Transient Analysis of Radiative Hydromagnetic Poiseuille fluid flow of Two-step Exothermic Chemical Reaction through a Porous Channel with Convective Cooling

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Abstract

In this research, the transient analysis of two-step exothermic chemical reactive viscous combustible fluid flow past a porous channel with radiation under different chemical kinetics i.e Bimolecular, Arrhenius and Sensitized are investigated. The liquid is influence by a periodic vicissitudes in the axial pressure gradient and time along the channel axis in the occurrence of magnetic field and walls asymmetric convective cooling. The convectional heat transport at the wall surfaces with the neighboring surrounding takes after the Newton's law of cooling. The dimensionless principal flow equations are computationally solved by applying convergent and absolutely stable semi-implicit finite difference method. The influence of the various fluid parameters associated with the momentum and energy equations are graphically presented and discussed quantitatively. The results shows that the reaction parameter (λ) is very sensitive to an increase and it is therefore needs to be carefully monitor to avoid finite time blow up of the solutions.

Keywords: Radiation; Hydromagnetic; Poiseuille flow; Exothermic; Convective cooling

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1. INTRODUCTION

In fluid mechanics, Poiseuille flow is a viscous, laminar fluid flow in the space within fixed surfaces. Poiseuille flow arises in fluid mechanism without motioning parts. If the plate surfaces are flat and smooth with unchanged liquid characteristics, this result in the linear simple flow profile, with a drag inversely relative to the gap width and proportionate to the relative velocity [1,2]. In several machines operation and technology units under diverse circumstance need different types of lubricants. Commonly, lubricating oils viscosity frequently reduces with a rise in temperature. The difference in viscosity of the lubricant will definitely impact its efficiency. To circumvent unwanted changes in viscosity owing to heat, the study of magnetic field and electrically conducting liquids has attracted the mind of many researchers which includes [3-7]. Electrical conductivity and high thermal is attributed to hydromagnetic lubricants with lesser viscosity than the conventional lubricating oils. The heat produced by viscous friction is freely conducted away with high thermal conductivity but lower viscous property reduces the amount of load-carrying that in turn affect the electrical conducting of the fluid which is possibly enhanced by applying electromagnetic fields externally. Nevertheless, ohmic heating as a result of electrical current raises the lubricants viscosity. Many studies on the hydrodynamic of lubricants in bearing cases have been established as it can be see in examine magnetic effects on hydrostatic bearing [7,8].

The study of hydromagnetic reactive fluid past porous media at low Reynolds numbers in the occurrence of heat radiation has long remained a subject of discussion in the area of environmental engineering, biomedical, chemical and science. Also in polymer extrusion, groundwater movement, nuclear reactor design, geophysics and energy storage systems. In the light of these applications, effects of radiation on convection magnetohydrodynamic (MHD) flow through permeable surface occupied with porous media was investigated by [9,10].

The studied of radiative hydromagnetic fluid flow through walls considering the consequence of energy and species transport on the flow was examined by [11] while, [6] studied an oscillatory viscous mixed convection current carry liquid in the presence of heat radiation. Investigation of thermal stability of convective boundary layers in a saturated viscous reactive flow liquid past a permeable channel was examined by [12]. Meanwhile, internal heating of a combustible materials result in an impulsive eruption such as manufacturing wool waste, fuel waste and coal waste maybe seen as heat explosion materials reported by [13,14]. In fact, assessment of the main regimes through a regime splitting the region of explosive and no explosive reactions is the core theory of ignition see [15-17]. The mathematical model of the problem was initiated by Frank-Kamenestkii. The important of two-step chemical reaction in combustion processes can not be over emphasis due to it support in complete combustion of unburned ethanol by [18]. This process helps in reducing the release into the environment the toxic car pollutant called carbon (II) oxide (CO). The exothermic reaction of two-step thermal stability in a slab was reported by Makinde et al. [19], considering the reactant diffusion and assumed the pre-exponential variable factor for both steady and unsteady state. Recently, the problem of an unsteady two step exothermic chemical combustible, viscous, reactive flowing fluid past porous media with radiation under different chemical kinetics was investigated by Kareem and Gbadeyan [20]. The authors use couple Laplace transform along with differential transform method to obtain solution to the problem under consideration.

The core interest of this study is to examine the flow of transient incompressible magnetohydrodynamic fluid of a reactive two-step exothermic chemical reaction moving through fixed walls with asymmetric convective cooling and uniform transverse magnetic field under diverse kinetics. In section 2, the flow model is presented while in section 3, the adopted numerical scheme is employ in space and time for the computation. In section 4, the computational results are established graphically and well explained in references to the existing fluid parameters entrenched in the problem.

