

Steady of Thermal and Concentration Effect on a Fully Developed Jeffrey Fluid with Baffle in a Vertical Passage

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The consistency of the hot effect and concentration on Jeffrey's fully developed fluid in the vertical passage was examined. We considered two circuits by using a small, efficient aircraft. The more complex ruling ODE is solved by taking the right boundary and co-operative conditions in complex areas. The results are illustrated in a variety of important parameters and are illustrated to analyze important aspects of the results in all confusing areas. It is concluded that the stimulus in the Jeffrey parameter increases the flow rate, temperatures and concentration while the chemical reaction parameter suppresses the flow of fluid in all complex areas. The solutions obtained are compared to DS solved valued and the results hold good consistency. The current results are well supported by the current study of the specific conditions of the mathematical model.

KEYWORDS: Baffle, Jeffrey Fluid, Heat Transmission and Mass, Chemical Reaction Parameter, Surface Layer Flow.

1. INTRODUCTION

In a chemical reactor Baffles are often attached to interior walls to promote mixing and improve heat transfer and concentration. An important role in heat and mass transfer is played by baffles play, its performance enhances the use of the flow method. The flow control panel is divided into vessels such as tube heat exchangers, direct mixers and chemical reactors. Baffle panels vary depending on construction materials, weight and other features, but these are made of high quality materials as fiberglass is ideal. A baffle is also called a baffle panel or baffle plate. Baffle vans disrupt the flow used to direct the transfer of liquid or gas. Baffle is used in some indoor and other stoves in the industrial system, namely shell and heat transfer tube, as well as chemical reactors. The Baffle panel is designed in such a way that it supports a large number of tubes and emphasizes fluid flow for maximum accuracy. Baffle prevents the resulting systemic hunger, which increases with the speed of fluid and the magnitude of temperature changes.

The size of the heat exchangers plays an important role in cost improvement. Similarly, the efficiency of heat exchangers takes into account an important parameter when selecting heat exchangers. Many ways to improve

heat transfer have been considered over the years to achieve higher cost efficiency.¹ STHX can be divided into three groups according to the pattern of water flow near the shell: helical flow, longitudinal flow and opposite flow. The heat transfer characteristics on the side of the STHX shell vary according to the flexible flow, which has a significant impact on the heat exchange function¹ Rao and Babu² performed a temperature analysis of tube and shell fluids using different components of glycerin. If the concentration of glycerin is 20%, it will provide excess heat transfer and slightly reduce the pressure that concludes the study. Ji et al.³ introduced a numerical investigation of the shell beyond the dual shell and the heat exchanger with continuous helical baffles.

Flexible heat transfer from fixed or circulating paths embedded in perforated sources has been extensively researched by many researchers due to their many engineering applications, such as accidental removal of heat from nuclear reactors, solar collectors, drying processes, heat exchangers, renewable energy from geothermal, and geothermal energy. Groundwater pollution, thermal energy conservation, construction of buildings, flow of filter sources, modeling of full circular beds, groundwater pollution and filtration processes, to name a few of these applications. In the field of chemicals and industries that have played a major role in heat and mass transfer to research in recent years, the study of the direct flow of heat transfer of hydroelectric power station has attracted the attention of many observers, forums such as underground

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transport, water pollution. And the use of the problem of free convection is found as Bodia et al.⁴ full convection heat transfer to a direct channel was considered, Aung⁵ heat transfer wall, Aung et al.⁶ and Miyatake and Fujii⁷ studied the asymmetric boundary conditions examined by Nelson and Wood⁸ which does not measure the vortex viscosity parameter and buoyancy ratio in the fully developed natural convection of temperature and concentration. Cheng,⁹ Bodoia and Osterle¹⁰ are provided with a straight line that has both the same temperature and asymmetric wall to transmit fully flexible temperature fluctuations. The kinetic processes of heat and mass transfer are possible and studied separately in mathematical contexts in the case of distribution and convection transfer and thus are very effective in self-expression.¹¹⁻³¹

Jeffrey fluid is able to explain Newtonian non-productive properties of liquids, a common component of unspecified viscous fluids. In the non-Newtonian water memory class, (breaks), can be better explained with the help of Jeffrey fluid. Of the many non-Newtonian fluid models, Jeffrey fluid attracted many researchers because of its reputation as.

