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# Effects of Dufour and Hall on MHD Flow past a Linearly Accelerated Vertical Plate with variable Temperature and Mass Diffusion

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**ABSTRACT**

This article goes into further detail about electrically conducting incompressible viscous fluid in an electrically conducting medium with no scattering properties, which is described in greater detail. In this issue, the Laplace Transforms Technique was used to do a combined analysis of the "Dufour Effect and the Hall Effect" on a for components such as temperature, velocity, and concentration. For a range of "parameters such as Schmidt Number, Magnetic Field Parameters, Time, and Prandtl Number, the magneto hydrodynamic" flow over a vertical plate with changing temperature and mass diffusion that has been linearly increased is graphically represented. Furthermore, we used MATLAB software to create the principles of fluid flow equations as well as the Grashof Number, which was used in the equations.

**Keywords: "**Magneto hydrodynamics, Dufour effect, Hall Effect, Vertical plate, Linear, Mass diffusion".

**Introduction**

The necessity for some fluid dynamics understanding developed from the demand for a stable water supply. People thought that wells needed to be dug and primitive pumping apparatus needed to be built, for example. With the increase in population came the need to find a waste (sewage) solution, and with that came some basic understanding. Humans were ecstatic when they discovered that water could be utilized to move objects and create power. Rivers were created when cities grew in size. These rivers reached their greatest length and breadth of coverage in the cities.

Combustion and reactor design have a key influence in the industrial business. To mention a few instances, this is notably true in the design of "nuclear power plants, steel mills, gas turbines, and different aircraft propulsion systems". In the design of combustion and reactor systems, material processing, energy consumption, temperature and heat transfer effects, as well as "heat and mass transfer effects", are all essential factors. The Navier-Stokes equations (or even the Euler equations) describing the flow were considered unsolvable due to their high complexity in the middle of the nineteenth century.

The emergence of multiple firms at the turn of the century created a need for true scientific knowledge that could be applied to a wide range of fluids rather than equations particular to each fluid. As a consequence of this necessity, several new notions emerge, altering the study of fluid dynamics.

Swetha Matta and colleagues looked into how chemical reactions and heat sources affected magneto hydrodynamics flow on A micropolar fluid is sprayed over a vertical porous plate, according to their results. Balamurugan and colleagues explored hydro magnetic oscillatory flow through a porous material bound by two vertical porous plates using a heat source and the Dufour effect, and determined that it was highly successful. Heat and mass transfer were studied using a vertical plate with variable surface temperature and concentration in the magnetic field pressure, according to Elbashbeshy. In their study, the researchers observed that both heat and mass transfer were useful.
Robert and his colleagues investigated the issues of heat and mass transportation. In their study, M. Muralidharan and colleagues looked at the "Radiation Effects on a Linearly Accelerated Isothermal Vertical Plate with Variable Mass". In

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his lecture, Raptis discussed the impact of “mass transfer and free convection on the flow through an accelerating vertical infinite plate with variable suction or injection”. The effects of “mass transfer on accelerated vertical plate past flow with constant heat flux were examined by Singh and colleagues”.

Basanth Kumar and colleagues studied They looked at the effects of free convection and mass transfer on accelerated vertical plate past flow in the presence of heat sources as part of their study. To further understand how the plate travels, Dhanasekar et al. used a first-line chemical reaction to investigate the effects of mass transfer on a vertical plate driven in a spinning fluid. The influence of free convection on the past flow of a vertical plate travelling at high speed in a non-compressible dispersion fluid was investigated by Soundalgekar et al. The effects of cyclic motion on magnetohydrodynamic free convection flow on an accelerating vertical plate were investigated using a cyclic motion simulator, and the findings were reported in the journal Applied Physics.

Sahim discovered that the “Prandtl Number and Grashof Number had a significant impact on the temperature and velocity profiles of a transient natural convection flow across an accelerated infinite vertical plate during a transient natural convection flow”. Murali et al. investigated “the influence of heat radiation on a linearly accelerated vertical plate with variable mass distribution and uniform temperature distribution in a spinning medium”.

The effects of “free convection flow through a porous media controlled by a vertical surface on radiation and mass transfer were studied by Raju and colleagues”. Chaudary and colleagues investigated “the integrated heat and mass transfer effects in an magneto hydrodynamic free convection flow employing a swinging plate implanted in the microscopic medium, as evidenced by the findings”. As part of their study, E. Magyari and colleagues looked at analytic solutions for unstable free convection in porous media.

When the temperature and mass diffusion are altered, magnetic hydrodynamic flow across a linearly accelerated vertical plate with changing temperature and mass diffusion shows both the Dufour and Hall phenomena, according to this research. The results of numerically solving “the fundamental fluid flow equations using the Laplace Transform techniques are shown here”. Exponential and complementary error function representations will be used to describe the mathematical solutions that have been discovered.

This kind of probe improves efficiency [or is important] in the steel industry, for example, "magnetic regulating abilities of molten iron in the steel industry, nuclear reactors for cooling liquid metals, semiconducting materials for suppressing molten iron, Meteorology," and other disciplines..

