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Investigating Magnetohydrodynamics Two-phase Flow of Jeffrey Fluid with Magnetic Particles Under the Influence of Viscous and Magnetic Dissipation

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ABSTRACT

This study aims to investigate the influence of magnetic particle concentration, Darcy number, Brinkman number, and Hartmann number on the steady magnetohydrodynamics (MHD) of two - phase flow of Jeffrey fluid with magnetic particles considering the effects of viscous and magnetic dissipation. The flow occurs between two parallel porous plates. The upper plate is stationary, while the lower plate slides due to the pressure and velocity gradients. The governing equations were solved using method of perturbation. The impact of these variables on the fluid's temperature and velocity profiles are analyzed through graphical representation. An increase in magnetic particle concentration at the lower pressure (0.01) decreases the fluid velocity, whereas at higher pressures (5.0), the fluid velocity increases, with no effect on the fluid temperature. Additionally, an increase in the Brinkman number, irrespective of the pressure has no impact on the fluid velocity but leads to a rise in fluid temperature.

Keywords: Two-phase flow, magnetic dissipation, Jeffrey fluid, porous channel, magnetic field.

INTRODUCTION

The numerous applications of non-Jeffrey and Jeffrey fluids in industrial processes, medicine and engineering have garnered researchers' attention over the past few decades. Non-Jeffrey fluid behaviour is typically exhibited by inorganic and organic substances, salts solutions with low molecular mass, and molten metals. In these materials, shear stress is directly proportional to shear rate. However, many studies have shown that the non-Jeffrey model is not consistently accurate. Materials such as adhesives, polymeric melts, dispersions, suspensions, emulsions and slurries do not exhibit a linear relationship between strain and stress.

Jeffrey fluid is a non-Newtonian viscoelastic fluid characterized by its ability to exhibit both elastic and viscous behaviour. It is also an extension of the Maxwell fluid model, incorporating both relaxation time and retardation time, which allows it to capture more complex flow behaviours. These fluids are classified as non - Newtonian or nonlinear with the following features: viscoelastic behaviour, stress relaxation, time-dependent rheology and applicability to biological fluids. In both the medical field and industry, this fluid has widespread applications due to its viscoelastic properties. Blood, mocus and toothpaste are good examples of these fluids due to their model. The impact of radiated joule heating and heat flux on the electro-osmotic flow of non-Newtonian fluid was investigated by Nazeer et al. (2021). It was concluded that the temperature and velocity decrease with respect to the non-Newtonian, electro kinetic and radiation parameters. Hayat et al. (2016) studied the thermal radiation effects on the mixed convection stagnation point flow in a Jeffrey fluid and found that an increase in Deborah number elevated the fluid velocity. Dalir (2014) conducted a numerical study on entropy generation for forced convection flow and heat transfer of a Jeffrey fluid over a

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stretching sheet and discovered that an increase in Deborah number elevated the entropy generation number, while the entropy generation number decreased as the ratio of relaxation to retardation time increased. The simultaneous effects of nanoparticles and slip on Jeffrey fluid flow through a tapered artery with mild stenosis were investigated by Rahman et al. (2016), who found that the direct proportionality of stress to the height increased the amplitude of the stress, and an increase in the Brinkman number (Br) decreased the fluid velocity.

Magnetohydrodynamics (MHD) refers to the movement of electric charges within which magnetic forces act. The medical and pharmaceutical fields, including wound treatment using magnetic fields and hyperthermia, are among the several applications of magnetohydrodynamic flow in fluids, as well as in compressors and cancer treatment. Lot et al. (2024) studied the effect of the magnetic field on two-phase flow of Jeffrey and non-Jeffrey fluids with partial slip and heat transfer in an inclined medium. They concluded that an increase in magnetic field values reduced the fluid velocity and elevated the fluid temperature in the Jeffrey fluid. Abbasi et al. (2016) analyzed the MHD effects of Jeffrey nanofluids and found that increasing the Jeffrey fluid parameters enhances the fluid temperature. Jamil et al. (2020) investigated the MHD fractionalized Jeffrey fluid and observed that both the shear stress and velocity significantly decreased with increasing values of the MHD parameter (M) and the porosity parameter (k). Chu et al. (2021) performed a scale analysis and numerical study of non-Newtonian fluids and discovered that the skin friction coefficient decreased with higher values of the Hartmann number, while the heat flow increased with a higher Prandtl number. Khan et al. (2016) examined the exact solutions for MHD flow of couple stress fluids with heat transfer and noted that when $\eta \to 0$ and $c + a_o < 0$ the non-Newtonian viscous fluids did not yield exponential solutions under couple stress effects. A comparative study by Hassan et al. (2019) on nanofluids containing magnetic and non-magnetic particles propagating over a wedge revealed that the addition of nanoparticles enhanced the base heat transfer rate, especially when small-sized magnetic nanoparticles were used.