2. MODEL FORMULATION

Consider incompressible transient flow of viscous, reactive hydromagnetic fluid of two-step exothermic chemical reaction taking placed within two fixed parallel plates of width a. The flow is prompted by the action of bimolecular chemical kinetic and pressure. Taken that the flow is influenced by magnetic field B_0 applied externally. The upper and lower surface of the plates are exposed to exchange heat with the environ temperature. The x-axis is chosen towards the channel center and the y-axis is assumed perpendicular to it. The flow geometry is presented in figure 1 and the equations governing the momentum and energy are defined as follows:

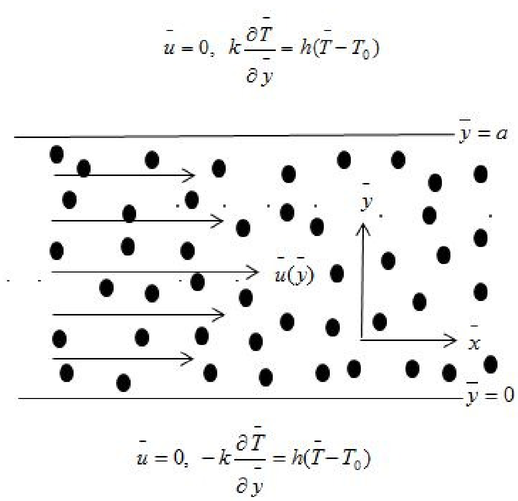

Figure 1. The formulation Geometry

$$\rho \frac{\partial \bar{u}}{\partial \bar{t}} = -\frac{\partial \bar{P}}{\partial \bar{x}} + \mu \frac{\partial \bar{u}^2}{\partial \bar{y}^2} - \sigma B_0^2 \bar{u} - \frac{\mu \bar{u}}{\bar{K}_1} \quad (1)$$

$$\rho C_p \frac{\partial \bar{T}}{\partial \bar{t}} = k \frac{\partial^2 \bar{T}}{\partial \bar{y}^2} - \frac{\partial q}{\partial \bar{y}} + \mu \left(\frac{\partial \bar{u}}{\partial \bar{y}}\right)^2 + \frac{\mu \bar{u}^2}{\bar{K}_1} + Q_1 C_1 A_1 \left(\frac{k\bar{T}}{vl}\right)^m e^{\frac{E_1}{RT}} + Q_2 C_2 A_2 \left(\frac{k\bar{T}}{vl}\right)^m e^{\frac{E_2}{RT}} + \sigma B_0^2 \bar{u}^2 + Q_0 (\bar{T} - T_w) \quad (2)$$

Subject to relevant boundary conditions

$$\bar{u}(a, \bar{t}) = 0, \bar{u}(\bar{y}, 0) = 0, \bar{u}(0, \bar{t}) = 0, \bar{T}(\bar{y}, 0) = T_0,$$
$$-k \frac{\partial \bar{T}}{\partial \bar{y}}(0, \bar{t}) = h(\bar{T}(0, \bar{t}) - T_0), k \frac{\partial \bar{T}}{\partial \bar{y}}(a, \bar{t}) = h(\bar{T}(a, \bar{t}) - T_0) \quad (3)$$

where C_p, ρ, k, μ, σ, B_0, Q_1, l, C_1, v, E_1, A_1, R, Q_2, C_2, A_2, E_2, Q_0, T_w and K_1 are respectively specific heat, fluid density, thermal conductivity, fluid viscosity, electrical conductivity, magnetic strength, first step heat of reaction term, planck's number, first step reactant species, vibration frequency, first step energy activation, first step constant reaction rate, universal gas constant, second step heat of reaction term, second step reactant species concentration, second step constant rate of reaction, second step activation energy, heat generation coefficient, wall temperature and porosity parameter. The computational indies $m \in \{-2, 0, 0.5\}$ respectively depict the chemical kinetics for Sensitized, Arrhenius and Bimolecular.

The subsequent dimensionless parameters are used

$$y = \frac{\bar{y}}{a}, x = \frac{\bar{x}}{a}, T = \frac{E_1(\bar{T} - T_W)}{RT_W^2}, G = -\frac{\partial P}{\partial x}, P = \frac{a\bar{P}}{\mu U}, H^2 = \frac{\sigma B_0^2 a^2}{\mu}, \varepsilon = \frac{RT_W}{E_1},$$
$$r = \frac{E_2}{E_1}, Br = \frac{\mu U^2 E_1}{kRT_W^2}, \lambda = \frac{Q_1 C_1 A_1 E_1 a^2}{kRT_W^2} \left(\frac{kT_W}{vl}\right)^m e^{\frac{1}{\varepsilon}}, \beta = \frac{Q_0 RT_W^2}{Q_1 C_1 A_1 E_1} \left(\frac{vl}{kT_W}\right)^m e^{-\frac{1}{\varepsilon}},$$
$$\gamma = \frac{Q_2 C_2 A_2}{Q_1 C_1 A_1}, Pr = \frac{\mu c_p}{k}, t = \frac{\mu t}{\rho a^2}, u = \frac{\bar{u}}{U}, \varphi = \frac{a^2}{K_1}, R = \frac{4\delta T_\infty}{k a_r} T_a = \frac{E_1(T_0 - T_W)}{RT_W^2}. \quad (4)$$