**Mathematical Analysis**

By introducing a magnetic field to an electrically conductive viscous compressible fluid in an infinite vertical plate, our research team was able to investigate its magnetic hydrodynamic motion. The y-axis is perpendicular to the x-axis, which is parallel to the upward motion of the plate. The B0 current is constantly exposed to a high cross magnetic field. Because of their little influence, viscoelastic scattering and induced magnetic fields were not considered. At first, the liquid concentration C and the temperature T are considered to be at their starting levels. The plate begins to move quickly in its own plane when t> 0, with a velocity equal to the square of the time interval, after raising the concentration and temperature to Cw and Tw.

The governing equations are as follows, as approximated using Boussinesq's Approximations:

The Momentum Equation has two components because of the Hall Effect.

$$\frac{\partial u}{\partial t} = \vartheta \frac{\partial^2 u}{\partial y^2} + g\beta(T - T_\infty) + g\beta^*(C - C_\infty) - \frac{\sigma\mu^2 B_0^2}{\rho(1+m^2)}(u + mv) \tag{1}$$

$$\frac{\partial v}{\partial t} = \vartheta \frac{\partial^2 v}{\partial y^2} + \frac{\sigma\mu^2 B_0^2}{\rho(1+m^2)}(mu - v) \tag{2}$$

$$\frac{\partial T}{\partial t} = \frac{k}{\rho C_P}\frac{\partial^2 T}{\partial y^2} + \frac{D_m K_T}{C_s C_P}\frac{\partial^2 C}{\partial y^2} \tag{3}$$

$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial y^2} \tag{4}$$

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The following are the initial and final conditions:

$$\left.\begin{array}{c} u = 0;\ v = 0;\ T = T_0;\ C = C_0 for\ each\ y : t \leq 0 \\ u = u_0 t; v = 0; T = T_\infty + (T_w - T_\infty)\dfrac{u_0^2 t}{\vartheta}; C = C_\infty + (C_w - C_\infty)\ \dfrac{u_0^2 t}{\vartheta}\ at\ y = 0 :\ t > 0 \\ u \to 0; v \to 0; T \to T_\infty; C \to C_\infty\ as\ y \to \infty \end{array}\right\}$$

(5)

Using the following dimensionless quantities

$$\bar{y} = \frac{yu_0}{\vartheta}, \bar{t} = \frac{tu_0{}^2}{\vartheta}, \bar{u} = \frac{u}{u_0}, \theta = \frac{T-T_\infty}{T_w-T_\infty}, \bar{C} = \frac{C-C_\infty}{C_w-C_\infty}, Pr = \frac{\mu Cp}{k},\ Sc = \frac{\vartheta}{D},\ \mu = \vartheta\rho, \bar{\omega} = \frac{\omega\vartheta}{u_0{}^2},\ Gm = \frac{g\beta^*\vartheta(T_w-T_\infty)}{u_0{}^3},\ , Gr = \frac{g\beta\vartheta(T_w-T_\infty)}{u_0{}^3}, M = \frac{\sigma\mu^2 B_0{}^2\vartheta}{\rho u_0{}^2(1+m^2)},\ Df = \frac{DmK_T(C_w-C_\infty)}{\vartheta CsCp(T_w-T_\infty)} \quad (6)$$

Equations (1) to (4) are transformed into dimensionless form,

$$\frac{\partial\bar{u}}{\partial\bar{t}} = \frac{\partial^2\bar{u}}{\partial\bar{y}^2} + Gr\theta + Gm\bar{C} - M(\bar{u} + m\bar{v}) \quad (7)$$

$$\frac{\partial\bar{v}}{\partial\bar{t}} = \frac{\partial^2\bar{v}}{\partial\bar{y}^2} + M(m\bar{u} + \bar{v}) \quad (8)$$

$$\frac{\partial T}{\partial\bar{t}} = \frac{1}{Pr}\frac{\partial^2 T}{\partial\bar{y}^2} + Df\,\frac{\partial^2 C}{\partial\bar{y}^2} \quad (9)$$

$$\frac{\partial\bar{C}}{\partial\bar{t}} = \frac{1}{Sc}\frac{\partial^2\bar{C}}{\partial\bar{y}^2} \quad (10)$$

**The initial and terminal conditions become**

$$\left.\begin{array}{c} \bar{u} = 0;\ \bar{v} = 0;\ \theta = 0;\ \bar{C} = 0 \quad \forall\,\bar{y}\ : \bar{t} \leq 0 \\ \bar{u} = \bar{t};\ \theta = \bar{t};\ \bar{C} = \bar{t} \quad at\ y = 0 :\ \bar{t} > 0 \\ u \to 0; v \to 0;\ \theta \to 0; \bar{C} \to 0 \quad as\ y \to \infty \end{array}\right\} \quad (11)$$