A porous channel (or material) is a structure containing pores (voids) filled with fluid. Such channels are commonly used in industries for applications including filtration, distillations towers, ion exchange columns, catalytic reactions, heat exchangers and transpiration cooling. Kahshan et al. (2019) investigated the heat and mass transfer of Jeffrey fluid through a porous- walled channel. The solution was obtained using the Perturbation method. Ramesh (2018) studied the effects of viscous dissipation and joule heating on Jeffrey fluid flow, considering slip conditions for Couette flow, generalized Couette flow, and Poiseuille flow. Turkyilnazoglu and pop (2013) analyzed the analytical solutions for mass and heat transfer in Jeffrey fluid flow. They evaluated the effects of various parameters on temperature and velocity distributions.

A magnetic particle is a nano-, micro-, or millimeter- sized particle dispersed in a fluid that can be energized by an external magnetic field. These particles are commonly used in the design of smart materials, micromachines, and various applications in engineering and biotechnology. Examples of these particles include iron oxide, nickel, cobalt, steel, stainless steel, gadolinium and dysprosium. The amount of these particles in the fluid determines its concentration. Hu et al. (2021) studied the two phase flow of MHD Jeffrey flows with the suspension of tiny metallic particles and found that as the Hartman number increases, the fluid temperature and

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velocity decrease. Additionally, heat transfer and fluid flow increase as concentration of metallic particle rises.

To the researchers' knowledge, the magnetohydrodynamics of Jeffrey fluid with two- phase flow through a porous channel containing viscous dissipation and magnetic particles has not yet been examined. Therefore, the innovation of the current study is to examine the steady-state magnetohydrodynamics of Jeffrey fluid with two- phase flow, incorporating viscous dissipation, magnetic particles, and concentration effects. The aim of the current study is to use the magnetic particle concentration, Brinkman number, Darcy number and Hartmann number to examine the velocity and temperature of the Jeffrey fluid. The effects of these parameters on the fluid velocity and temperature profiles are described using graphs.

In this study, we consider the steady magnetohydrodynamic (MHD) flow of a Jeffrey fluid with two - phase flow, incorporating magnetic materials and accounting for both viscous and magnetic dissipation effects. The flow takes place through a porous channel bounded by two horizontal walls, with the plates located at a spaced of $y=+h$ and $y=-h$ where (h) is the plate distance. An external magnetic field of strength B_O is applied perpendicular to the channel.

The fluid motion within the channel is driven by the combined effects of the magnetic field and a pressure gradient. The analysis includes the influence of magnetic particle concentration (Cr), Brinkman number (Br), Hartmann number (Ha) and Darcy number (Da). It is assumed that the particle and fluid velocities are u_p and u_f, respectively, where (u_p) denotes the particle velocity and (u_f) denotes the fluid velocity.

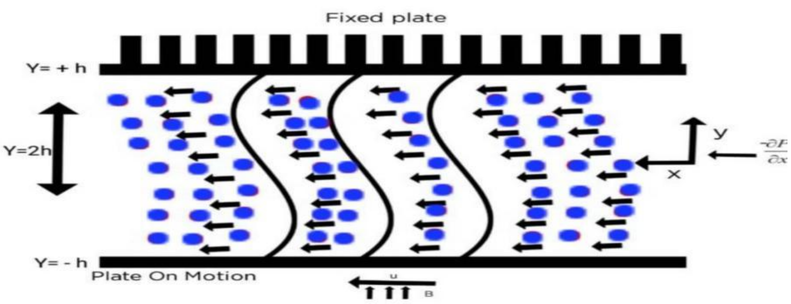

Figure 1: Generalized Couette Flow

I

n Figure 1, consider a two-phase MHD Jeffrey fluid flowing between two horizontal plates embedded in a porous channel, with both plates located at a distance y = ± h. The upper channel wall is stationary, while the lower wall moves with constant pressure and velocity. The T_1 and T_0 temperature is sustained at upper and bottom channel appropriately. The corresponding governing equations for the magnetohydrodynamic (MHD) two-phase Jeffrey fluid subjected to an external magnetic field, following Nazeer et al. (2021), are presented as follows