Following Rosseland approximation see Uwanta (2011), the radiative heat flux in the direction can be modeled as

$$q = -\frac{4\delta}{3a_r} \frac{\partial T^4}{\partial \bar{y}} \quad (5)$$

where a_r is the absorption mean coefficient and δ is the constant of Stefan-Boltzmann. If the heat difference in the liquid is of lower quantity so that T^4 can be written as a linear temperature combination. Therefore, by Taylor series expansion of T^4 for about T_∞, ignoring greater order terms, is

$$T^4 = 4T_\infty^3 - 3T_\infty^4 \quad (6)$$

Using the dimensionless parameters (4) along with (5) and (6) on equations (1)-(3), to obtain

$$\frac{\partial u}{\partial t} = G + \frac{\partial^2 u}{\partial y^2} - H^2 u - \varphi u \quad (7)$$

$$Pr \frac{\partial T}{\partial t} = \left(1 + \frac{4}{3} R\right) \frac{\partial^2 T}{\partial y^2} + Br \left[\left(\frac{\partial u}{\partial y}\right)^2 + (H^2 + \varphi) u^2\right] + \lambda \left[(1 + \varepsilon T)^m \left(e^{\frac{T}{1+\varepsilon T}} + \gamma e^{\frac{rT}{1+\varepsilon T}}\right) + \beta T\right] \quad (8)$$

with the corresponding initial and boundary conditions

$$u(y,0) = 0,\, u(1,t) = 0,\, u(0,t) = 0,$$

$$T(y,0) = T_a,\, \frac{\partial T}{\partial y}(0,t) = -BiT(0,t),\, \frac{\partial T}{\partial y}(1,t) = BiT(1,t) \qquad (9)$$

where $u, T, G, H, Br, \lambda, \gamma, Bi, \Pr, \varepsilon, r, \beta, \varphi$ and R are respectively the fluid velocity, fluid temperature, pressure gradient, Hartmann number, Brinkman number, Frank-Kamenetskii term, second step exothermic reaction, Biot number, Prandtl number, activation energy, activation energy ratio, heat source parameter, porosity parameter and radiation. The other non-dimensional quantities of engineering concern are the skin friction (C_f) and the heat transfer rate at the wall (Nu) gotten as

$$C_f = \frac{du}{dy}(1,t),\, Nu = -\frac{dT}{dy}(1,t) \quad (10)$$

Hence, equations (7) to (10) are computationally solved by the adopted numerical scheme.

3. METHOD OF SOLUTION

The computational procedure involved in the velocity and heat equations is semi-implicit finite difference scheme as in [21], the method takes implicit terms in-between the time level $(\xi + N)$ for $1 \geq \xi \geq 0$. In order to make large time steps, ξ is assumed to be 1. In fact, being completely implicit, the adopted computational procedure offered in this work is hypothesized to be suitable for any estimation of time steps. The equations are discretized on a Cartesian linear mesh with unvarying grid in which the finite-differences are defined. Approximating the first and second derivatives spatial with central differences of order two, the equations following the last and first points grid used to integrate the boundary conditions. The velocity component can be express as follows:

$$\frac{(u^{(N+1)} - u^{(N)})}{\Delta t} = u_{yy}^{(N+\xi)} - H^2 u^{(N+\xi)} + G - \varphi u^{(N+\xi)} \qquad (11)$$

The equation for $u^{(N+1)}$ takes the form:

$$\begin{aligned} -b_1 u_{j-1}^{N+1} + [1 + 2b_1 + (H^2 + \varphi)\Delta t]u_j^{N+1} - b_1 u_{j+1}^{N+1} = u^{(N)} + \Delta t(1-\xi)u_{yy}^{(N)} \\ + \Delta t G - \Delta t(\varphi + H^2)(1-\xi)u^{(N)} \end{aligned} \qquad (12)$$

where $b_1 = \xi \Delta t / \Delta y^2$ and the derivatives of time in forward difference schemes taken. The solution technique for $u^{(N+1)}$ decreases to inversion tri-diagonal matrices.

The semi-implicit expression for heat equation resembles that of velocity equation. The unvaried second derivatives of the heat takes the form :

$$\begin{aligned} Pr\frac{T^{(N+1)} - T^{(N)}}{\Delta t} = \left(1 + \frac{4}{3}R\right)\frac{\partial^2 T^{(N+\xi)}}{\partial y^2} + Br[u_y^2 + (H^2 + \varphi)u]^{(N)} + \\ \lambda\left[(1 + \varepsilon T)^m \left(e^{\frac{T}{1+\varepsilon T}} + \gamma e^{\frac{rT}{1+\varepsilon T}}\right) + \beta T\right]^{(N)} \end{aligned} \qquad (13)$$