"By deleting the bars from (7) and (11) and solving equations (7, 8), combining equations (7, 8), and include the complex velocity q = u + iv, the combined equations" are obtained (12)

$$\frac{\partial q}{\partial t} = \frac{\partial^2 q}{\partial y^2} + Gr\theta + GmC - aq \quad (12)$$

$$\frac{\partial\theta}{\partial t} = \frac{1}{Pr}\frac{\partial^2\theta}{\partial y^2} + Df\,\frac{\partial^2 C}{\partial y^2} \quad (13)$$

$$\frac{\partial C}{\partial t} = \frac{1}{Sc}\frac{\partial^2 C}{\partial y^2} \quad (14)$$

Where a = $M(1 - im)$

**With the following initial and terminal conditions:**

$$\left.\begin{array}{c} u = 0;\ v = 0;\ \theta = 0;\ C = 0 \quad \forall\, y :\ t \leq 0 \\ u = t;\ \theta = t;\ C = t \quad at\ y = 0 :\ t > 0 \\ u \to 0; v \to 0;\ \theta \to 0; C \to 0 \quad as\ y \to \infty \end{array}\right\} \quad (15)$$

"The Laplace Transform technique is used to solve the dimensionless equations (12) to (14) that have no dimensions, subject to the boundary conditions (15)".

The following is how you get the answer:

$$C = t\left[(1+2\eta^2 Sc)erfc\left(\eta\sqrt{Sc}\right) - \frac{2\eta\sqrt{Sc}}{\sqrt{\pi}}e^{-\eta^2 Sc}\right] \quad (16)$$

$$\theta = \left[1+\frac{DfPrSc}{Sc-Pr}\right]t\left[(1+2\eta^2 Pr)erfc\left(\eta\sqrt{Pr}\right) - \frac{2\eta\sqrt{Pr}}{\sqrt{\pi}}e^{-\eta^2 Pr}\right] - \frac{DfPrSc}{Sc-Pr}\,t\left[(1+2\eta^2 Sc)erfc\left(\eta\sqrt{Sc}\right) - \frac{2\eta\sqrt{Sc}}{\sqrt{\pi}}e^{-\eta^2 Sc}\right] \quad (17)$$

And $q = q_1 + d(q_2 - q_3) + e(q_4 - q_5)$ (18)

Where,

$$q_1 = \frac{t}{2}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) + e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] - \frac{\eta\sqrt{t}}{2b\sqrt{a}}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) - e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] \quad (18.1)$$

$$q_3 = -\frac{1}{2b^2}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) + e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] - \frac{t}{2b}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) + e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] + \frac{\eta\sqrt{t}}{2b\sqrt{a}}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) - e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] + \frac{e^{bt}}{2b^2}\left[e^{-2\eta\sqrt{(a+b)t}}erfc\left(\eta-\sqrt{(a+b)t}\right) + e^{2\eta\sqrt{(a+b)t}}erfc\left(\eta+\sqrt{(a+b)t}\right)\right] \quad (18.2)$$

$$q_4 = -\frac{1}{2c^2}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) + e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] - \frac{t}{2c}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) + e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] + \frac{\eta\sqrt{t}}{2c\sqrt{a}}\left[e^{-2\eta\sqrt{at}}erfc\left(\eta-\sqrt{at}\right) - e^{2\eta\sqrt{at}}erfc\left(\eta+\sqrt{at}\right)\right] + \frac{e^{ct}}{2c^2}\left[e^{-2\eta\sqrt{(a+c)t}}erfc\left(\eta-\sqrt{(a+c)t}\right) + e^{2\eta\sqrt{(a+c)t}}erfc\left(\eta+\sqrt{(a+c)t}\right)\right] \quad (18.3)$$

$$q_2 = -\frac{1}{b^2}erfc\left(\eta\sqrt{Pr}\right) - \frac{t}{b}\left[\left[(1+2\eta^2 Pr)erfc\left(\eta\sqrt{Pr}\right) - \frac{2\eta\sqrt{Pr}}{\sqrt{\pi}}e^{-\eta^2 Pr}\right] + \frac{e^{bt}}{2b^2}\left[e^{-2\eta\sqrt{Prbt}}erfc(\eta\sqrt{Pr}-\sqrt{bt}) + e^{2\eta\sqrt{Prbt}}erfc(\eta\sqrt{Pr}+\sqrt{bt})\right]\right. \quad (18.4)$$

$$q_5 = -\frac{1}{c^2}erfc\left(\eta\sqrt{Sc}\right) - \frac{t}{c}\left[\left[(1+2\eta^2 Sc)erfc\left(\eta\sqrt{Sc}\right) - \frac{2\eta\sqrt{Sc}}{\sqrt{\pi}}e^{-\eta^2 Sc}\right] + \frac{e^{ct}}{2c^2}\left[e^{-2\eta\sqrt{Scct}}erfc(\eta\sqrt{Sc}-\sqrt{ct}) + e^{2\eta\sqrt{Scct}}erfc(\eta\sqrt{Sc}+\sqrt{ct})\right]\right. \quad (18.5)$$

$$d = \frac{DfPrScGr}{(Sc-Pr)(Pr-1)} - \frac{Gr}{Pr-1} \quad (18.6)$$

*and*

$$e = \frac{DfPrScGr}{(Sc-Pr)(Sc-1)} + \frac{Gm}{Sc-1} \quad (18.7)$$

**We've simplified the enormous number of constants used in the preceding Mathematical Analysis into a few important phrases in this part to make it easier to grasp.**

