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Numerical Simulation for Heat Transfer Analysis of Mixed Nano Fluid flow with Internal Heat Generation

T.Vijay Kumar[1*]
vijayt314@gmail.com
[1*]Professor, Mechanical Engineering Department, CMR Engineering College, Hyderabad, India.
Y.Bhargavi[2]
[2]Asst Professor, Mechanical Engineering Department, CMR Engineering College, Hyderabad, India
Mr.P.Bhaskar[3]
[3]Asst Professor, Mechanical Engineering Department, CMR Engineering College, Hyderabad, India
B. Pavan Kumar[4]
[2]Asst Professor, Mechanical Engineering Department, CMR Engineering College, Hyderabad, India
Pavan Bagali[4]
[2]Asst Professor, Mechanical Engineering Department, CMR Engineering College, Hyderabad, India

Abstract:

In this task, limit layer blended convection liquid stream, warm exchange age of a Nano liquid over a semi - boundless level plate of 50*10*2mm with warm age impacts are examined scientifically. The speed, Nusselt number, Reynolds number, entropy, warm exchange coefficient profiles and skin erosion and warmth exchange rates are resolved for various Prandtl number 0.01, 0.1, 1,10, 100 for various Nano liquids. The base liquid water is blended with Nano particles of Aluminum oxide, Cop per Oxide with various volume parts 0.4 and 0.6 are considered. The properties of the Nano liquids are figured hypothetically. CFD Fluent analysi s is done in ANSYS. The limit condition for CFD investigation is speed of liquid which is ascertained for various Prandtl number and blended convection esteems.

Keywords: Nano particles, Aluminium oxide, Copper Oxide, Ansys

I. INTRODUCTION AND LITERATURE SURVEY

In the paper by M.Chandrasekar, M. S. Kasiviswanathan [1], is centered around the numerical arrangement of relentless MHD blended convection limit layer stream of a nanofluid over a semi-unending level plate with warm age/assimilation and gooey dispersal impacts within the sight of suction and infusion. In The Paper by SatyajitMojumder [2];A liddriven L-formed depression loaded with a permeable medium is investigated. The Galerkin weighted lingering strategy is connected to acquire numerical arrangements. The impact of the Reynolds number (Re = 1– 100), Grashof number (Gr = 103– 105) and Darcy number (Da = 10 5– 10 3) on the speed and temperature fields is analyzed. For the vertical divider, a higher warmth exchange rate is watched when a low Grashofnum-ber,

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higher Darcy number and higher Reynolds number are connected, yet the contrary trademark is found in the level divider. [3] discussed about E-plane and H-plane patterns which forms the basis of Microwave Engineering principles. It is apparent that warmth exchange diminishes up to 63% in the even divider when the stream has a high Reynolds number (Re = 100).

1.1 Objective of this paper

- Two liquids Aluminum oxide and Copper oxide are blended with base liquid water with various volume divisions 0.4 and 0.6. The properties of liquid Viscosity, Density, Thermal Conductivity and Specific warmth are ascertained hypothetically.
- The limit conditions for CFD investigation are speed of liquid and blended convection esteems. The speeds are computed for various Prandtl numbers 0.01, 0.1, 1, 10 and 100.
- The yields decided are outlet speeds, Reynolds number, nusselt number, warm exchange coefficient, skin erosion coefficient and warmth exchange rates.
-

II. PROPOSED NANO FLUID PROPERTIES AND CALCULATIONS

The properties of the Aluminum oxide and Copper oxide Nano liquids blended with base liquid water are figured for distinctive volume parts 0.4 and 0.6 of the two liquids.

Formulae: (Quoted from Journals)
Density (ρ): ρnf=Øρs + (1-Ø) ρw
Where ρnf = Density of Nano fluid
ρs= Density of the substance (Al2O3 orCuO)
ρw= Density of Base fluid (Water)
Ø = Volume fraction of the substances

Specific Heat (CP): (nf) = Ø(cps) +(1-Ø) cpw
Where ( ) = Specific Heat of Nano fluid
cps= Specific Heatof the substance (Al2O3 /CuO)
cpw= Specific Heat of Base fluid (Water)