The equation for $T^{(N+1)}$ becomes:

$$-b_2 T_{j-1}^{(N+1)} + (Pr + 2b_2) T_j^{(N+1)} - b_2 T_{j+1}^{(N+1)} = T^{(N)} + \Delta t(1-\xi)\left(1+\frac{4}{3}R\right) T_{yy}^{(N)} + Br\Delta t[u_y^2 + (H^2+\varphi)u]^{(N)} + \lambda\Delta t\left[(1+\varepsilon T)^m\left(e^{\frac{T}{1+\varepsilon T}} + \gamma e^{\frac{rT}{1+\varepsilon T}}\right) + \beta T\right]^{(N)} \quad (14)$$

where $b_2 = \xi\Delta t/\Delta y^2$. The solution technique for $T^{(N+1)}$ also decreases to tri-diagonal inversion matrices. The systems (9) and (11) were tested for regularity. When $\xi = 1$ allow us to take huge time steps that is second order in space but first-order exact in time. As formerly assumed, the scheme satisfies any time step values! The Maple code was used to carried out the numerical analysis.

4. RESULTS AND DISCUSSIONS

The initial temperature of the reactive fluid is taken to be the same as wall temperature, therefore parameter $T_a = 0$. The following default parameters values $G = 1$, $Pr = 7.0$, $Br = 1$, $\gamma = 1$, $\lambda = 2$, $r = 1$, $m = 0.5$, $t = 5$, $R = 0.5$, $\varphi = 0.2$, $\varepsilon = 1$, $H = 1$ and $\beta = 0.5$ are used based on existing theoretical research except otherwise stated on the graph.

Table 1: The effects of different parameters on the system blow up solutions.

Br	r	Bi	G	H	γ	φ	R	β	m	ε	λ_c
0.5	2.0	1.0	1.0	1.0	1.0	0.1	0.5	0.5	0.5	0.5	0.06543286595758994
0.5	3.0	1.0	1.0	1.0	1.0	0.1	0.5	0.5	0.5	0.5	0.02643637641373641
0.5	1.0	1.0	1.0	1.0	1.0	0.1	0.5	0.5	0.5	0.5	0.14307817321101074
0.5	1.0	1.0	1.0	1.0	2.0	0.1	0.5	0.5	0.5	0.5	0.08463136436821836
0.5	1.0	1.0	1.0	1.0	1.0	0.2	0.5	0.5	0.5	0.5	0.14316085047224741
0.5	1.0	1.0	1.0	1.0	1.0	0.3	0.5	0.5	0.5	0.5	0.14324120784003946
0.5	1.0	2.0	1.0	1.0	1.0	0.1	0.5	0.5	0.5	0.5	0.13900376624897837
0.5	1.0	3.0	1.0	1.0	1.0	0.1	0.5	0.5	0.5	0.5	.13519246785211794
0.5	1.0	1.0	1.0	1.0	1.0	0.1	0.0	1.0	0.5	0.5	0.13558848416143185
0.5	1.0	1.0	1.0	1.0	1.0	0.1	0.5	1.5	0.5	0.5	0.12885813171589758

Table 1 illustrates the effect of various fluid parameters under consideration on the thermal runaway for two-step exothermic chemical reaction. An increase in the parameters γ, Br, Q and r causes a reduction in the critical values (λ_c) of Frank-Kamenettski parameters because they leads to reduction in the thermal fluid layer that causes diffusion of heat away from the system while a revised behaviour is noticed with an increase in the parameter φ that leads to a rise in the critical values (λ_c) of Frank-Kamenettski parameter due to an enhancement in the heat content of the system. The reaction parameter λ need to be consciously checked and managed as ''large'' values can cause finite time temperature blow up of the solutions as presented in table 1 because the terms related to λ are stronger source of heat.

Table 2 shows that explosion reaction in bimolecular takes place faster than the reactions in Senstitized and Arrhenius kinetics. This is because the bimolecular reaction is assumed with smaller value of the thermal criticality. An increase in the extent of thermal criticality is noticed with a decrease in the activation energies, therefore thermal stability is enhanced while thermal runaway is early discouraged.

Table 2: Comparison of computational results showing thermal criticality for different chemical kinetics $Br = R = G = \varphi = \beta = G = Bi = H = 0, Pr = 1,$

				Makinde et al. (2015)		Present results	
ε	r	m	γ	θ_{max}	λ_c	θ_{max}	λ_c
0.1	0.1	0.5	0.0	1.420243875	0.932216072	1.420244002	0.932216754
0.1	0.1	0.5	0.1	1.476474346	0.897649656	1.476473998	0.897648864
0.1	0.1	0.5	0.2	1.529465440	0.866522770	1.529465722	0.866523029
0.1	0.1	0.0	0.1	1.585899049	0.953645221	1.585898894	0.953644916
0.1	0.1	-0.2	0.1	2.320778138	1.282091040	2.320777965	1.282099988
0.1	0.5	0.5	0.1	1.467926747	0.880606329	1.467927112	0.880606809
0.1	1.0	0.5	0.1	1.420243875	0.847469156	1.420244097	0.847469561
0.2	0.1	0.5	0.1	1.905274235	0.968086041	1.905273899	0.968085638
0.3	0.1	0.5	0.1	3.046841932	1.074421454	3.046842131	1.074422119

The transient solutions for momentum and energy distributions on an even finer mesh ($\Delta t = 0.0001$ with $\Delta y = 0.01$) are presented in Figures 2 and 3. The plots denoted a transient rise in both the momentum and heat transfer rate until it reaches steady state.