2. FORMULATION

The dominant equation of speed, temperature and concentration are present

Region-I

$$\rho g \beta_{T1}(T_1 - T_{w2}) + \rho g \beta_{c1}(c_1 - \bar{c}_2) + \frac{\mu_1}{(1 + \lambda)} \frac{d^2 u_1}{dy^2} - \frac{dp}{dx} = 0 \quad (1)$$

$$\frac{d^2 T_1}{dY^2} = -\frac{v_1}{\alpha_1 c_p} \left(\frac{dU_1}{dY} \right)^2 \quad (2)$$

$$D1 \frac{d^2 C_1}{dY^2} - K_1 C_1 = 0 \quad (3)$$

Region-II

$$\rho g \beta_{T2}(T_2 - T_{w2}) + \rho g \beta_{c2}(c_2 - \bar{c}_2) + \mu_2 \frac{d^2 u_1}{dy^2} - \frac{dp}{dX} = 0 \quad (4)$$

$$\frac{d^2 T_1}{dY^2} = -\frac{v_1}{\alpha_1 c_p} \left(\frac{dU_2}{dY} \right)^2 \quad (5)$$

$$D2 \frac{d^2 C_2}{dY^2} - K_2 C_2 = 0 \quad (6)$$

Boundary conditions and interface conditions of speed, temperature, concentrations are present

$$U_1 = 0, T_1 = T_{w1}, C_1 = \bar{C}_1 \quad \text{at } Y = -h$$

$$U_2 = 0, T_2 = T_{w2} \quad \text{at } Y = h$$

$$U_1 = 0 = U_2, T_1 = T_2, \frac{dT_1}{dY} = \frac{dT_2}{dY} \quad \text{at } Y = h^*$$

$$\phi_1(-h) = 1, \phi_2(h) = 0, \frac{d\phi_1}{dY}(Y^*) = \frac{d\phi_2}{dY}(Y^*) \quad (7)$$

We now introduce the following non-dimensional transformations

$$u_i = \frac{U_i}{U_1}, \quad y_i = \frac{Y_i}{h_i}, \quad \theta_1 = \frac{T_1 - T_{w2}}{T_{w1} - T_{w2}}, \quad \theta_2 = \frac{T_2 - T_{w2}}{T_{w1} - T_{w2}},$$

$$Gr = \frac{g \beta_{T1} h_1^3 (T_{w1} - T_{w2})}{v_1^2}, \quad Re = \frac{\bar{U}_1 h_1}{v_1}, \quad H = \frac{nh_1}{\bar{U}_1}$$

$$p = \frac{h_1^2}{\mu_1 \bar{U}_1} \frac{dp}{dX}, \quad K = \frac{\kappa}{\mu_1} \quad (8)$$

and $K = (\kappa/\mu_1)$ is the material parameter of region-I. We note that it describes the state of viscous or Newtonian fluid.

Substituting the non-dimensional variables into Eqs. (1) to (6) we get

Region-I

$$\frac{d^2 u_1}{dy^2} + (1 + \lambda)G_1 \theta_1 + (1 + \lambda)G_2 \phi_1 - (1 + \lambda)p = 0 \quad (9)$$

$$\frac{d^2 \theta_1}{dy^2} = -B_r \left(\frac{du_1}{dy} \right)^2 = 0 \quad (10)$$

Region-II

$$\frac{d^2 u_2}{dy^2} = a_1 \theta_2 + a_2 \phi_2 + m p h^2 \quad (11)$$

$$\frac{d^2 \theta_2}{dy^2} = -B_r \left(\frac{du_2}{dy} \right)^2 = 0 \quad (12)$$

where

$$GR_T = G_1, \quad GR_C = G_2, \quad h = \frac{h_2}{h_1}, \quad m = \frac{\mu_1}{\mu_2},$$

$$b_r = \frac{\beta_{T2}}{\beta_{T1}}, \quad n = \frac{\rho_2}{\rho_1}, \quad k = \frac{K_1}{K_2}$$

