rotation on hydro magnetic free temperature change. Sakiadis [10,11] discussed the limiteded layer flow of a viscous fluid with a constant velocity , this research was applied in the numerical results confirmed by Tsouetal [12] various aspects of this problem in Newtonian. The different researchers analyzed the problem of non-linear stretching sheet for several cases of fluid. Vajravelu [14] proposed the fluid flow by using a nonlinearly derivations in stretching sheet. Cortell [15,16]discussed the thermal layer of heat transfer and viscous flow by using a non-linearly derivations stretching sheet and examined on the effects of radiation and viscous dissipation by using a non-linearly derivations stretching sheet. Raptis et al [18] discussed in a chemical compound reaction and magnetic field in viscous flow over a non-linear stretching plate. Abbas and Hayat [17] discussed a stretching sheet in porous space using the radiation belongings on MHD flow.

In this paper section 1 focuses introduction and related works of research work. In Section 2 focuses materials and methods, In Section 3 focuses results and analysis, and finally conclusion of this research work.

2. MATERIALS AND METHODS

The platform for this CFD analysis in a constant transverse magnetic field the effect of chemical free reaction on temperature change flow and mass transfer of a viscous, incompressible and electrically performing fluid on a stretching plate.

The non-linear limited layer derivations with certain conditions are exchanged by a similarity of exchanging into non-linear ordinary differential derivations the certain conditions.

Therefore, fourth orders Runge-Kutta scheme with the shooting method are suing similarity derivations for solving numerical methods. This output has shown for gases with a Prandtl number of 0.71 of different kinds of value with constraints of the skin friction coefficient, the local Sherwood number S_h, the local Nusselt number N_u, the velocity, temperature and concentration.

This computational fluid dynamics results by using ANSYS CFX software. The FVM based numerical scheme are using in CFD all transport equations are resolved in this research work. Discrete geometry applied for FVM method the nonlinear partial differential derivations into linear algebraic derivations. Iteratively the linear algebraic derivations are solved in this research work.

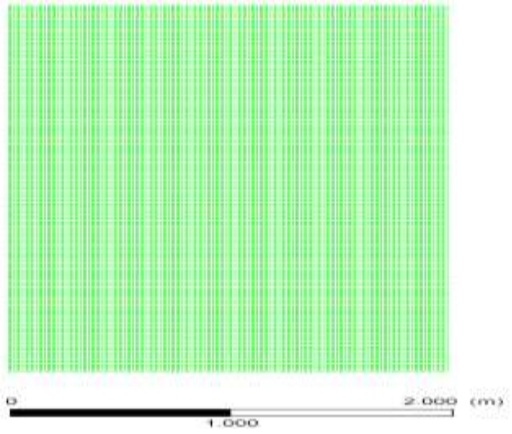

Figure 1 Mesh geometry using GAMBIT preprocessing tool

2.1. An Implementation of CFX

- Instead of an infinite domain as required by the approach of the publication, a finite domain has been considered.
- The domain dimensions are:
  - Width (x-direction) = 2m,
  - Length (y-direction) = 4m.
- The mesh: The 2 D rectangular geometry is meshed using 20,000 quadrilateral cells in GAMBIT pre – processing tool. The two dimensional mesh imported in CFX is considered as a three dimensional mesh with an individual layer of cell. The CFX resolved by using the numeric method derivations and the output are 40,602 nodes in porus medium.
- The input file is CFX Pre. def for the resolver and the output file is Ansys CFX. res from Ansys CFX resolver.

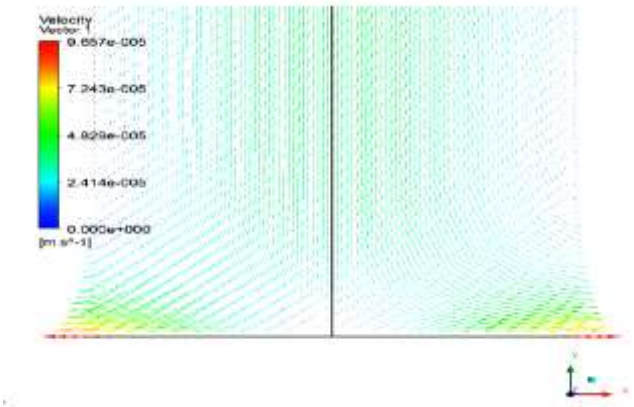

Figure 2 Distribution of Velocity vectors in porus medium

Minimum velocity is at the center of sheet and maximum velocity is at the extreme edge of sheet which is = a . x

Velocity in the x-direction reduces as we move away from the sheet i.e. along y-axis. Velocity well above the sheet is primarily in the negative y-direction. Flow is symmetric along y- axis.