Figure 4 denotes the temperature blow up for huge values of λ. It is important to note that depending on some certain parameters values under consideration, the steady momentum and temperature profiles as shown in Figures 2 and 3 may not be achievable. Most especially, the reaction parameter λ needs to be cautiously managed and guided because huge values can cause finite time temperature solutions blow up as displayed in the graph 4. As depicted in the plot, the parameter λ is related to high heat source.

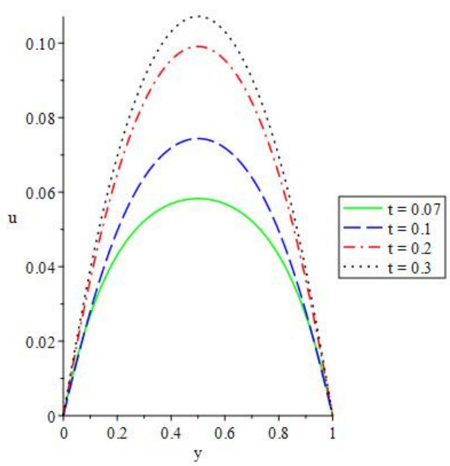

Figure 2. Transient state velocity profile

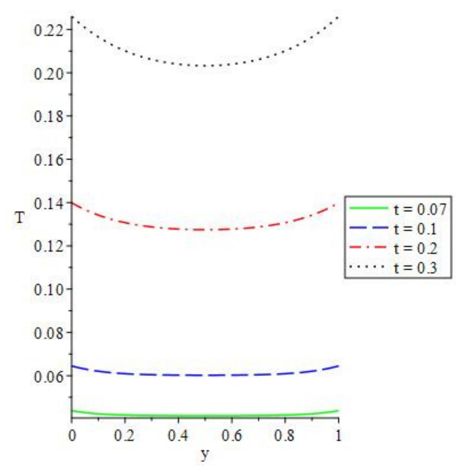

Figure 3. Transient state temperature profile

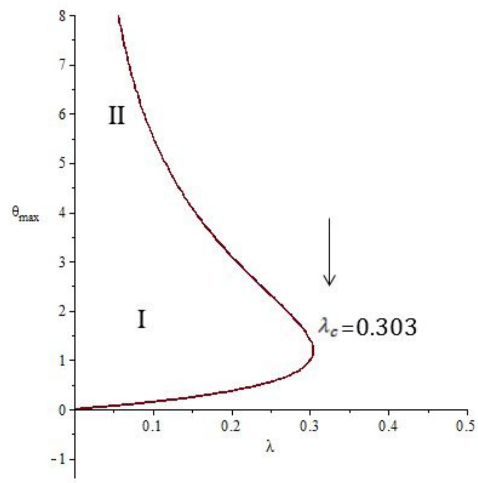

Figure 4. Blow up of fluid temperature for large (λ)

Figure 5 represents the impact of differences in the pressure gradient values G on the flow momentum fields. An increase in the pressure gradient values enhances the fluid velocity in the system i.e. the highest velocity is experience as the parameter values G is increases which infers that the enormous the pressure introduced on the liquid flow in a channel, the quicker the flow as a result of warmth in the fluid as the pressure is increases. Figure 6 depicts the influence of diverse values of Hartmann number H on the flow velocity. It is noticed that as the values of magnetic field parameter H is enhancing, the damping magnetic properties rises due to the existent of the Lorentz force that leads to amplification in the liquid flow resistances and thereby slow down the convective fluid flow motion. Accordingly, the electrically conducting fluid takes a drive from the magnetic force, hence the fluid flow micro scale system is induced by an electrical conductivity. Therefore, the velocity profile reduces.