On substituting Eq. (8) into Eq. (13), The non-dimensional form of boundary and interface conditions becomes,

$$u_{10}(-1) = 0, \quad u_{20}(1) = 0, \quad \theta_{10}(-1) = 1, \quad \theta_{20}(1) = 0,$$

$$u_{11}(-1) = 0, \quad u_{21} = 0, \quad u_{10}(y^*) = 0, \quad u_{20}(y^*) = 0,$$

$$\theta_{10}(y^*) = \theta_{20}(y^*) = \theta_{11}(y^*) = \theta_{21}(y^*), \quad \varphi_1(-1) = 1,$$

$$\varphi_2(1) = 0 \frac{d\theta_{10}}{dy}(y^*) \frac{d\theta_{20}}{dy}(y^*)$$

$$\frac{d\theta_{11}}{dy}(y^*) = \frac{d\theta_{21}}{dy}(y^*), \quad u_{11}(y^*) = 0, \quad u_{21}(y^*) = 0,$$

$$\theta_{11}(-1) = 0, \quad \theta_{21}(1) = 0, \quad \varphi_1(y^*) = \varphi_2(y^*),$$

$$\frac{d\varphi_1}{dy}(y^*) = \frac{d\varphi_2}{dy}(y^*) \quad (13)$$

3. METHOD OF SOLUTION

The governing, The fluid model (see in Fig. 1 built in 2002) Eqs. (9) to (12) are solved by analyzing using the appropriate boundary and interaction conditions (13) and the solutions found are shown below.

Regular perturbation method:

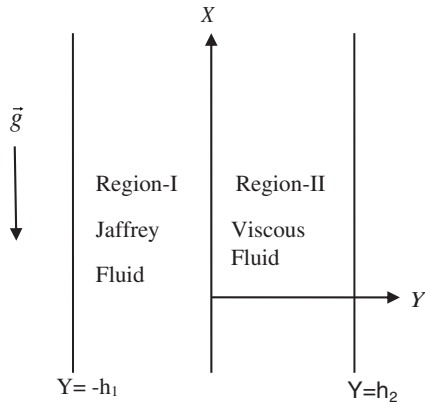


Fig. 1. Physical configuration.

Solutions are provided with the help of the common interference method, by taking that Brinkman number as the smallest interference parameter, and comparing the same epsilon strength with zero force and one obtaining zero order and pre-ordering the normal equation and negligence. High quality words we find solutions and results discussed in drawings. For the most important parameter such as the Jeffrey parameter and the chemical reaction parameter

$$\epsilon = Br \tag{14}$$

The solution are assumed to be of the form

$$u_i(y) = u_{i0}(y) + \epsilon u_{i1}(y) + \epsilon^2 u_{i2}(y) + \dots \tag{15}$$

$$\theta_i(y) = \theta_{i0}(y) + \epsilon \theta_{i1}(y) + \epsilon^2 \theta_{i2}(y) + \dots \tag{16}$$

Region-I

Zeroth-Order Equations

$$\theta_{10} = c_1 + c_2 y \tag{17}$$

$$u_{10} = A_2 + A_1 y + q_1 y^2 + q_2 y^3 + q_3 \text{Cosh}[\alpha_1 y] + q_4 \text{Sinh}[\alpha_1 y] \tag{18}$$

$$\phi_1 = b_1 \text{Cosh}[\alpha_1 y] + b_2 \text{Sinh}[\alpha_1 y] \tag{19}$$

Region-II

$$\theta_{20} = c_3 + c_4 y \tag{20}$$

$$\phi_2 = b_3 \text{Cosh}[\alpha_2 y] + b_4 \text{Sinh}[\alpha_2 y] \tag{21}$$

$$u_{20} = A_4 + A_3 y + q_5 y^2 + q_6 y^3 + q_7 \text{Cosh}[\alpha_2 y] + q_8 \text{Sinh}[\alpha_2 y] \tag{22}$$

First-Order Equations

Region-I

$$\theta_{11} = A6 + A5y + y^2 q9 + y^3 q10 + y^4 q11 + y^5 q12 + y^6 q13 + q14 \text{Cosh}[\alpha_1 y] + q15 y \text{Cosh}[\alpha_1 y] + q16 y^2 \text{Cosh}[\alpha_1 y] + q17 \text{Cosh}[2\alpha_1 y] + q18 \text{Sinh}[\alpha_1 y] + q19 y \text{Sinh}[\alpha_1 y] + q20 y^2 \text{Sinh}[\alpha_1 y] + q21 \text{Sinh}[2\alpha_1 y] \tag{23}$$