Thermal Conductivity (K): Knf= Ks+2Kw+2 Ks–Kw 1+β ³×ϕ Ks+2Kw–Ks–Kw 1+β ³×ϕ × kw
Where Knf = Thermal conductivity of Nano fluid ;
KS =Thermal conductivity of the substance (Al2O3 /CuO)
KW= Thermal conductivity of Base fluid (Water)
β = Film temperature

Viscocity (μ): μnf =Pr* knf (nf) Where
Pr = Prandtl number

Velocity Calculations by Varying Prandtl Number Velocities are calculated for different Prandtl number, which is used as inlet in the CFD analysis.
pr=cp μ k μ =pr k cp v =μ ρ Re v L = u($velocity$)
Re = Reynolds number
v= kinematic Viscosity (m/s2)
L = length of the component (m)

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III. RESULTS & DISCUSSIONS

CFD Analysis CFD analysis is done on the plate by applying velocity of fluid and using mixed convection flow to determine outlet velocities, Reynolds number, entropy, Nusselt number, Heat transfer coefficient, skin friction coefficient and heat transfer rates.

Aluminum Oxide (Al_2O_3) with VF - 0.4 Prandtl Number: 0.01

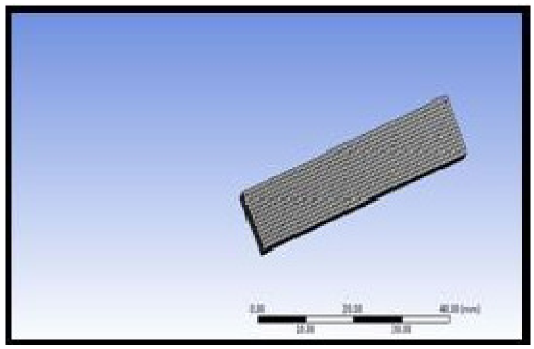

Figure 1: Meshed model

Viscous → edit → k- epslon Select Viscous Model – Laminar Boundary conditions → select air inlet → Edit → Enter Inlet Velocity

The speed esteems are computed from the Prandtl number. The blended convection is considered for the investigation. In divider, select warm and select

Mixed choice. Enter warm exchange coefficient of water and free stream temperature.

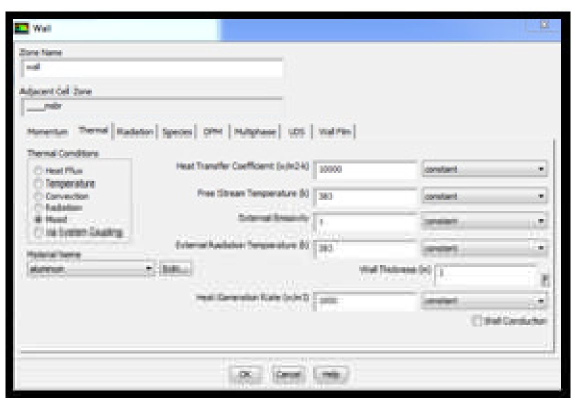

Figure 2: Velocity Inlet for Aluminum oxide with VF 0.4 at Pr = 0.01

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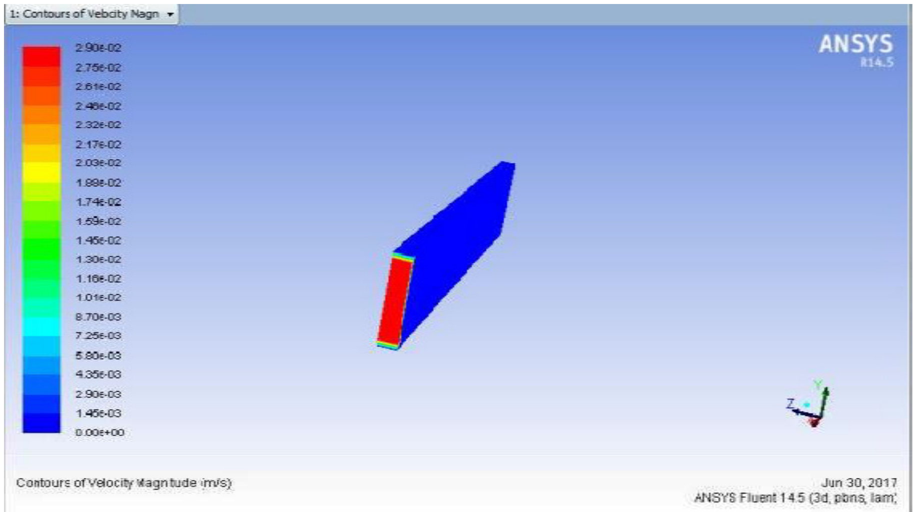