Equations of the fluid

According to Makheimer et al. (1998), the following are the momentum linear and continuity equations;

$$V_f \bullet \nabla = 0 \tag{1}$$

$$(1-Cr)\nabla\tau-(1-Cr)\nabla_p-NCr(V_p-V_f)-\frac{\mu_s}{k_o}u_f+J\times B=P_f(1-Cr)\frac{DV_f}{Dt} \tag{2}$$

The definition of Jeffrey fluid stress tensor τ is as follows;

$$\tau = \frac{\mu_s}{1+\lambda_1}(\dot{\gamma} + \lambda_1 \ddot{\gamma}) \tag{3}$$

Where (λ_1) is the Jeffrey parameter. The substantial derivative $(\ddot{\gamma})$ and deformation tensor $(\dot{\gamma})$ are given as;

$$\dot{\gamma} = L + L^T \tag{4}$$

$$\ddot{\gamma} = \frac{d\dot{\gamma}}{dt} = \frac{d\dot{\gamma}}{dt} + (u.\nabla)\dot{\gamma} \tag{5}$$

In the present case,

$$L = \begin{vmatrix} 0 & \partial u_f & 0 \\ 0 & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix} \tag{6}$$

Equation (4) and (5) substituting into equation (3), we have,

$$\tau = \frac{\mu_s}{1+\lambda_1}\begin{vmatrix} 0 & \partial u_f & 0 \\ \partial u_f & 0 & 0 \\ 0 & 0 & 0 \end{vmatrix} \tag{7}$$

Therefore, from the expression above we have,

$\tau_{xx} = \tau_{yy} = \tau_{zz} = \tau_{xz} = \tau_{zx} = \tau_{yz} = \tau_{zy} = 0$ and

$$\tau_{xy} = \tau_{yx} = \frac{\mu_s}{1+\lambda_1}\frac{\partial u_f}{\partial y} \tag{8}$$

Hence, the definition of J the present vector;

$$J = \sigma E + \sigma V \times \sigma B \tag{9}$$

With $B = (0, Bo, 0)$

$$J \times B = (-\sigma Bo^2 u_f, 0, 0) \tag{10}$$

By substituting equation (8) and (10) into (2), the following momentum linear equation is given:

$$(1-C_r)\frac{\partial}{\partial y}\left(\frac{\mu_s}{1+\lambda_1}\frac{\partial u_f}{\partial y}\right) - NC_r(u_p - u_f) - \sigma Bo^2 u_f - \frac{\mu_s}{k_*}u_f = (1-C_r)\frac{\partial P}{\partial x} \tag{11}$$

Where (N) is the drag force coefficient, (μ_s) the solid-liquid dimensional viscosity of the fluid and (P) the pressure gradient. Therefore, the fluid continuity and momentum linear equations are given as:

$$\frac{\partial u_f}{\partial x} = 0 \tag{12}$$

$$\frac{\partial}{\partial y}\left(\frac{\mu_s}{1+\lambda_1}\frac{\partial u_f}{\partial y}\right) - \frac{NC_r}{(1-C_r)}(u_p - u_f) - \frac{\sigma Bo^2 u_f}{(1-C_r)} - \frac{\mu_s}{k_*(1-C_r)}u_f = \frac{\partial P}{\partial x} \tag{13}$$

Equations for particle phase

According to Nazeer et al. (2021), continuity and momentum linear equation of the present case becomes;

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$$V_p \bullet \nabla = 0 \quad (14)$$

$$\rho C_p \frac{DV_p}{Dt} = -C_r \Delta_p + NC_r (V_p - V_f) + J_p \times B_P \quad (15)$$

Simplifying the above we have:

$$-C_r \frac{\partial p}{\partial x} + NC_r (u_p - u_f) = 0 \quad (16)$$

Therefore, the particle continuity and momentum linear equations become:

$$\frac{\partial u_p}{\partial x} = 0 \quad (17)$$

$$u_f = u_p \left(1 - \frac{\sigma_p {Bo_p}^2}{NC_r}\right) - \frac{1}{N} \frac{\partial p}{\partial x} \quad (18)$$