$$u_{11} = B2 + B1y + q35 y^2 + q36 y^3 + q37 y^4 + y^5 q38 + y^6 q39 + y^7 q40 + y^8 q41 + q42 \text{Cosh}[\alpha_1 y] + q43 y \text{Cosh}[\alpha_1 y] + q44 y^2 \text{Cosh}[\alpha_1 y] + q45 \text{Cosh}[2\alpha_1 y] + q46 y^2 \text{Cosh}[2\alpha_1 y] + q47 \text{Sinh}[\alpha_1 y] + q48 y \text{Sinh}[\alpha_1 y] + q49 y^2 \text{Sinh}[\alpha_1 y] + q50 y^3 \text{Sinh}[2\alpha_1 y] + q51 y \text{Sinh}[2\alpha_1 y] \tag{24}$$

Region-II

$$\theta_{21} = A8 + A7y + q22 y^2 + y^3 q23 + q24 y^4 + q25 y^5 + q26 y^6 + q27 \text{Cosh}[\alpha_2 y] + q28 y \text{Cosh}[\alpha_2 y] + q29 y^2 \text{Cosh}[\alpha_2 y] + q30 \text{Cosh}[2\alpha_2 y] + q31 \text{Sinh}[\alpha_2 y] + q32 y \text{Sinh}[\alpha_2 y] + q33 y^2 \text{Sinh}[\alpha_2 y] + q34 \text{Sinh}[2\alpha_2 y] \tag{25}$$

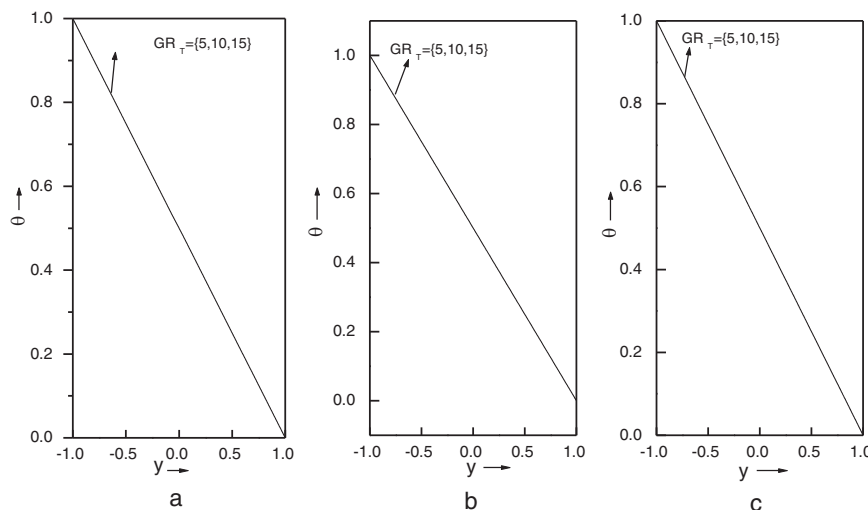


Fig. 2. (a-c) Temperature profile of different value for Thermal Grashof number GR7.

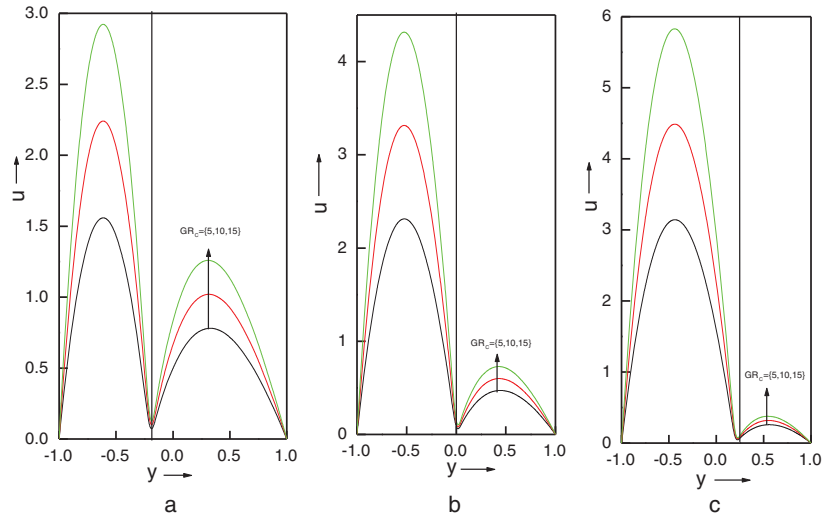


Fig. 3. (a-c) Velocity profile for different value of Mass Grashof number GR_c .