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**Results and Discussion**

In the magnetic hydrodynamic flow described by Dufour and Hall, the direct source of a high-velocity vertical plate, changeable temperature, and variable mass distribution may be seen and mathematically explained. The equations for this model were obtained using the Laplace Transform approach. The "Dufour number, the Grashof number, the Hall parameter, the Hartmann number, the Schmidt number, the Prandtl number, and the dynamic effects" of time are all shown with the help of MATLAB.

The Dufour and Hall effects were utilized to generate solutions for assessing concentration efficiency, temperature efficiency, and velocity efficiency, which is explored in more depth in the next section. When the Schmidt number (Sc) is raised, the temperature seems to rise briefly at first before gradually falling.

**Graphs**

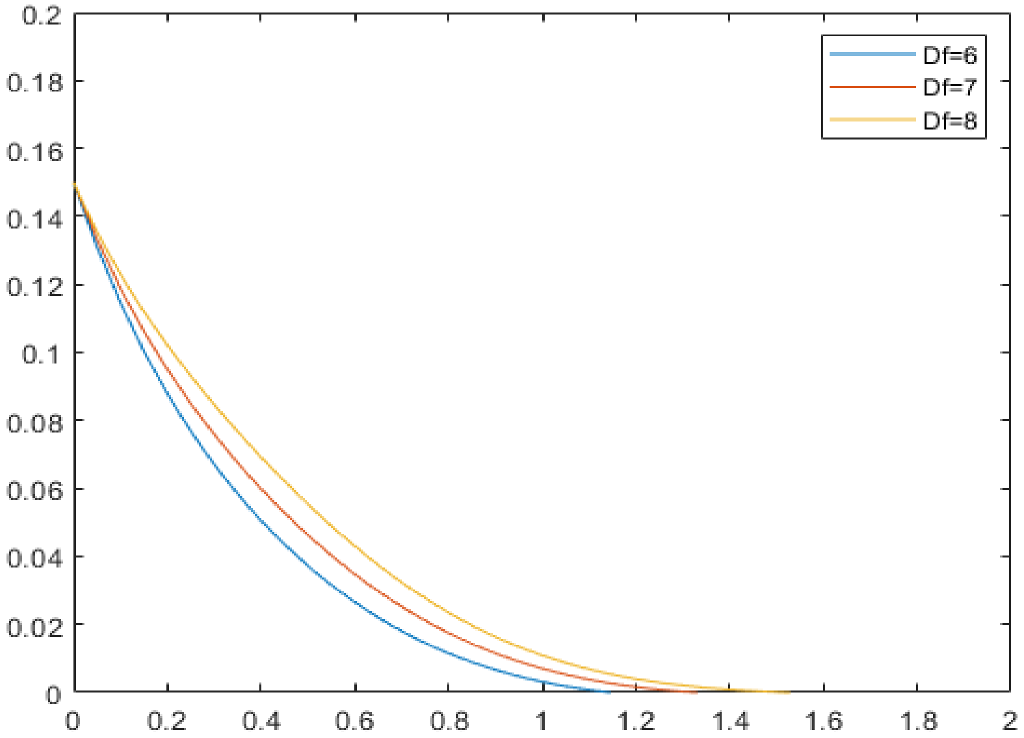


**Fig 1. Velocity Trend for Df**

In fig.1, for the parameters of t=0.2, M=3, m=2, Sc=0.16, Pr=0.71, Gm=10, and Gr=5, the influence of fluid speed rises as the Dufour values rise.

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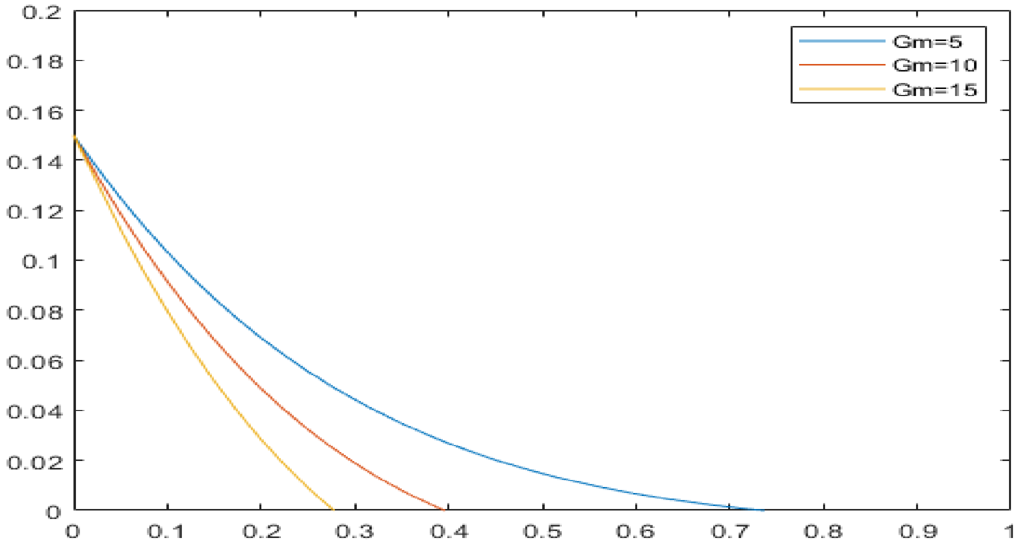