Energy equation

The existing problem energy equation can be given by

$$\rho_f (C_p)_f \left(\frac{\partial T}{\partial t} + u_f \frac{\partial T}{\partial x} + v_f \frac{\partial T}{\partial y} + w \frac{\partial T}{\partial z}\right) = \nabla \cdot (k \nabla T) + \mu_s \phi + \sigma Bo^2 u_f^2 \quad (19)$$

With (σ) the Stefan Boltzmann constant, (ρ_f) the fluid density and (C_p) specific heat. In making the simplifications appropriately the dimensional equation of energy becomes;

$$\frac{\partial}{\partial y}\left(k \frac{\partial T}{\partial y}\right) + \frac{\mu_s}{1+\lambda_1}\left(\frac{\partial u_f}{\partial y}\right)^2 + \sigma Bo^2 u_f = 0 \quad (20)$$

Take $\phi = tr(\tau \cdot L)$.

The conditions for the boundary

The boundary dimensional equivalent conditions for the boundary are:

$$u_f = 0 \quad at \quad y = -h, \quad u_f = u_0 \quad at \quad y = h \quad (21)$$

$$T = T_0 \quad at \quad y = -h, \quad T = T_1 \quad at \quad y = h \quad (22)$$

With (T) the dimensional fluid temperature (T_o) the upper plate temperature

METHOD OF SOLUTION

The method of perturbation was used in solving the governing equations above: the continuity equations (14) and (17), the momentum equation (15) and (18), as well the energy equation (19) and (20), with the interface conditions and boundary condition (21) and (22) for the velocity and temperature distribution.

The continuity dimensionless equation and dimensionless equation for momentum

These dimensionless types of equations are derived using the following modifications for converting the dimensional form of the equations:

$$u_f^* = \frac{u_f}{u}, \quad y^* = \frac{y}{h}, \quad \mu_s^* = \frac{\mu_s}{\mu} \quad x^* = \frac{x}{h} \qquad p^* = \frac{hp}{\mu u} \quad k^* = \frac{\bar{k}}{k} \quad (23)$$

With the equations (23) substitutes into (12) and (13), after the asterisks have been dropped for simplicity, then, the continuity dimensionless equation phases for fluid and momentum equation are as follow:

$$\frac{\partial u_f}{\partial x} = 0 \quad (24)$$

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$$\frac{\partial}{\partial y}\left(\frac{\mu_s}{1+\lambda_1}\frac{\partial u_f}{\partial y}\right)-\frac{Cr}{m(1-Cr)}(u_p-u_f)-\frac{(H_a^2+\frac{\mu_s}{Da})}{(1-Cr)}u_f=-P \quad (25)$$

Where, $m=\frac{\mu}{h^2N}, \quad p=-\frac{\partial p}{\partial x}, \quad H_a=\sqrt{\frac{\sigma}{\mu}}h\,Bo$

By placing equation (23) into equation (17) and (18), after the asterisks have been dropped for simplicity, the non-dimensional phase particle equations for continuity and momentum are as follow:

$$\frac{\partial u_p}{\partial x}=0 \quad (26)$$

$$u_f=u_p\left(1-\frac{mH_{ap}}{Cr}\right)+mP \quad (27)$$

By substituting (27) into equation (25), the final type of the momentum dimensionless equation become:

$$u_p=\frac{u_f-mP}{\left(1-\frac{mH_{ap}^2}{Cr}\right)} \quad (28)$$

Formalized Equation of Energy

$$T^{\bullet}=\frac{T-T_0}{T_1-T_0}, \quad u_p^*=\frac{u_p}{u} \quad (29)$$

By substituting equation (29) above into (20), after the asterisks have been dropped for simplicity, the dimensionless equation for energy become:

$$k\frac{\partial^2 T}{\partial y^2}+\frac{\mu_s}{1+\lambda_1}Br\left(\frac{\partial u_f}{\partial y}\right)^2+BrH_a^2u_f^2=0 \quad (30)$$

Where, $Br=\frac{\mu u^2}{k(T_1-T_0)}$, (k) the thermal conductivity and (T_1) the lower plate temperature.