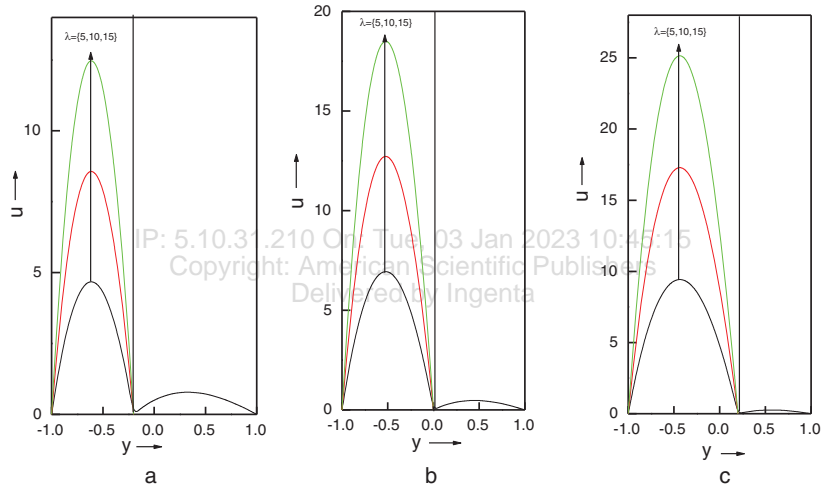


Fig. 4. (a-c) Velocity profile for different value of Jeffrey parameter λ .

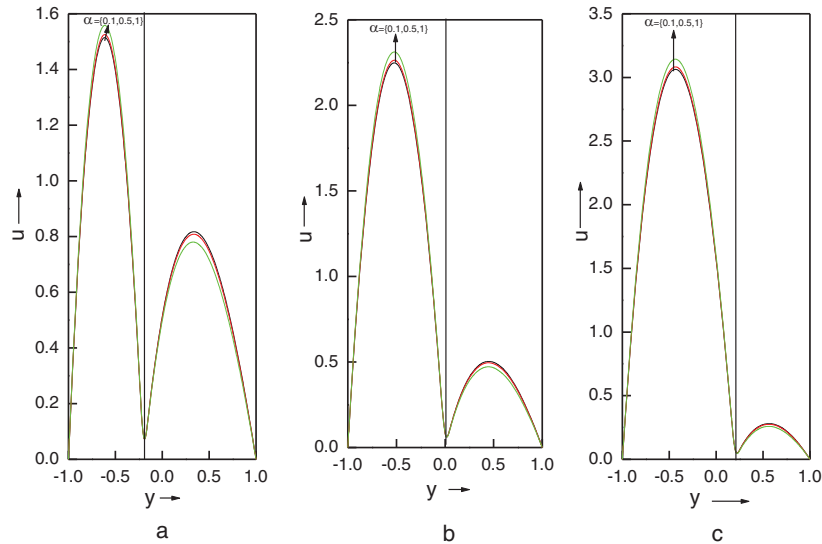


Fig. 5. (a-c) Velocity profile for different value of chemical parameter α .

$$\begin{aligned}
 u_{21} = & B4 + B3y + q52y^2 + q53y^3 + q54y^4 + q55y^5 + q56y^6 \\
 & + q57y^7 + q58y^8 + q59\text{Cosh}[\alpha_2y] + q60y\text{Cosh}[\alpha_2y] \\
 & + q61y^2\text{Cosh}[\alpha_2y] + q62\text{Cosh}[2\alpha_2y] + q63\text{Sinh}[\alpha_2y] \\
 & + q64y\text{Sinh}[\alpha_2y] + q65y^2\text{Sinh}[\alpha_2y] \\
 & + q66\text{Sinh}[2\alpha_2y]
 \end{aligned}
 \tag{26}$$

4. RESULTS AND DISCUSSION

In this paper we have explored how you can warm up and concentrate on a fully developed jeffrey liquid that may confuse a particular channel. heat transfer flow as assessed by the effect of the control parameters.

The average value of Thermal Grashoff in Reynold, Mass Grashoff number to Reynold number, pressure gradient and disturbing parameter p is set at 5.5, -1.5 and 0.1 respectively.