**Fig 2. Velocity Trend for Gm**

In fig. 2, the increase in the mass Grashof number causes the fluid's velocity to progressively decrease for different parameters of t=0.2, M=3, M=2, Sc=0.16, Pr=0.71, Df=0.5, and Gr=5.

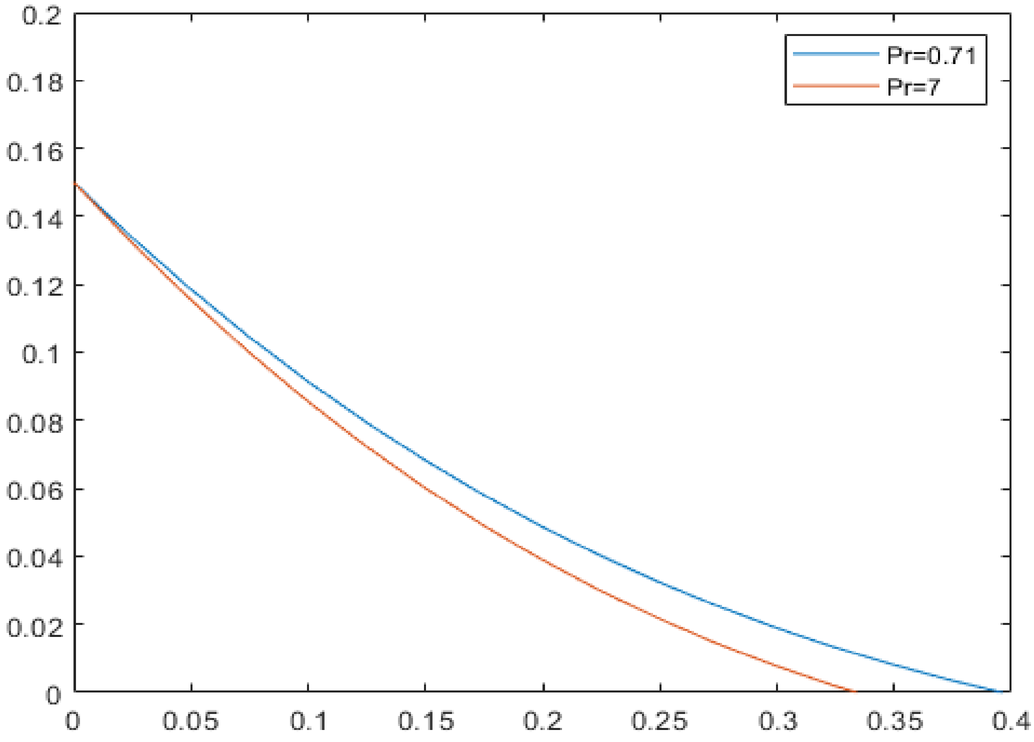


**Fig 3. Velocity Trend for Pr**

The existence of the Prandtl number (air=0.71 and water vapour=7) causes the fluid velocity to decrease, i.e. air has a higher velocity than water vapour in Fig.3, as well as for the combinations of t=0.2,M=3,m=2,Sc=0.16,Gm=10,Df=0.5, and Gr=5.