Figure 3: Velocity value for Aluminum oxide with VF 0.4 at Pr = 0.01

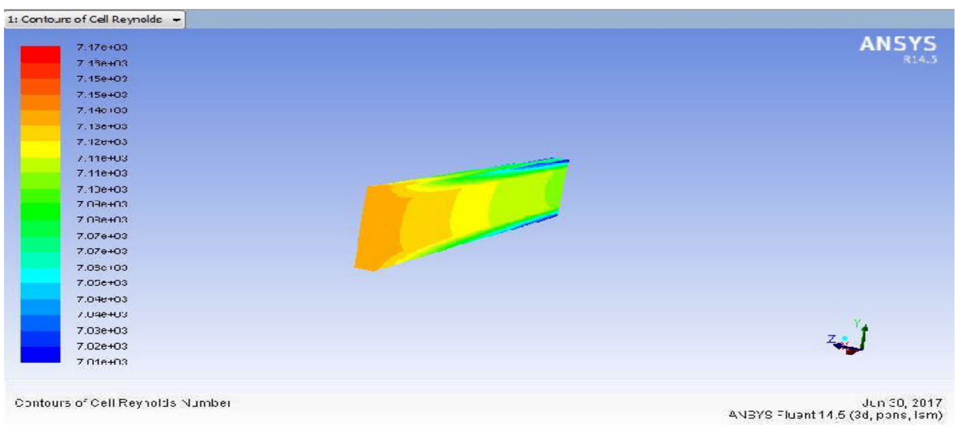

Figure 4: Reynolds number for Aluminum oxide with VF 0.4 at Pr = 0.01

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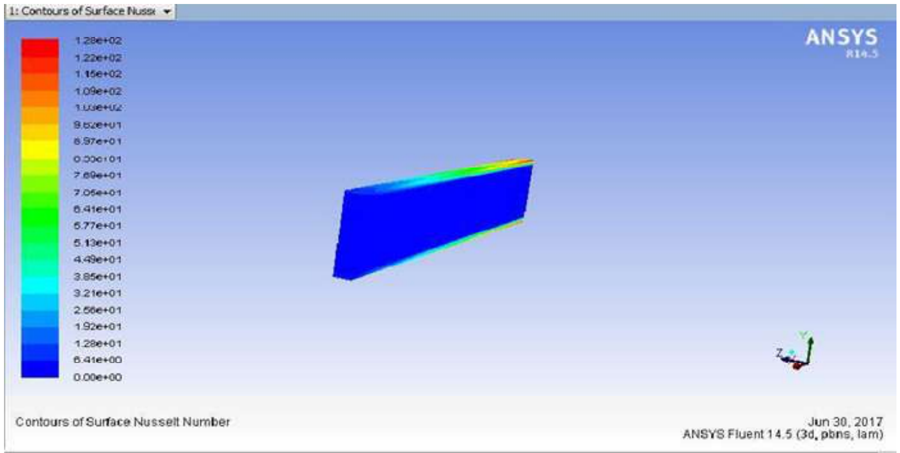