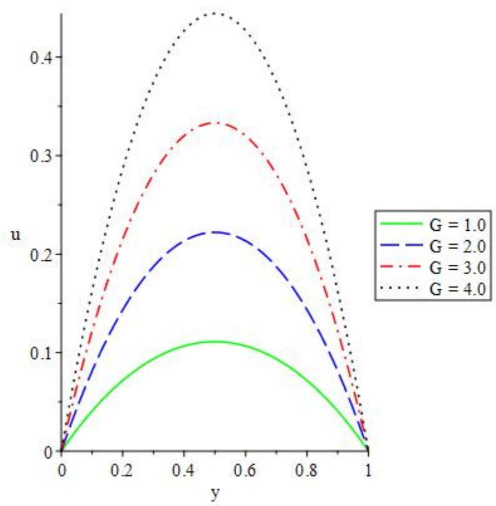

Figure 5. Effects of (G) on velocity

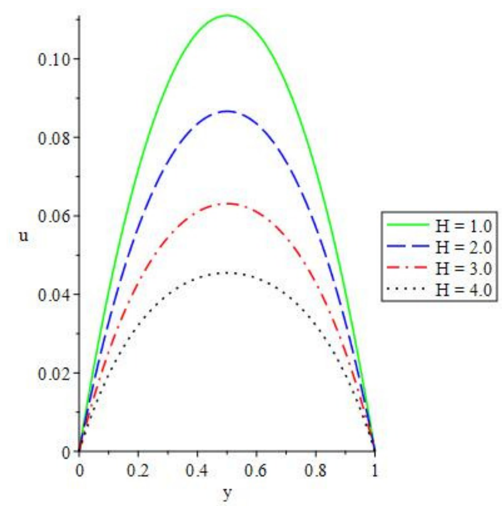

Figure 6. Effects of (H) on velocity

Figure 7 illustrates the impact of Brinkman number Br on the energy distribution. It is seen that a rise in the Brinkman number amplifies the temperature field. The parameter Br is associated with viscosity dissipation in the heat equation, and consequently higher values of Br leads to an enhancement in the heat production by the shear stress in the fluid in this way causing a rise in the fluid temperature within the system. Figure 8 shows the effect of varying in the values of second-step exothermic chemical reaction parameter γ on the energy profiles. It is observed that a rise in values of γ produces a significant increase in the temperature profiles. This is because the boundary layer thickness is improved as the values of γ rises and result in the reduction in the amount of heat leaving the system that in turn build up the temperature field.

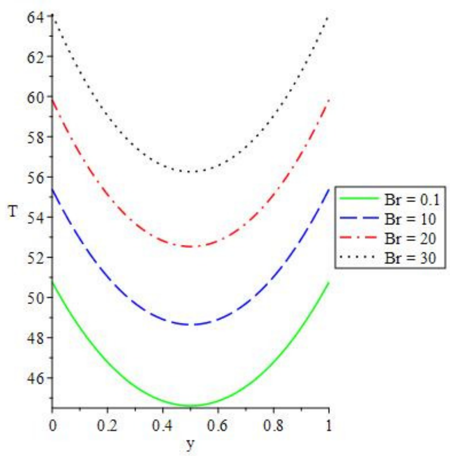

Figure 7. Effects of (Br) on temperature

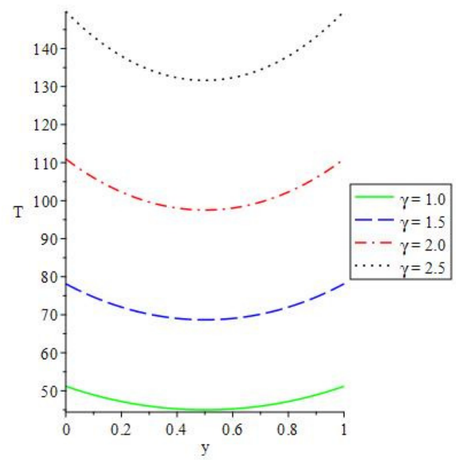

Figure 8. Effects of (γ) on temperature

Figure 9 confirms the effect of the term λ on the temperature field. A rise in the Frank-Kamenetskii parameter λ enhances the heat distributions in the system, this against the role perform by the Prandtl number. Raising the values of λ brings about a rise in the reaction as well as the heating viscous source terms, and thus absolutely enhances the flow liquid temperature as appeared in the Figure. The momentous rises in the heat is because of an increment in the parameter λ which implies that the viscosity related to the fluid momentum is strengthen and consequently gives rise to an increase in the temperature distribution. Figure 10 portrays the reactions of porosity parameter φ on the velocity profiles. It is noticed from the figure that the fluid flow velocity diminishes as the porosity parameter is increases, this is because the surfaces of the plate provides a supportive resistance to the fluid flow mechanism which causes the fluid to move at a slowed rate.

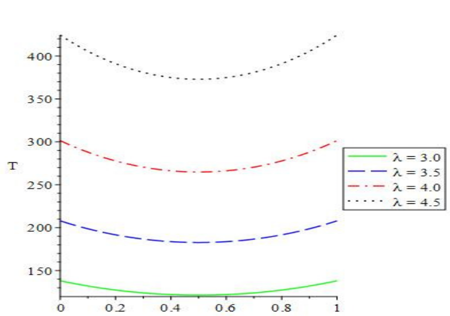

Figure 9. Effects of (λ) on temperature

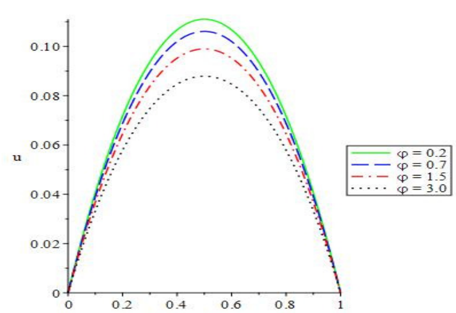

Figure 10. Effects of (φ) on velocity

Figures 11-13 independently show the response of the temperature field to differences in the chemical kinetics m i.e, the Sensitized, Arrhenius and Bimolecular on the increase in the activation energy ε. It is obtained from the figures a noteworthy diminishing in the fluid temperature as the parameter values ε increases for Sensitized and Arrhenius and Bimolecular chemical kinetics i.e at $m = -2,0,0.5$. However, the term defines the source terms in the heat component.

