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The performance of a critical review of heat transfer characteristic using nanofluid flow

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INTRODUCTION

This paper presents the results of a numerical simulation performed to study the nanofluid flow around a set of 2D cylinders arrangement. Using two types of nanofluids consisting of Al_2O_3 and CuO nanoparticles dispersed separately in base fluids of water and ethylene glycol mixture 60:40, those nanofluids were selected to evaluate their effect on the flow over different equilateral-triangular arrangement of cylinders. The continuity and the momentum equations have been numerically solved using a SIMPLE algorithm. The thermo-physical parameters of nanofluids have been estimated using the theory of one fluid phase, thus, a contemporary correlations of thermal conductivity and viscosity of nanofluids have been used in this paper as well as our previous work [1]. The correlations are functions of particle volumetric concentration as well as temperature. The results of heat transfer characteristics of nanofluid flow over 2D cylinders arrangement reveled clear improvement comparing with the base fluids. This enhancement is more important in flows with different equilateral-triangular arrangement characteristics of cylinders, while the gap ratios (G/D) of the three cylinders and incidence angle exert an enhancement efficiency influence on the heat transfer characteristics. The obtained results indicate that the use of aspect ratio 2.26 and incidence angle 1.98°lead to the high amounts of heat transfer inside the tube. In this study the results obtained can be a fruitful source for developing and validating of new codes both in scientific and commercial manner.

THE MODULATION AND SIMULATION FORM

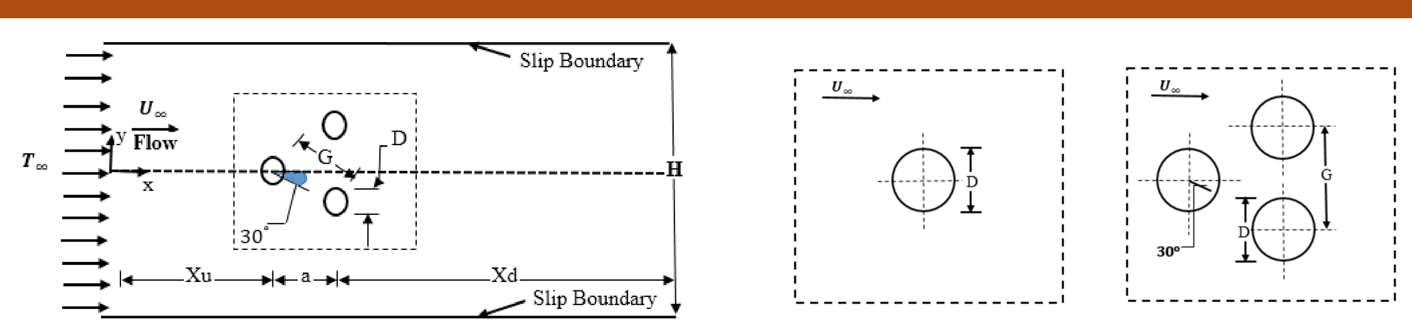

Figure 1: Schematics of the flow and the computational domain [2]

Numerical solution methodology

The present study was carried out using the control volume method. A first order upwind scheme is used for the convective and diffusive terms and other quantities resulting from the governing equations and the SIMPLE algorithm is employed to solve the coupling between the velocity and pressure fields. For all the simulations performed in this study, the solutions were only considered to be converged when the residuals were lower than 10^{-6}. The two-dimensional, laminar, segregated solver was used to solve the incompressible flow on the collocated grid arrangement. The resulting data were then post-processed to obtain the temperature field and convective heat transfer coefficients of the block walls.Certainly, the accuracy and consistency of the numerical results are strongly affected by the choice of the numerical parameters, namely, domain size, grid, time step and convergence criterion. As far as our knowledge, there is no available information on nanofluids flow around an elliptical cylinder thus; the values of aforementioned parameters used when studying the air flow over elliptical cylinder were used as preliminary guesses.

from the details of the domain and the flow characteristics the governing equations for the flow and heat transfer are written as:

- **Continuity**

$$\nabla . U = 0 \qquad (1)$$

- **Momentum**

$$\rho_{nf}(\nabla . U) = -\nabla P + \nabla . (\mu_{nf} \nabla U) \qquad (2)$$

- **Energy**

$$\rho_{nf}(\nabla . U) = -\nabla P + \nabla . (\mu_{nf} \nabla U) \qquad (3)$$

RESULTS AND DISCUSSION

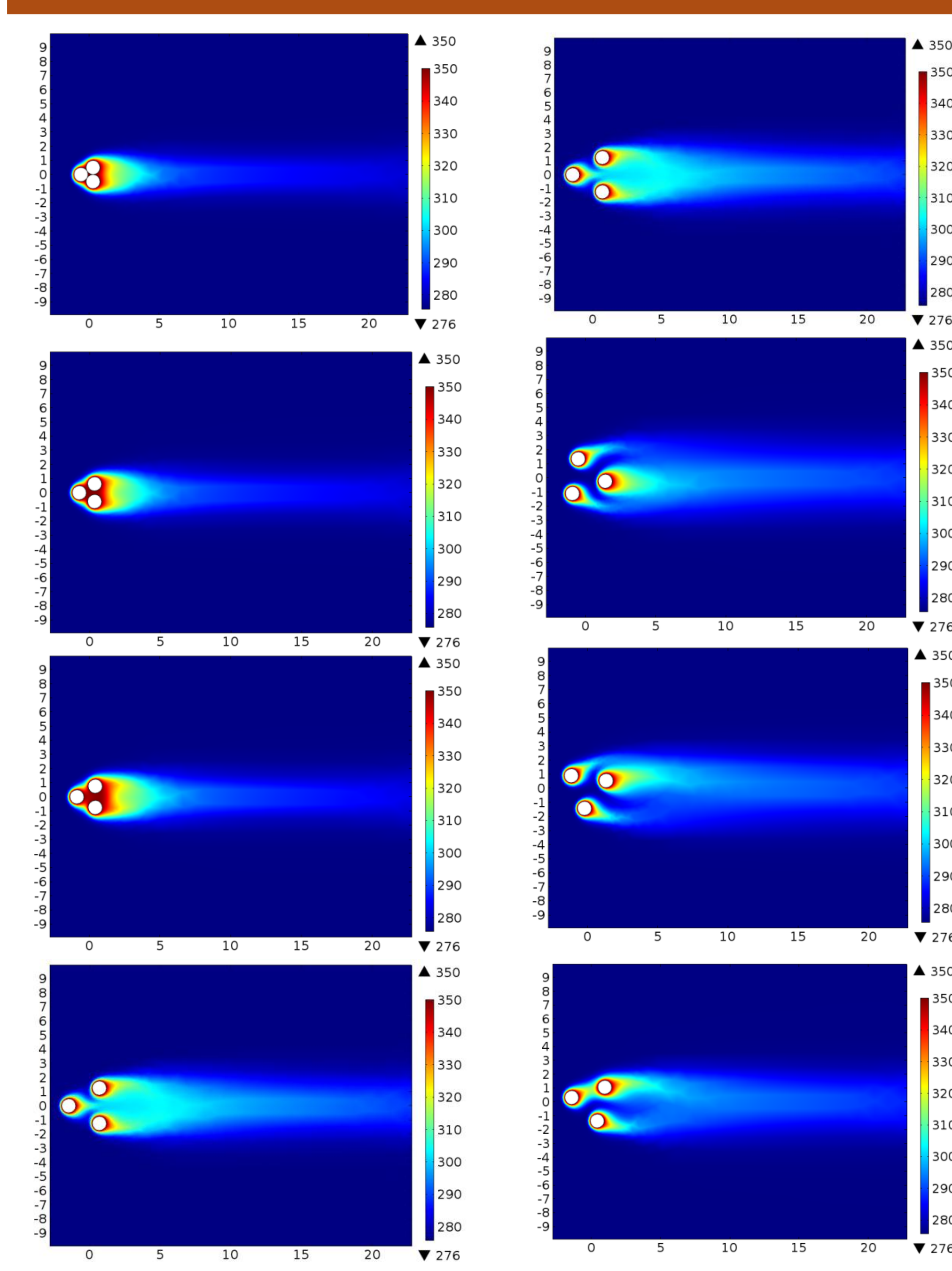

Figure 2: Temperature profile over heated equilateral triangle arrangement of three cylinders A (γ =0°, ε=1), B (γ =0°, ε=1.25), C (γ =0°, ε=1.5), D (γ =0°, ε=2.5), E (γ =0°, ε=2.5), F (γ =0.88°, ε=2.5) , G (γ =1.43°, ε=2.5), H (γ =1.87°, ε=2.5) [2]