The effect of Thermal Grashoff’s thermal value on speed, and the temperature profile is shown in Figures 2(a)–(c) and 3(a)–(c) in all three different baffle features $y^* = (-0.2, 0, 0.2)$. As Grashoff temperature rises Grashoff value and Reynolds number speed and region temperature-I and region-II increase, as increasing pressure forces increase Grashoff number which is why it increases speed and temperature.

Grashoff’s Reynolds number in the flow field is shown in Figures 3(a)–(c) the rate of increase in different values

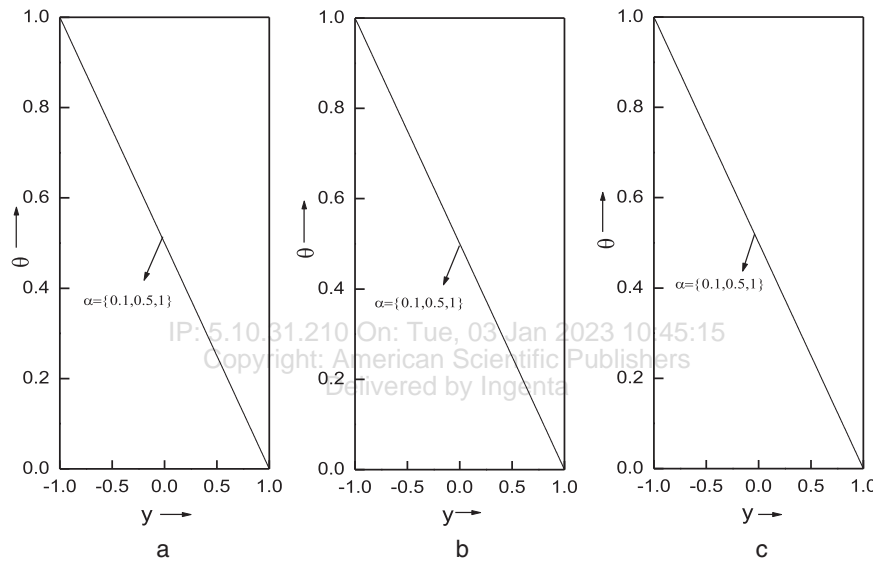


Fig. 6. (a–c) Temperature profile for different value of chemical parameter α .

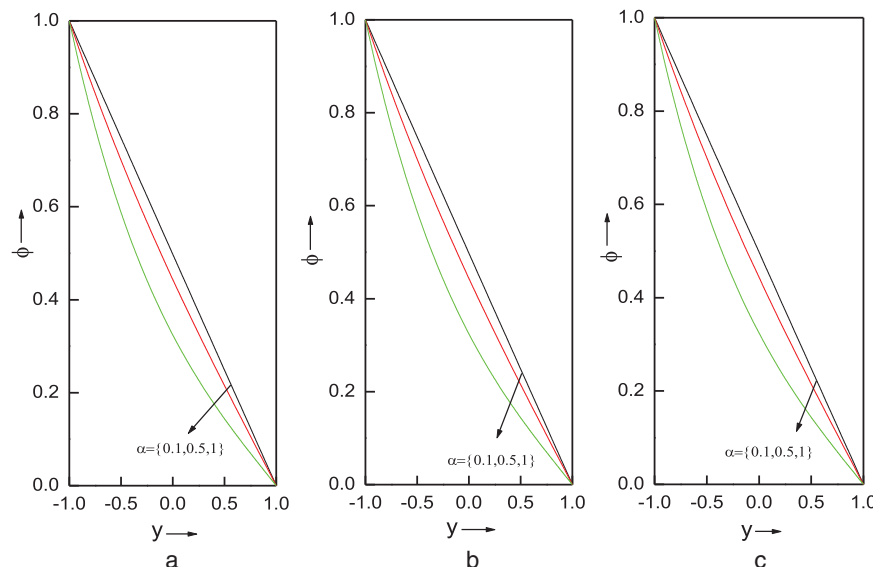


Fig. 7. (a–c) Concentration profile for different value of chemical parameter α .

Table I. Comparison table for jeffrey parameter by regular perturbation method and D solve (see in Table I).

Scale (y)	RPM	DS	Error
-0.95	0.09	0.15	0.06
-0.6	0.45	0.74	0.29
-0.2	0.27	0.47	0.19
0.2	0.11	0.16	0.05
0.6	0.16	0.22	0.06
0.95	0.03	0.04	0.001

Table II. Comparison table for chemical reaction parameter by regular perturbation method and D solve (see in Table II).