Formalized Boundary Conditions

After the asterisks have been dropped for simplicity, the dimensionless boundary conditions with the assistance of equations (23) and (29) become:

$$at\ y=1 \quad u_f=1, \quad at\ y=-1 \quad u_f=0 \quad (31)$$

$$at\ y=1 \quad T=1, \quad at\ y=-1 \quad T=0 \quad , \quad (32)$$

The solution of equation (30) using boundary condition (32), for the temperature of the fluid becomes:

$$T=A20y^2-A17y+\frac{2BrA4\left(\cosh(\sqrt{A_1}(2y-1))+\sinh(\sqrt{A_1}(2y-1))\right)}{A3}-\frac{2BrA4\left(\cosh(\sqrt{A_1}(2y-1))-\sinh(\sqrt{A_1}(2y-1))\right)}{A3}$$
$$-\frac{2BrA5\left(\cosh(2\sqrt{A_1}(y-1))-\sinh(2\sqrt{A_1}(y-1))\right)}{A3}-\frac{2BrA5\left(\cosh(2\sqrt{A_1}(y-1))+\sinh(2\sqrt{A_1}(y-1))\right)}{A3}$$
$$+\frac{2BrA6\left(\cosh(\sqrt{A_1}(y-2))-\sinh(\sqrt{A_1}(y-2))\right)}{A3}+\frac{2BrA6\left(\cosh(\sqrt{A_1}(y-1))-\sinh(\sqrt{A_1}(y-1))\right)}{A3}$$

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$$
-\frac{2BrA7\left(\cosh(\sqrt{A_1}(y+1))-\sinh(\sqrt{A_1}(y+1))\right)}{A3}-\frac{2BrA6\left(\cosh(\sqrt{A_1}(y-2))+\sinh(\sqrt{A_1}(y-2))\right)}{A3}
-\frac{2BrA7\left(\cosh(\sqrt{A_1}(y+1))+\sinh(\sqrt{A_1}(y+1))\right)}{A3}-\frac{2BrA10\left(\cosh(2\sqrt{A_1}y)-\sinh(2\sqrt{A_1}y)\right)}{A3}
-\frac{2BrA10\left(\cosh(2\sqrt{A_1}y)+\sinh(2\sqrt{A_1}y)\right)}{A3}-\frac{2BrA11\left(\cosh(\sqrt{A_1}y)-\sinh(2\sqrt{A_1}y)\right)}{A3}
+A19-\frac{2BrA11\left(\cosh(\sqrt{A_1}y)+\sinh(\sqrt{A_1}y)\right)}{A3} \quad (33)
$$

$$
A_1=\frac{(1+\lambda_1)}{\mu_S}\left(\frac{Cr^2}{m(1-Cr)(Cr-mHap\ )}-\frac{Cr^2}{m(1-Cr)}+\frac{Ha^2+\frac{\mu_s}{Da}}{(1-Cr)}\right) \quad (34)
$$

$$
A_2=p\left(\frac{1+\lambda_1}{\mu_s}\right)\left(\frac{Cr^2mp}{m(1-Cr)(Cr-mHap^2}+1\right) \quad (35)
$$

$$
\frac{\partial^2 u_f}{\partial y^2}-u_f A_1+A_2=0 \quad (36)
$$

The solution of equation (36) using boundary condition (31), for the velocity of the fluid becomes:

$$
u_f=\frac{1}{2}\frac{\left(\cosh(\sqrt{A_1}y)+\sinh(\sqrt{A_1}y))((\cosh(\sqrt{A_1})-\sinh(\sqrt{A_1}))A_1+(\cosh(\sqrt{A_1})-\sinh(\sqrt{A_1}))A_2+A_1-A_2\right)}{A_1\sinh(\sqrt{A_1})}
-\frac{1}{2}\frac{\left(\cosh(\sqrt{A_1}y)-\sinh(\sqrt{A_1}y))((\cosh(\sqrt{A_1})+\sinh(\sqrt{A_1}))A_1+A_2(\cosh(\sqrt{A_1})+\sinh(\sqrt{A_1}))+A_1-A_2\right)}{A_1\sinh(\sqrt{A_1})}+\frac{A_2}{A_1}
$$

(37)

RESULTS AND DISCUSSION

The influence of the following variables; magnetic particle concentration, Darcy number, Hartmann number and Brinkman number on the steady flow of MHD Jeffrey fluid within the permeable medium are analysed. These are presented in graph using perturbation method to solve the governing equations for generalized couette flow as show below.