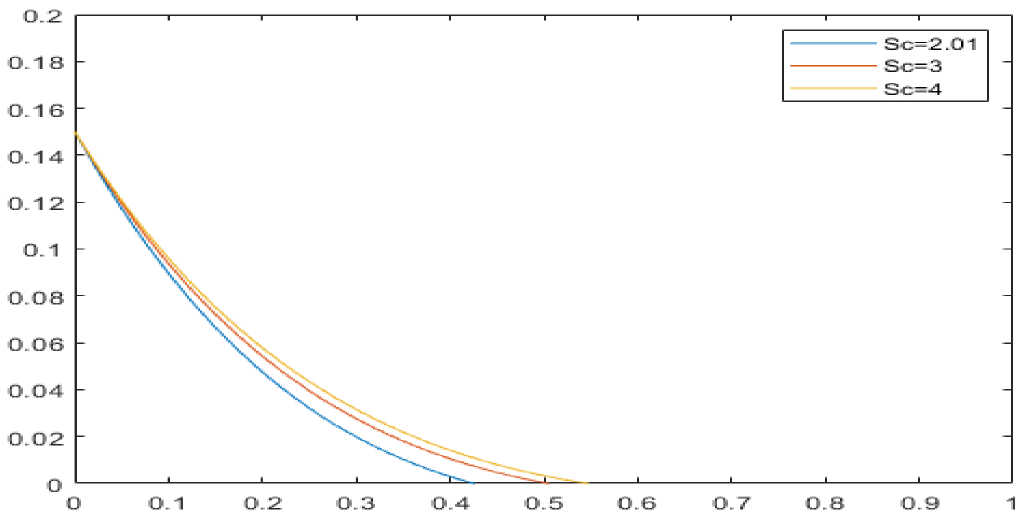


**Fig 4. Velocity Trend for Sc**

The effect of Schmidt's number, as seen in Fig. 4, slowly raises the fluid's velocity. Also, for t=0.2, M=3, m=2, Pr=0.71, Gm=10, Df=0.5, and Gr=5.

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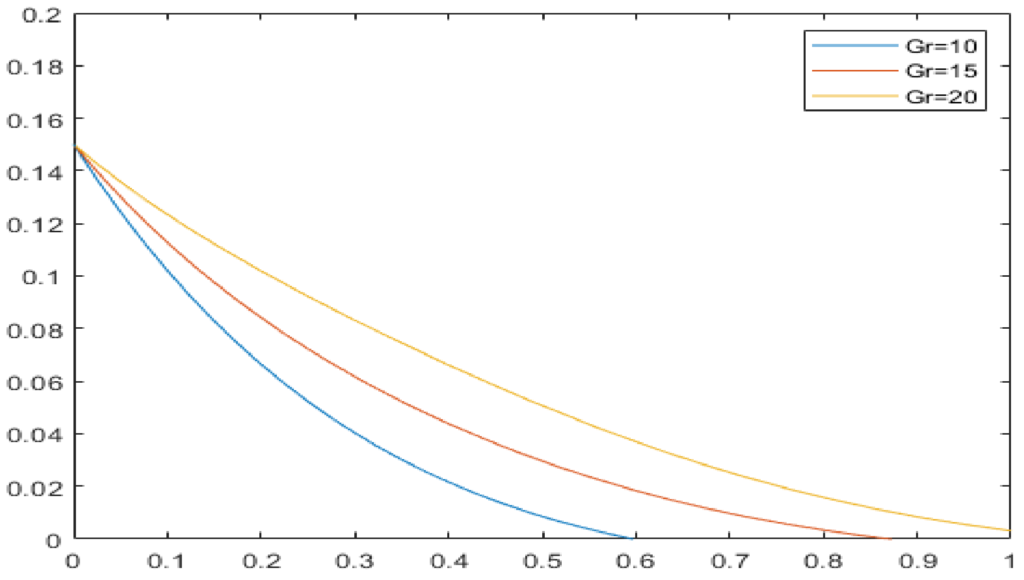


**Fig 5. Velocity Trend for Gr**

The influence of the thermal Grashof number, as shown in Fig.5, affects the fluid by increasing its velocity for t=0.2, M=3, m=2, Sc=0.16, Gm=10, Df=0.5, and Pr=0.71.

