Mechanics of Non-Newtonian Fluids in latest material development

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Introduction: Flow of flow against the gravitational force it's called non-Newtonian or non-linear fluids packing nature's resources but some another real non-Newtonian fluid as mud slides, , Manmade process involving chemicals, resins, Silicon-oil (polymers), avalanches, blood, serum some natural products like honey, ketchup, yogurt, somebody care and medicine like shampoo, creams, syrup etc. and some filtration membrane and some gas packing materials also formed by non-linear materials in short word , these fluids application in some certain features like as good rate value dependency in terms of viscosity it's term related with shear-thinning and the word shear-thickening aspects of the designed fluid), normal stress effects (its term related with die-swell and rod-climbing value), creep or relaxation properties of fluid(vis:coelasticity), yield stress effects of fluid (viscoplasticity), history ffects fluid like time dependent response etc. the e all term related study of good non-linear fluid design.

This special research of Fluids is dedicated novel recent composite fluid design with advances in the math m tical physic l molding non-linear fluids, with specific applications as lubricant, suspensions, visco-plastic fluids, ce ents, bio-fluids, oils-recovery, porous media, and relevant numerical issues. Formulating andsolving flows sof non-linear designed composite material inhomogeneous fluids with special difficulties, it's consider the pressure-on motion driven on thin-film flows offluids, it's viscosity based on density of the fluid. it's directly related thermodynamically framework and it's constitutive applications of fluid.

It's fluid based on Micro fluidic technologies have novel increasing attention in non-linear fluid research due to recently due have high applicable in field like as micro-electric mechanic systems and bio-sensor systems and on-chip design systems .The fluid flows encountered in micro pumps and micro mixers is specific flow in macro-scale for micro-machines, the flows behaviors in a micro-channel has to be very specific. The contact between electrolyte solution and the wall surface of micro-channel triggerexchange of charges, resulting in formation of electric double layer (EDL) When an electric field is apply along the central line of micro-channel, the migration of free ions in EDL case by the Columbic force and the fluid viscosity generates the so-called electro-osmotic flow (EOF). EOF has been main flow form in the above applications because of operational advantagesover conventional.

Mathematical Formulation: Bossiness's approximation represent of composite material in terms of density. it's consider time independent calculation in 2D, law liquid saturated in a square enclosure, with placement of a cold obstacle of radius 0.10 m. All the boundaries are at no-slip condition and kept cold, except the bottom wall which is non-uniformly heated; the rest of the walls are kept cold. All physical quantities are kept constant, A physical configuration of problem is demonstrated Figure 1.

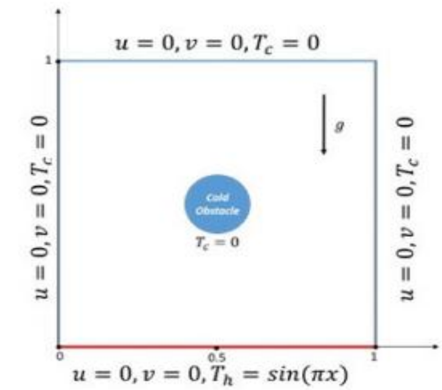


Figure 1. Graphical representation of the problem.

The constitutive equations for the current model are as follows:

$$\frac{\partial u}{\partial x} + \frac{\partial v}{\partial y} = 0, \tag{1}$$

$$\rho(u\frac{\partial u}{\partial x} + v\frac{\partial u}{\partial y}) = -\frac{\partial p}{\partial x} + \frac{\partial \tau_{xx}}{\partial x} + \frac{\partial \tau_{xy}}{\partial y}, \tag{2}$$

$$\rho(u\frac{\partial v}{\partial x} + v\frac{\partial v}{\partial y}) = -\frac{\partial p}{\partial y} + \frac{\partial \tau_{xy}}{\partial x} + \frac{\partial \tau_{yy}}{\partial y} + \rho g\beta(T - T_c), \tag{3}$$

$$u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y} = \alpha\left(\frac{\partial^2 T}{\partial x^2} + \frac{\partial^2 T}{\partial y^2}\right) \tag{4}$$

Stress tensor of fluid is expressed as under

$$\tau_{ij} = 2\mu_a D_{ij} = \mu_a\left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i}\right) \tag{5}$$

where μ_a is the deceptive viscosity derived from relation, as follows:

$$\mu_a = K\left\{2\left[\left(\frac{\partial u}{\partial x}\right)^2 + \left(\frac{\partial v}{\partial y}\right)^2\right] + \left(\frac{\partial v}{\partial x} + \frac{\partial u}{\partial y}\right)^2\right\}^{\frac{n-1}{2}}, \tag{6}$$

where K and n are power law constants, specifying $n < 1$for shear thinning, $n > 1$ as shear thickening and $n = 1$ for Newtonian liquids.