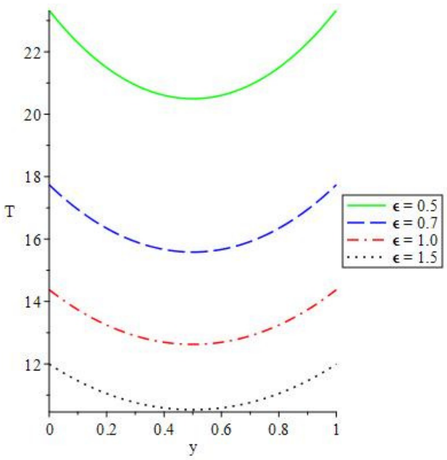

Figure 11. Effects of (ε) on heat when $m = -2$

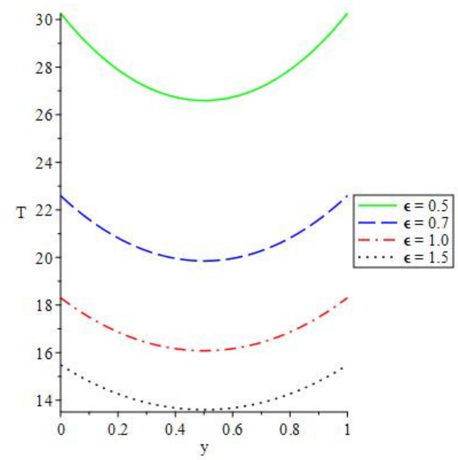

Figure 12. Effects of (ε) on heat when $m = 0$

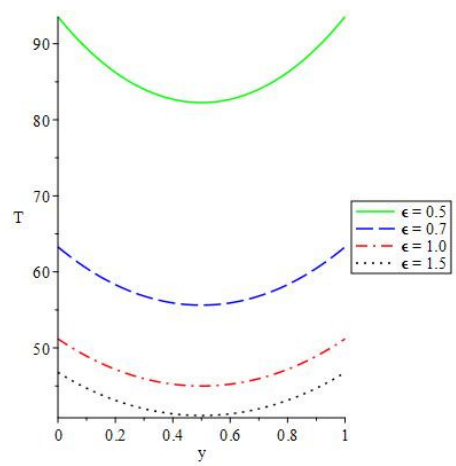

Figure 13. Effects of (ε) on temperature when $m = 0.5$

The effect of radiation on the energy distributions is reported in Figure 14. It is noticed that as the parameter values of R is increases, there is corresponding rises in the temperature profiles which results in a rise in the thickness of the temperature boundary layer. The figure specify that a rise in the term R, accelerates the thermal boundary layer thickness which in turn enhances the temperature field and slow down the energy transfer coefficient at the wall. Figure 15 illustrates the reaction of the fluid temperature to variational rise in the heat generation parameter β. As seen from the graph, an increase in the heat source increases the heat distribution in the channel due to a rise in the heat boundary layer that enhances the amount of heat within the chemical reactive system.

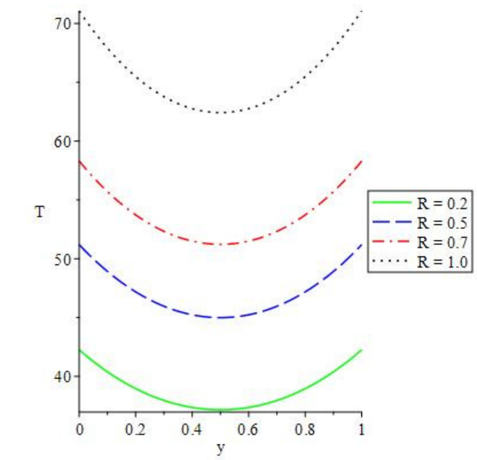

Figure 14. Effects of (R) on temperature

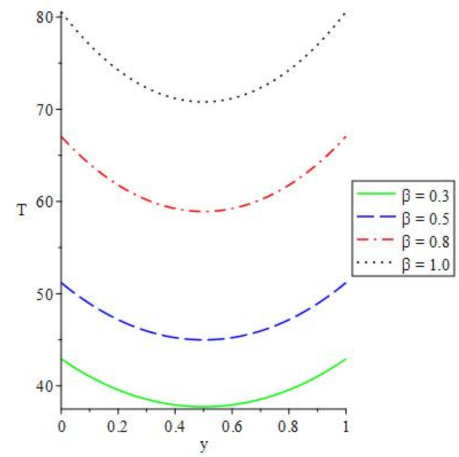

Figure 15. Effects of (β) on velocity

Figure 16 and 17 portrays the difference in the wall shear stress with an increase in the pressure gradient G and Hartmann number H depending on the reaction term λ. An early rise and fall are respectively noticed as the parameter values of G and H increases near the channel wall. But, a revised in the behaviour is observed as they respectively moves far away from the wall at $\lambda \geq 0.5$ towards the free flow.