Figure 5: Nusselt number for Aluminum oxide with VF 0.4 at Pr = 0.01

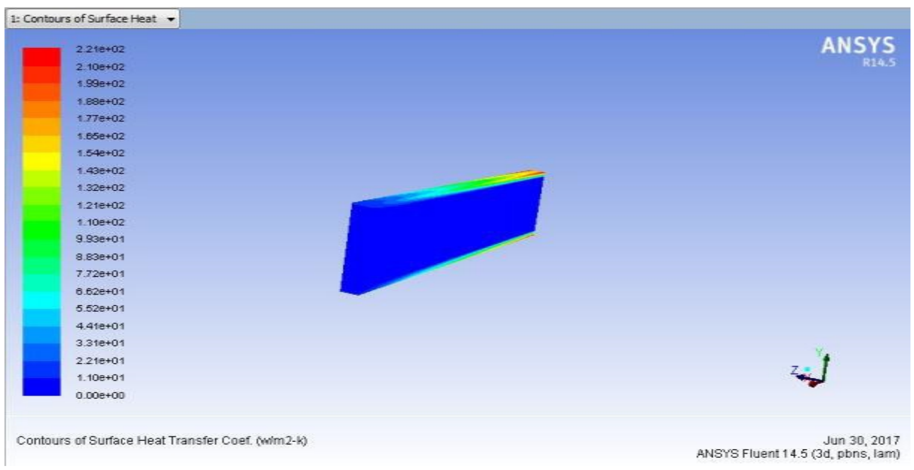

Figure 6: Velocity value for Aluminium oxide with VF 0.4 at Pr = 0.01

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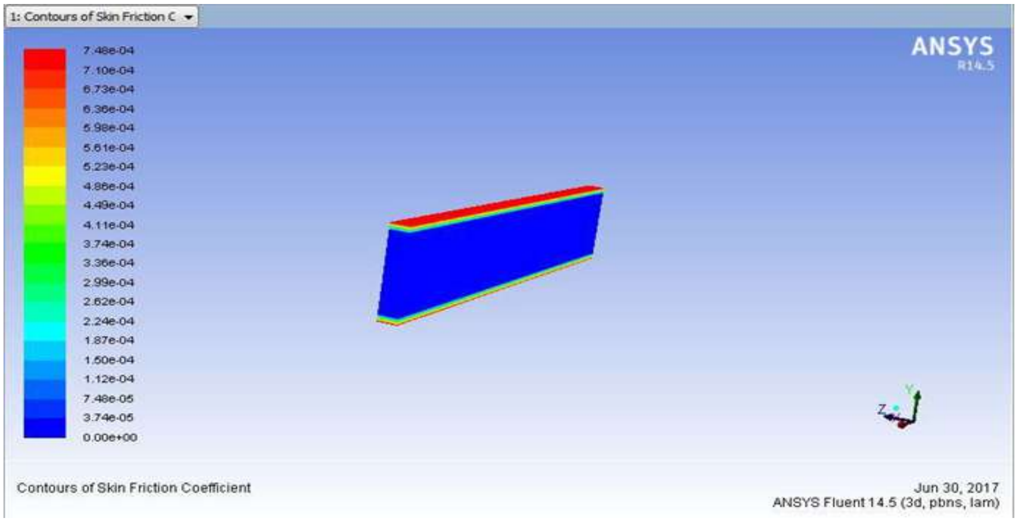

Figure 7: Skin friction coefficient for Aluminum oxide with VF 0.4 at Pr = 0.01

Total Heat Transfer Rate	(w)
inlet	253.23094
outlet	-77.108161
wall	0.83091736
wall-___msbr	-176.96509
Net	-0.011329651

Figure 8: Skin friction coefficient for Aluminum oxide with VF 0.4 at Pr = 0.01

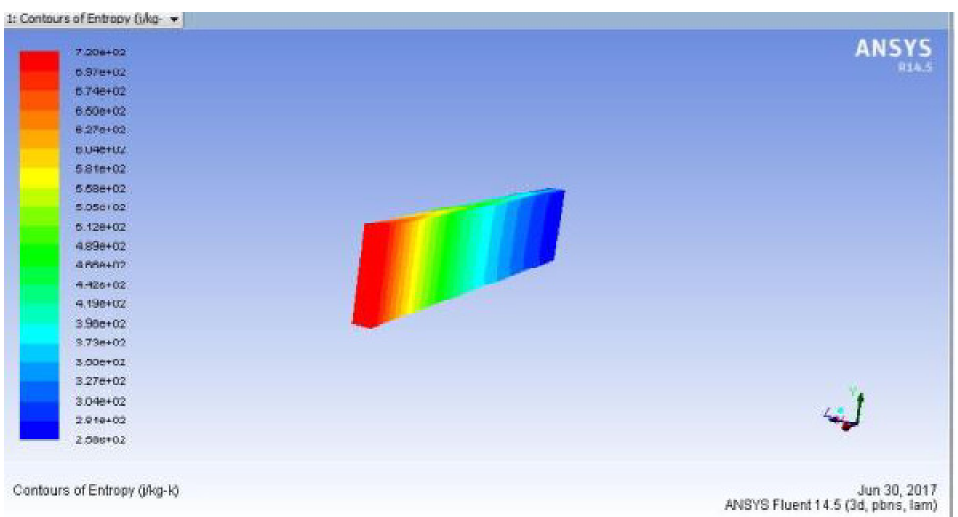

Figure 9: Entropy for Aluminum oxide with VF 0.4 at Pr = 0.01

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Table 1: Resultant Parameters of the Aluminium oxide Nanofluid @ VF 0.4