The associate boundary conditions in dimensional form are as under

$$u(x, 0) = 0 = v(X, 0),\ T(X, 0) = T_h - T_c \tag{7}$$

are attained:

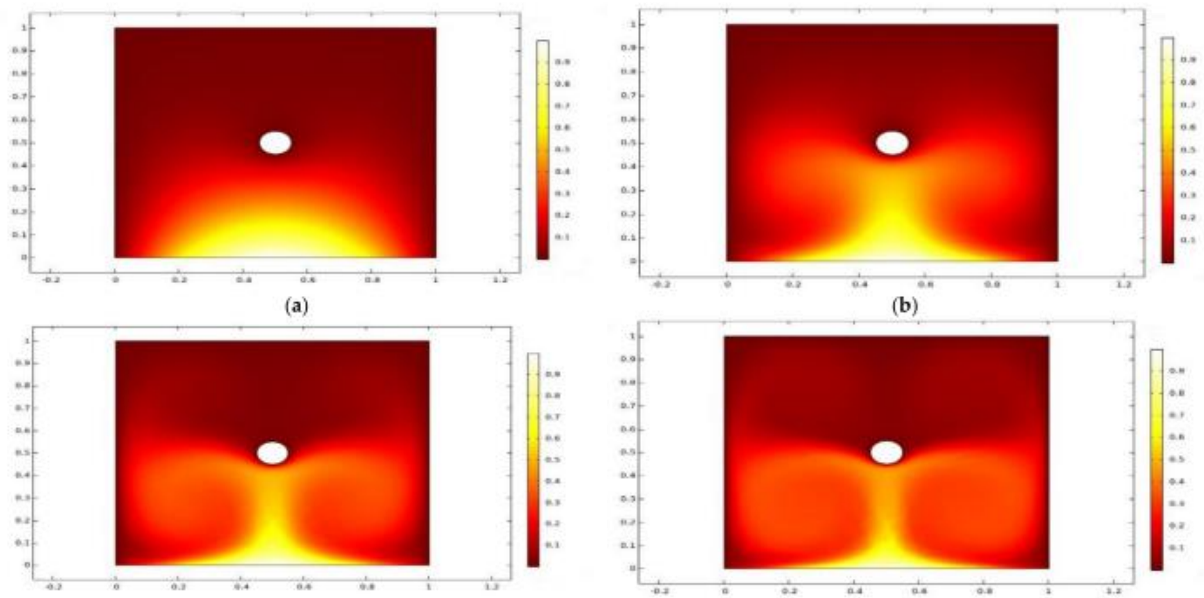
$$\frac{\partial U}{\partial X}+\frac{\partial V}{\partial Y}=0$$

$$U\frac{\partial U}{\partial X}+V\frac{\partial U}{\partial Y}=-\frac{\partial P}{\partial X}+\Pr\left[2\frac{\partial}{\partial X}\left(\mu_a^*\frac{\partial U}{\partial X}\right)+\frac{\partial}{\partial Y}\left(\mu_a^*\left(\frac{\partial U}{\partial Y}+\frac{\partial V}{\partial X}\right)\right)\right],$$

$$U\frac{\partial V}{\partial X}+V\frac{\partial V}{\partial Y}=-\frac{\partial P}{\partial Y}+\Pr\left[2\frac{\partial}{\partial Y}\left(\mu_a^*\frac{\partial V}{\partial Y}\right)+\frac{\partial}{\partial X}\left(\mu_a^*\left(\frac{\partial U}{\partial Y}+\frac{\partial V}{\partial X}\right)\right)\right]+Ra\Pr\theta,$$

$$U\frac{\partial\theta}{\partial X}+V\frac{\partial\theta}{\partial Y}=\frac{\partial^2\theta}{\partial X^2}+\frac{\partial^2\theta}{\partial Y^2},$$

Temperature Profiles:



Transmission of thermal energy study by apply external heating by gas chamber in non-uniform way at the base wall and with varying the Rayleigh portions

Since we apply non-uniform heating variation as a linear function of θ = sin(πx) in stage-01 than , at Ra = 110 parabolic with isothermal curves due to raise the magnitude of (Ra) deformation in bottom part, parabolic heat raise externally and escalation in heat transfer (Ra) is divulged for the (Ra) increase forces of fluid particles it's depending on temperature variation Therefore, increasing Rayleigh number (Ra) is affected on heat transfer was shown instead of lesser magnitudes. conclusion of the various temperature distribution against the Prandtl number (Pr) is shown in Figure 2 is the increase in temperatures are observed against the outer magnitude of (Pr) since the Prandtl number (Pr) ratio of momentum to viscous diffusi n rates. This, by increasing (Pr) momentum is difficult to increaseswith fluid particle kinetic energyescalates. Thisincrement on kinetic energy (K.E.) increases the temperature of fluid particles, and heat energy diffusion very fast.

Results and Discussions

The Practical part and calculation part shows that the effect of involvement parameters on considering, profile generated power-law non-Newtonian liquid have square cavity from incorporating release convection points. The flow field show momentum with heat transfer due to temperature difference is mathematically calculated in the terms of coupled non-linear relative differential equations. Highest element obliged to calculate the variation on flow profiles due to executing hybrid mixing. In order optimized variation with some another parametric variables are gave specific values, like heat c *cp,* isotropic thermal conductivity (*k*), density (*r*), ratio s heat specific heat (*ϒ*). all are in equal ratio the parameters is provided: *Ra* = 110-117, Pr = 7 - 59 and 0.5. with complies all data are gave finest resul applicable on the finite element method (FEM). howev discretization of numerous levels are articulated computation of results calculated at upper level. The m is analyzed by setting up *P*3 - *P*1 elements.

Conclusions

The conclusion of research on fluid flow characteristi power-law fluid in a square enclosure with placement of object. Mathematical and physical study of on modelir fluid rheological model is practiced via constructing differential equations. The various element schemesare for various simulation condition of fluid. The kinetic based on velocity of the fluid under the flow c raise with the higher magnitude of the Rayleigh numbe heat transfer coefficient raise against the increase Rayleigh number. Another word upper magnitude velocity profile and well as kinetic energy show deprecation with respect raise in the Rayleigh number gain the natural conversion aspects in nature.

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