The Figure 2 and 3 shows that, the rise in the values of magnetic particle concentration($0.01 \le Cr \le 0.05$) reduces the velocity of the fluid at a lower pressure of (0.01) and shows the opposite in Figure 3 at a high pressure of (5.0). It is noticed that the velocity profile reduces in Fig 2, based on the movement of the lower plate which exert an extra pull inside the fluid magnetic particles concentration. The additional force impacts around the magnetic particles elevate and generate a barrier to the plane flow. However, shows an increment in the flow of fluid at a high pressure of (5.0).

Figure 4 and 5, the observation is that the increment in the Darcy number values from ($0.01 \le Da \le 0.05$) elevates the fluid motion at both lower (0.01) and higher pressures (5.0). Obviously, the fluid velocity elevates with the existence of the porous medium and the Lorentz force.

In Figure 6 and 7, the fluid velocity reduces due to the Hartmann numbers of range ($0.01 \le Ha \le 0.05$) in respective of the pressure either low(0.01) or high (5.0). This reduction is due to the negative forces generated by elevating in the external magnetic field with the rise in the values of Hartmann numbers.

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Finally, it was found in Figure 8 and 9, that the elevation in Brinkman number values ($0.01 \leq Br \leq 0.05$) causes a viscous disintegration effect within the fluid. Therefore, its sequel in elevating heat origination, and hence, the temperature of the fluid rises in both low (0.01) and high (5.0) pressure.

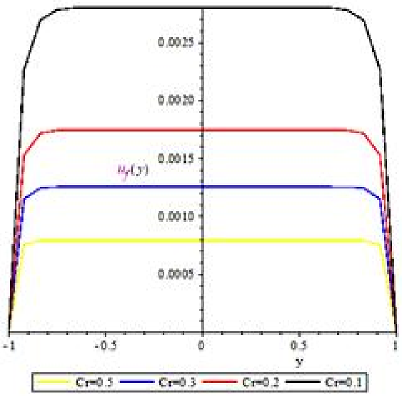

Fig. 2. Magnetic particle concentration effect on velocity profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 0.5, K = 0.5\ and\ \ Br = 0.01$

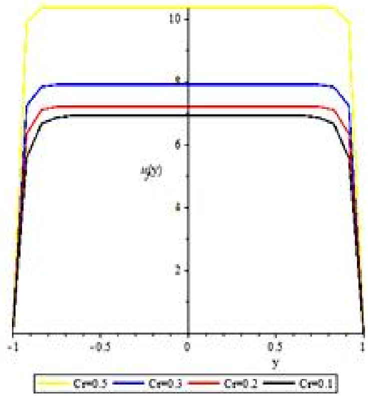

Fig. 3. Magnetic particle concentration effect on velocity profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 0.01, K = 0.5\ and\ \ Br = 0.01$

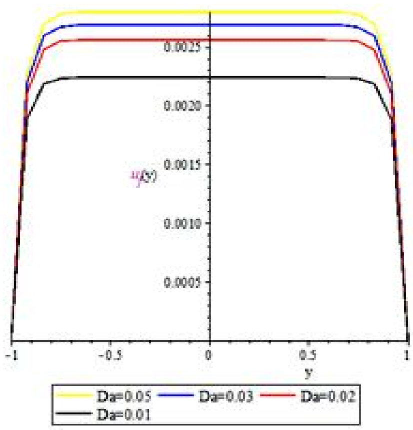

Fig. 4. Darcy number performance on velocity profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 0.01, K = 0.5\ and\ \ Br = 0.01$

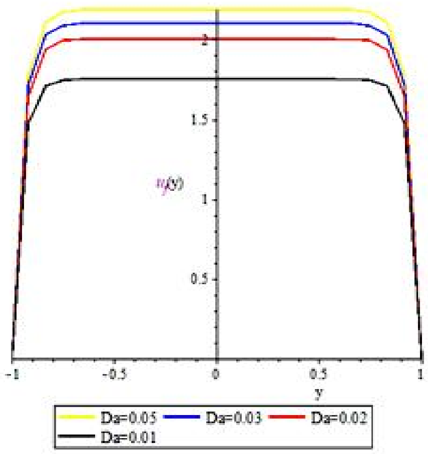

Fig. 5. Darcy number performance on velocity profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.01, Hap = 0.2, P = 5.0, K = 0.5\ and\ \ Br = 0.01$