	Prandtl Number				
Results	0.01	0.1	1	10	100
Velocity (m/s)	2.90E-02	2.95E-01	2.95E+00	2.95E+01	2.95E+02
Reynolds number	7.17E+03	7.30E+03	7.30E+03	7.30E+03	7.30E+03
Nusselt number	1.28E+02	1.93E+01	7.99E+00	6.87E+00	6.76E+00
Heat Transfer Coefficient (W/m^2-k)	2.21E+02	3.32E+01	1.37E+01	1.18E+01	1.16E+01
Skin friction coefficient	7.48E-04	7.61E-02	7.61E+00	7.61E+02	7.61E+04
Entropy (J/kg-k)	7.20E+02	7.26E+02	7.27E+02	7.27E+02	7.27E+02
Total heat transfer rate (W)	0.011329651	0.08340928	0.078575537	1.857763	8.6138779

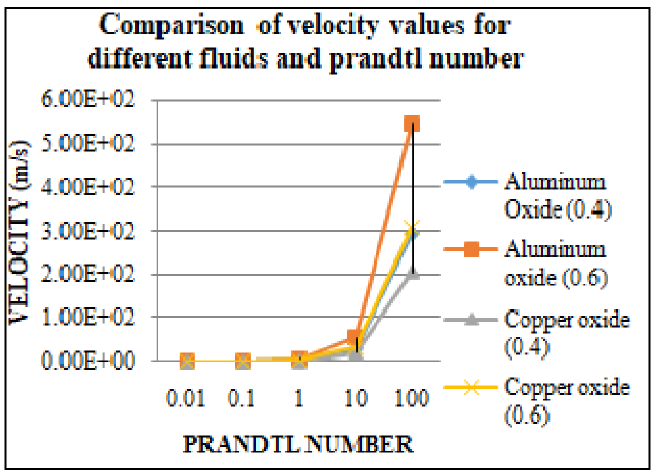

Figure 10: Comparison of velocity values for different fluids and Prandtl number

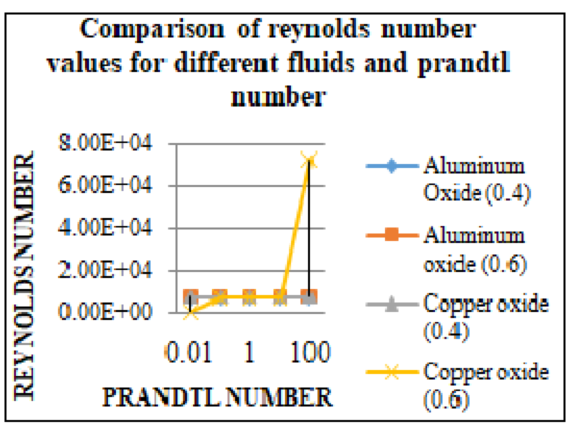

Figure 11: Comparison of Reynolds number for different fluids and Prandtl number

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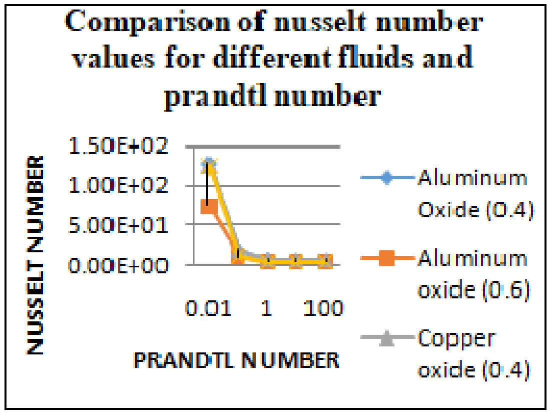