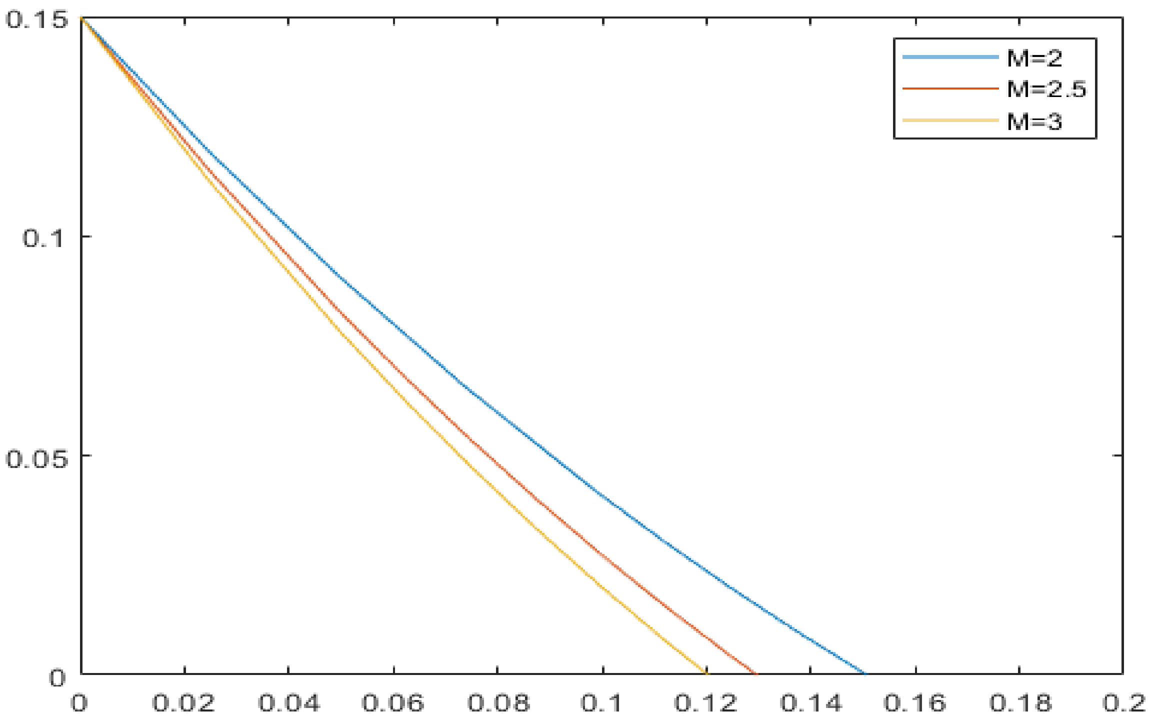


**Fig 6. Velocity Trend for M**

Fig.6 shows that when the Hartmann value increases, the velocity decreases for different values of t=0.2, m=2, Sc=0.16, Pr=0.71, Gm=10, Df=0.5, and Gr=5.

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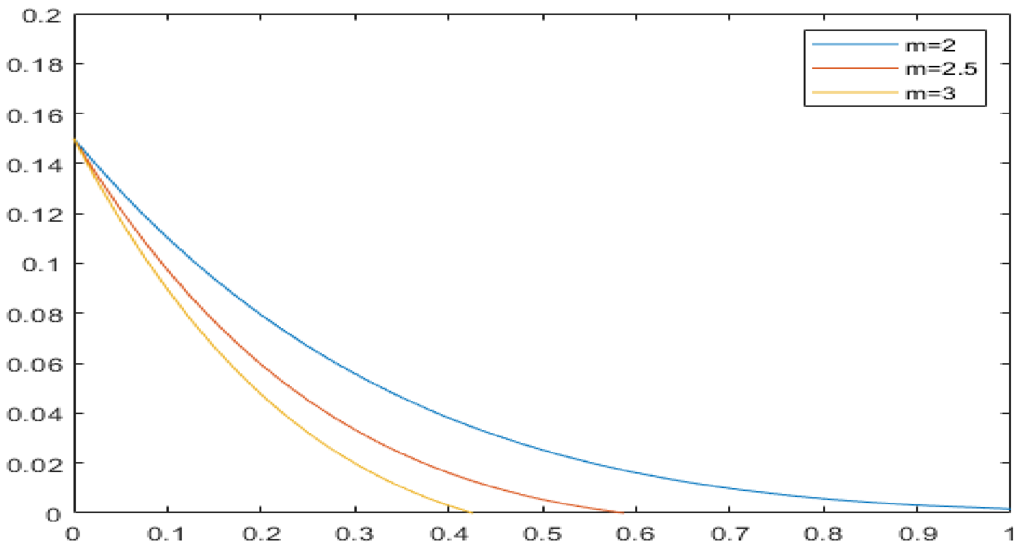


**Fig 7. Velocity Trend for m**

Fig.7 The fluid's speed decreased when the hall parameter was increased, as well as for the following levels: t=0.2, M=3, Pr=0.71, Sc=0.16, Gm=10, Df=0.5, and Gr=5.

**Conclusion**

The combined impact of “Dufour and Hall on Magneto hydrodynamic flow through a linearly accelerated vertical plate with variable temperature and fluctuating mass diffusion in a vertical plate with varying temperature and fluctuating mass diffusion is graphically and statistically illustrated” in this study. The “Laplace Transform Technique was used to derive the mathematical equations for this model”. The dynamic impacts of the “Dufour number, Grashof number, Hall parameter, Hartman number, Schmidt number, Prandtl number”, and time can be seen using MATLAB, which allows us to see the dynamic impacts of the “Dufour number, Grashof number, Hall parameter, Hartman number, Schmidt number, Prandtl number”, and time. The following condensed solutions use the Dufour and Hall effects, as well as additional approaches, to compute the potential of concentration, temperature, and velocity. The influence of fluid speed rises when “Dufour values, Schmidt numbers, and thermal Grashof” numbers rise. The velocity drops when the “Prandtl number, Hartmann number, Mass Grashof number, Hall parameter, and Schmidt number are present”.