Scale (y)	RPM	DS	Error
-0.95	0.1	0.14	0.04
-0.6	0.48	0.72	0.24
-0.2	0.297	0.46	0.16
0.2	0.115	0.16	0.05
0.6	0.173	0.23	0.06
0.95	0.034	0.04	0.01

in both regions and the same result will give the temperature profile, i.e., increase the concentration, increase the renewable energy.

The impact of Jeffrey's parameter speed profile is shown in Figures 4(a)–(c) as Jeffrey parameter increases speed in region-I.

The effect of speed and temperature and concentration profile of different chemical parameters is shown in Figures 5(a)–(c), 6(a)–(c) and 7(a)–(c). The speed decreases in the-II region and with the temperature, the concentration decreases. An increase in the parameter of the chemical reaction compresses the flow of fluid. The result is a decrease in speed, temperature and concentration caused by an increase in the chemical reaction parameter that increases the salute molecule thus reducing the flow of fluid.

We analyzed the consistency of the thermal impact and concentration on Jeffrey's fully developed fluid that can be confusing in a vertical channel for analysis. The most inaccurate mathematical calculations are solved in the normal way of distortion and the solutions are found in speed, temperature and concentration are solved by analysis and the results are expressed in terms of various important parameters.

From these Tables I, II shows the results obtained from analytical and from the DSolve method are very close to each other.

5. CONCLUSION

The current work is in line with previous publications, which have applications in the field of engineering. Some of the most important findings in this study are the following:

(1) Increasing the temperature of the Thermal Grashoff and the Grashoff number will lead to your improvement

in both liquid speeds and flow temperatures all confusing the surrounding environment. The opposite trend is seen when the parameters of the chemical reaction parameter.

(2) It shows that the axial velocity decreases by increasing the number of chemical reaction parameters.

(3) Increasing the Jeffrey parameter and ratio improves fluid flow in both regions thereby increasing heat transfer and fluid flow, in all confusing situations. Impact of Jeffrey fluid parameter and angle of inclination on temperature distribution; note that an increase in the Jeffrey fluid parameter affects the temperature profile in a manner opposite to that of the soft angle.

(4) We compared the results obtained in the analysis with the DSolve method very closely.

(5) The important role of baffles has shown improvement in the production of the heat exchanger because its position is focused on helping the heat transfer (due to the coefficient of heat transfer to the upper side of the tube) to reduce pressure in a small area.

(6) With the variability in number and shape of baffles, heat transfer can be improved.

NOMENCLATURE

h	Channel Width (m)
k	Thermal conductivity of fluid ($W \cdot m^{-1}k^{-1}$)
h^*	Width of Passage (m)
Br	Brinkman number ($Br = \frac{\bar{U}_1^2 \mu}{k \Delta T}$)
y^*	Baffle Position (m)
p	Pressure (Nm^{-2})
p	Non dimensional pressure Gradient ($\frac{h^2}{\bar{U}_1 \mu} \frac{dp}{dX}$)
c_p	Dimensionless specific heat at constant pressure ($kJkg^{-1}k^{-1}$)
α	Chemical reaction parameters (M/S)
ρ	Density (kgm^{-3})
GR_T & GR_C	Dimensionless parameters ($GR_T = \frac{Gr}{Re}$) & ($GR_C = \frac{Gc}{Re}$)
g	Acceleration due to gravity (ms^{-2})
μ	Viscosity ($kgm^{-1}s^{-1}$)
Gr	Grashoff number ($\frac{h^3 g \beta \Delta T}{\nu^2}$)
Re	Reynolds number ($Re = \left(\frac{\bar{U}_1 h}{\nu}\right)$)
β_T	Coefficients of thermal expansion (k^{-1})
β_c	Coefficients of concentration expansion
ϕ_1	Non dimensional concentrations
C_1	The concentration in region-I
$\Delta T, \Delta C$	Difference in temperature and concentration

The Importance of Reading

In this paper the performance of baffles in the presence of Jeffrey fluid with a chemical reaction parameter has a different engineering function, discussed briefly. The resulting result has been applied to many engineering machines, static mixers and chemical reactors, chemical reactors, heat exchangers, and solar collectors.

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