Figure 12: Comparison of Nusselt number for different fluids and Prandtl number

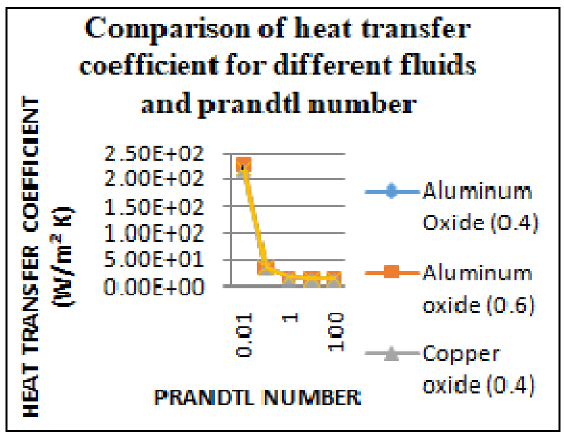

Figure 13: Comparison of Heat Transfer Coefficient for different fluids and Prandtl number

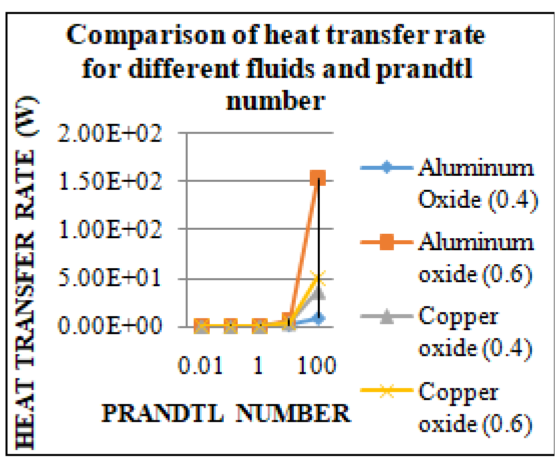

Figure 14: Comparison of Heat Transfer Rate for different fluids and Prandtl number

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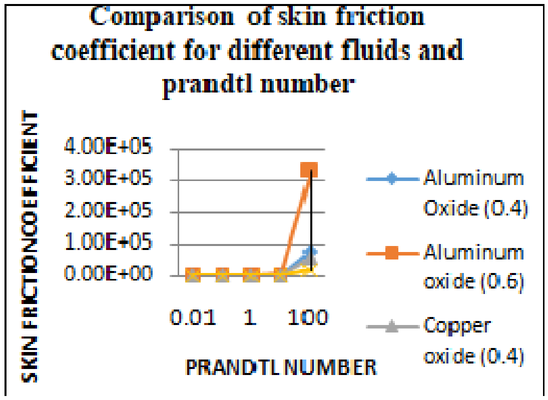

Figure 15: Comparison of Skin Friction Coefficient for different fluids and Prandtl number

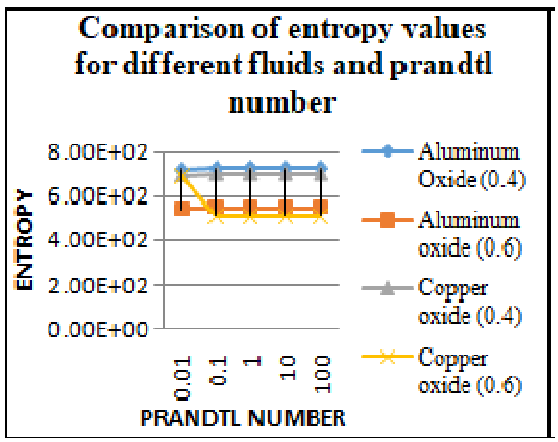

Figure 16: Comparison of Entropy values for different fluids and Prandtl numbe

4. Conclusions

From the examination comes about, it is watched that the warmth exchange increments with the estimations of Prandtl number. Since the higher Prandtl number has low warm conductivity, the nearby Nusselt number increments quickly. This implies the variety of the warmth exchange rate is more delicate to the bigger Prandtl number than the littler one. Skin grating coefficient is additionally expanding with increment of Prandtl number. Taking volume portions and looking at the outcomes between Al2O3nano liquid and CuOnano liquid, the speeds are not influenced by the adjustment in volume parts of nano liquids. Reynolds number and Heat Transfer Rate, Nusselt number and Heat Transfer coefficient are expanding with increment of volume part. The qualities are increasingly when Copper oxide is utilized. The Heat exchange rate is increasingly when Aluminum oxide is utilized. The entropy esteems does not impact with the change in

Prandtl number. It is expanding with diminish in volume fraction.This work can be reached out by performing test examinations and approving, considering other nano liquids and volume division.

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