**Nomenclature**

(u, v, w) “Components of velocity field Q”

$(\bar{u}, \bar{v}, \bar{w})$ “Non-Dimensional velocity components”

(x, y, z) “Cartesian Co-ordinates”

| | |
|---|---|
| g | “Acceleration due to gravity” |
| $\beta$ | “Volumetric Co-efficient of thermal expansion” |
| $\beta^*$ | “Volumetric Co-efficient of Concentration expansion” |
| t | “Time” |
| T | “Temperature of fluid” |

| | |
|---|---|
| $T_\infty$ | "Temperature of the plate at y$\rightarrow \infty$" |
| $T_w$ | "Temperature of the plate at y$=0$" |
| C | "Species concentration in the fluid" |
| $C_\infty$ | "Species concentration at y$\rightarrow \infty$" |
| $C_w$ | "Species concentration at y=0" |
| $C_p$ | "Specific heat at constant pressure" |
| $C_s$ | "Concentration Susceptibility" |
| $\upsilon$ | "Kinematic Viscosity" |
| $\rho$ | "Density" |
| k | "Thermal Conductivity of the fluid" |
| D | "Mass diffusion constant" |
| $K_T$ | "Thermal diffusion ratio" |
| $D_m$ | "Effective mass diffusivity rate" |
| $B_0$ | "Uniform magnetic field" |
| $\sigma$ | "Electrical conductivity" |
| m | "Hall parameter" |
| M | "Hartman number" |
| Gr | "Thermal Grashof number" |
| Gm | "Mass Grashof number" |
| Pr | "Thermal Prandtl number" |
| Df | "Dufour number" |
| Sc | "Schmidt number" |
| $\theta$ | "Dimensionless Temperature" |
| $\bar{C}$ | "Dimensionless Concentration" |
| $\bar{t}$ | "Dimensionless Time" |

**References**

1. Matta, S., Appidi, L., Malga, B. S., & Pramod Kumar, P. (2021). Chemical Reaction and Heat Source Effects on MHD Free Convective Flow over A Linearly Accelerated Moving Vertical Porous Plate. Indian Journal of Science and Technology (Online), 14(13), 1044-1055.
2. Balamurugan, K., & Gopikrishnan, V. (2016). Radiation effects of MHD oscillatory flow along a porous medium bounded by two vertical porous plates in presence of Hall current and dufour effect with chemical reaction. *International Journal of mathematics and computer applications research*, *6*, 35-54.
3. Elbashbeshy, E. M. A. (1997). Heat and mass transfer along a vertical plate with variable surface tension and concentration in the presence of the magnetic field. International Journal of Engineering Science, 35(5), 515-522.
4. Eckert, E. R., & Drake Jr, R. M. (1987). Analysis of heat and mass transfer.

**JOURNAL OF ALGEBRAIC STATISTICS**
Volume 13, No. 2, 2022, p. 2068 - 2078
https://publishoa.com
ISSN: 1309-3452

**5.** Muralidharan, M., & Muthucumaraswamy, R. (2013). Radiation effects on linearly accelerated isothermal vertical plate with variable mass diffusion in the presence of magnetic field. Applied Mathematical Sciences, 7(113), 5645-5656.

6. N.G. Kafousias, and A.Raptis, Mass transfer and free convection effects on the flow past an accelerated vertical infinite plate with variable suctionor injection, Rev. Roum. Sci. Techn.-Mec. Apl. 26 (1981) 11-22

7. A.K. Singh and J. Singh, Mass transfer effects on the flow past an accelerated vertical plate with constant heat flux, Astrophysics and Space Science, 97 (1983) 57-61

8. Basanth Kumar Jha and Ravindra Prasad, Free convection and mass transfer effects on the flow past an accelerated vertical plate with heat sources, Mechanics Research Communications, 17 (1990) 143-148.

9. Muthucumaraswamy, R., Dhanasekar, N., & Prasad, G. E. (2012). Mass transfer effects on accelerated vertical plate in a rotating fluid with first order chemical reaction. Journal of Mechanical Engineering and Sciences, 3, 346-55.

10. Gupta, A. S., Pop, I., & Soundalgekar, V. M. (1979). Free convection effects on the flow past an accelerated vertical plate in an incompressible dissipative fluid. Revue Roumaine des Sciences Techniques - Série de Mécanique Appliquée, 24,561-568.

11. Raptis, A., & Singh, A. K. (1985). Rotation effects on MHD free convection flow past an accelerated vertical plate. Mechanics Research Communications, 12, 31-40.

12. Sahim, K. (2015). Analysis of transient natural convection flow past an accelerated infinite vertical plate. International Journal of Engineering Research, 4(2), 47-50.

13. Murali, S. M., & Vijayalakshmi, A. R. (2018). Effect of Thermal Radiation on a Linearly Accelerated Vertical Plate with Variable Mass Diffusion and Uniform Temperature Distribution in a Rotating Medium.

14. Raju, M. C., Varma, S. V. K., & Anandareddy, N. (2011). Radiation and mass transfer effects on a free convection flow through a porous medium bounded by a vertical surface. i-Manager's Journal on Future Engineering and Technology, 7(2), 7.

15. Chaudhary, R. C., & Jain, A. (2007). Combined heat and mass transfer effects on MHD free convection flow past an oscillating plate embedded in porous medium. Romanian Journal of Physics, 52(5-7), 505-524.

16. Magyari, E., Pop, I., & Keller, B. (2004). Analytical solutions for unsteady free convection in porous media. Journal of engineering mathematics, 48(2), 93-104.