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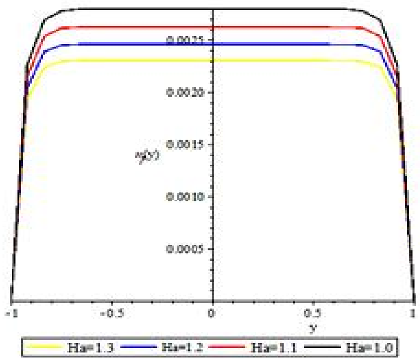

Fig. 6. Hartmann number performance on velocity profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 0.01, K = 0.5\ and\ Br = 0.01$

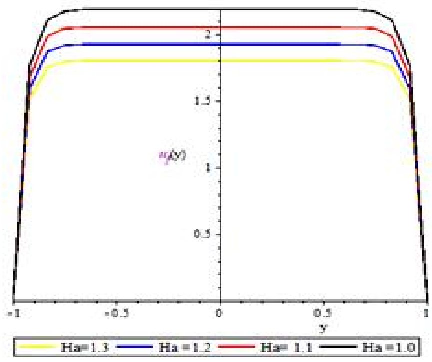

Fig. 7. Hartmann number performance on velocity profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 5.0, K = 0.5\ and\ Br = 0.01$

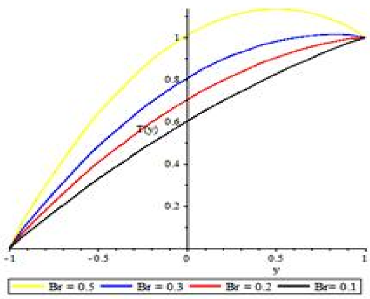

Fig. 8. Brinktman number performance on tempereture profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 0.01, K = 0.5\ and\ Br = 0.01$

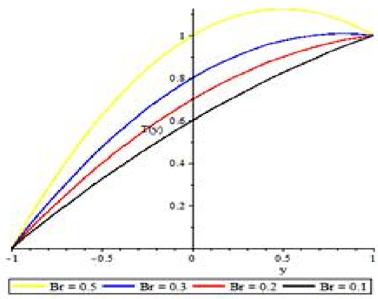

Fig. 9. Brinkman number performance on temperature profile

$where\ \lambda = 0.1, \mu_x = 0.01, Cr = 0.1, m = 0.05, Ha = 1$
$Da = 0.05, Hap = 0.2, P = 5.0, K = 0.5\ and\ Br = 0.01$

CONCLUSION

This study considered the magnetohydrodynamics of Jeffrey fluid with two-phase flow and the inclusion of magnetic particle concentration under the impact of viscous and magnetic dissipation. The B-field and unvarying fluid possessions are examined in this finding by the parallel walls and Generalized Coutte flow of the non- Newtonian fluid. The boundary value problem solution with the performance of magnetic particle concentration and other variables on the Jeffrey fluid flow is determined. The governing equations are solved using Perturbation method and found by Jeffrey stress tenor that is the energy nonlinear momentum. The result of the magnetic particle concentration, Brinkman number, Hartmann number and Darcy number to the fluid temperature and velocity are presented graphically and analysed. The performance of the pertinent variables on the fluid flow has been discussed with the aid of temperature and velocity profile. Due to the graphical results, the following permanent conclusions are made: The magnetic particle concentration reduces the flow of the fluid (velocity) at a lower pressure and shows the opposite at a high

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pressure but has no effect on the fluid temperature. The rise in the rates of Darcy number elevates the fluid velocity at both lower and higher pressures. This shows that the existence of the porous media did not affect the temperature distribution but elevates the fluid velocity**.** The reduction in fluid velocity at both lower and higher pressures is cause by the Harmann number but shows no effect on temperature profile. This happen due to the resistant forces (friction) generated by the elevation in the horizontal magnetic field as Harmann number is elevated. Hence, the presence of an absorbent medium for Jeffrey fluid can be analysed in the heat transfer impacts with this study.

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