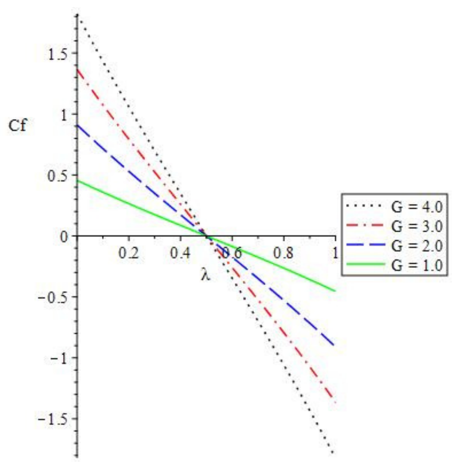

Figure 16. Wall shear stress with (λ) and (G)

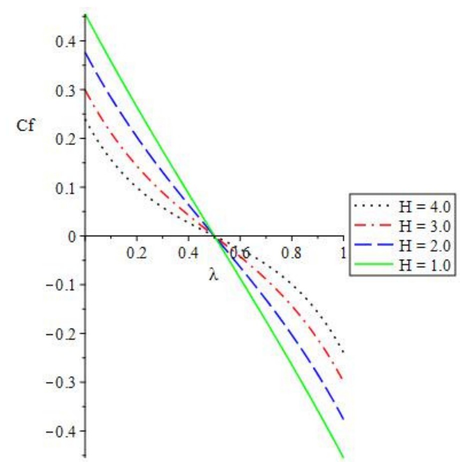

Figure 17. Wall shear stress with (λ) and (H)

Figures 18 and 19 represent the variation of wall heat transfer rate with a rise in the parameter values β and ε depending on the second-step exothermic chemical reaction term γ. Follow from the plots, a gradual rise in the rate of heat transfer at the wall from a very lower state is seen between $0 \leq \gamma \leq 0.5$. While, a conversed behaviour is obtained in the solutions at finite time temperature, hence, the rate at which energy transfer in a two-step chemical reactive at the wall decreases at $\gamma \geq 0.5$ for a free reactive flow.

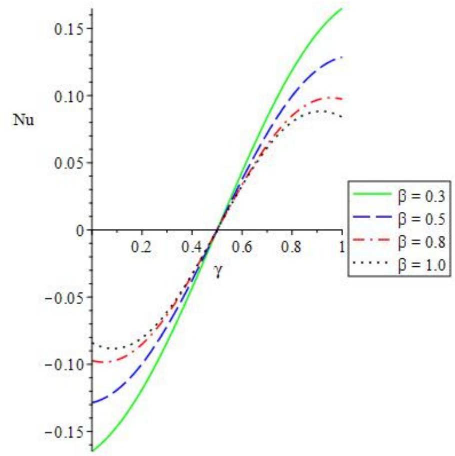

Figure 18. Wall heat transfer rate with (γ) and (β)

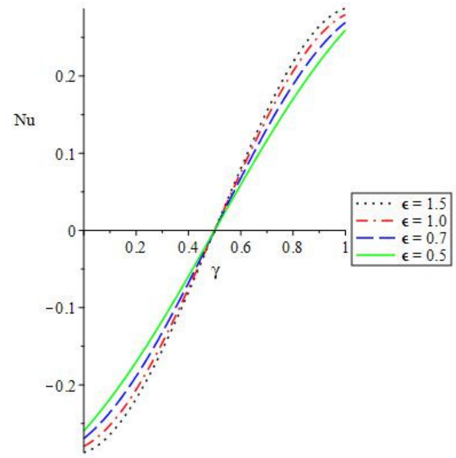

Figure 19. Wall heat transfer rate with (γ) and (ε)

5. CONCLUSION

The analysis transient reactive fluid flow of a two-step exothermic chemical reaction through porous fixed channel with asymmetry convective cooling have been investigated in the present of magnetic field. The governing dimensionless equations the flow and energy was solved using convergent, stable and unconditional semi-implicit finite difference method. from the studied it was noticed that the temperature within the system reduces for all the chemical kinetics i.e the Sensitized Arrhenius and Bimolecular chemical kinetics for variational rises in the activation energy also the magnetic field help in reducing the flow and to avoid unwanted changes in the fluid viscosity due to temperature, electrical conductivity and high thermal is credited to hydromagnetic lubricants with lesser viscosity than the conventional lubricant oils. Moreover, two-step exothermic chemical reaction parameter γ produces a significant rises in the temperature profiles that which depicted a complete combustion of unburned ethanol. Moreover, the reaction parameter λ is very sensitive to an increase and it is therefore needs to be carefully monitor to avoid blow up of the solutions.

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