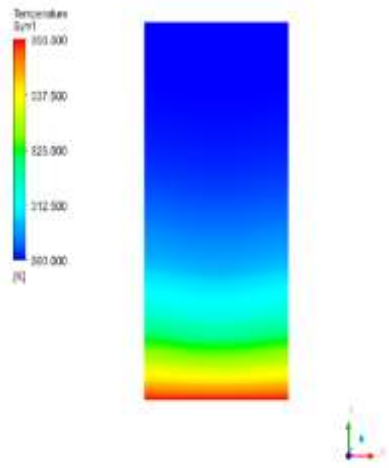

Figure 3 Distribution of Temperature in porus medium

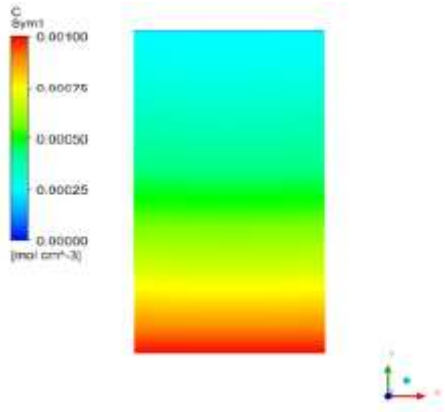

Figure 4 Distribution of concentration in porus medium

3. RESULTS AND DISCUSSIONS

3.1. Variation in permeability constraint (K*)

This analysis has an extra term included for the porous media on the stretching sheet. The formulation is through a sink term given by the Darcys Law. The additional pressure drop is given as:

$$-\frac{\partial p}{\partial x} = \frac{\mu}{K^*} u$$

Parametric study is performed for 3 kinds value of K* to show the result on velocity (v), temperature(t) and concentration(c).

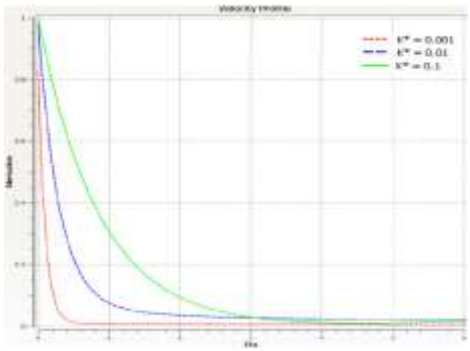

Figure 5 The velocity vector for different constarint(K*)

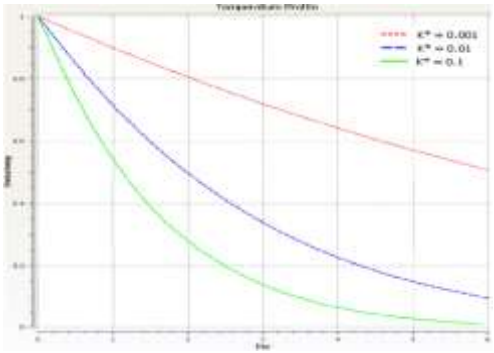

Figure 6 The temperature for different constraint(K*)

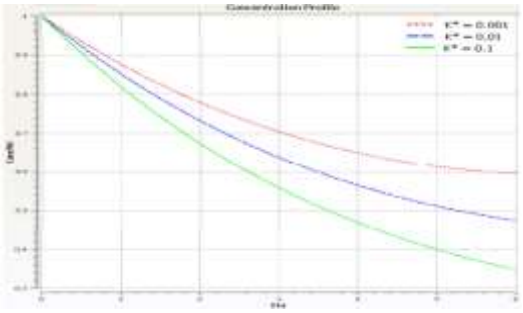

Figure 7 The concentration for different constraint (K*)

The above figures represents the trends of velocity vector for different permeability constraint (K*), the temperature for different permeability constraint (K*), the concentration for different constraint (K*). K* demonstrates clearly.

4. CONCLUSION

In this work, CFD model of Analysis of heat transfer in porus medium on a Stretching Sheet carried out for different values of magnetic constraints, reaction, permeability constraint and Schmidt number. The velocity vector, temperature and absorption are given for gases with a Prandtl number of 0.71.

The software ANSYS CFX has successfully employed for this particular work. The results obtained from CFD analysis has compared with graphical results of Ahmed A. Afify and the present output are well in according to the Afify's results.

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