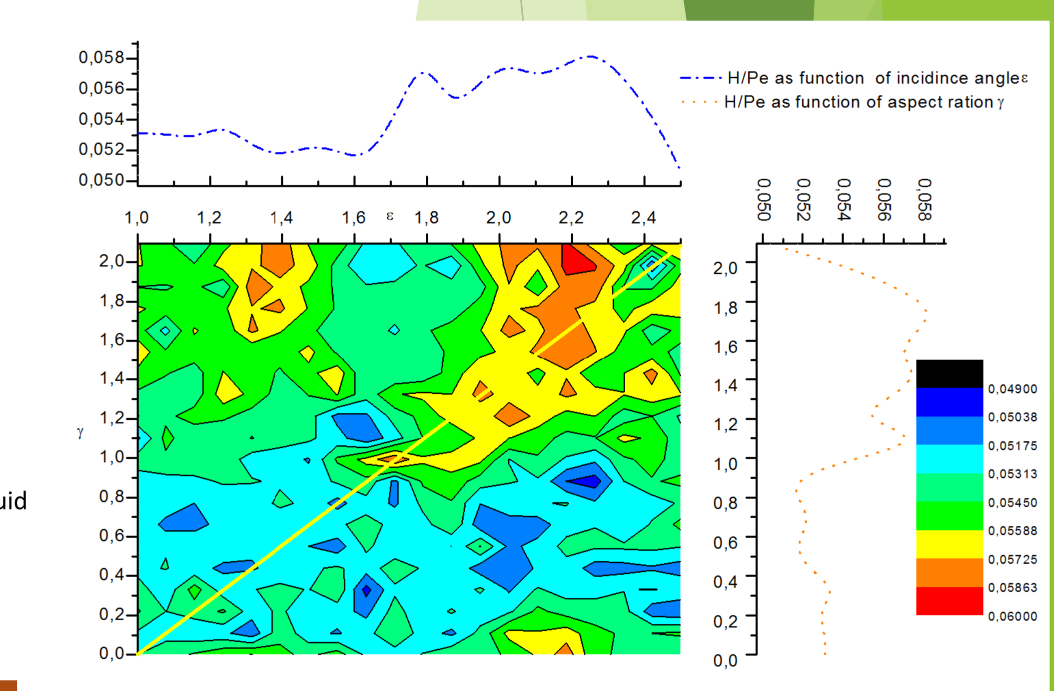

Figure 3: 2D presentation of ratio Heat transfer coefficient and peclet number as function of incidence angle γ and aspect ratio ε, using nanofluid EG-water (60:40) Al_2O_3 1% . [2]

CONCLUSION

In the present, a new model of the two-dimensional steady flow of incompressible nanofluids has been constructed. This work presents an excellent result of using nanofluids in the flow structures around an equilateral triangle arrangement of the three cylinders showing the increased efficiency of heat transfer for different nanofluid concentration. Two types of nanofluids are used consisting of Al_2O_3 and CuO nanoparticles dispersed separately in base fluids of water and ethylene glycol mixture 60:40 (by mass) The thermo-physical parameters of nanofluid have been estimated using the theory of one fluid phase, a contemporary correlations of thermal conductivity and viscosity of nanofluids have been used in this paper, which are functions of particle volumetric concentration as well as temperature. The effects of certain parameters such as the type of nanoparticles and the volume fraction of nanoparticles and numerical investigations have been conducted to study the dynamic field of heat transfer. The temperature and heat transfer coefficient profile for fixed velocities are studied to highlight the distribution inside the tube for different gap ratio and incidence angle. Finally, our results are presented and discussed to gain further physical insights into the role of the block shape and nanofluid on the heat transfer inside the tube. The obtained results indicate that the use of gap ratio 2.26 and incidence angle 1.98° lead to the highest amount of heat transfer inside the tube. This is why the results obtained can be a fruitful source for the development and validation of new codes in a scientific and commercial way and especially real heat exchanger

REFERENCES

[1] Zerradi H, Mizani S, Dezairi A, Loulijat H, Rochd S (2016) Heat Transfer Characteristics of Nanofuid Flow around an Elliptical Cylinder. Int J Adv Technol 7: 171. doi:10.4172/0976-4860.1000171

[2] Mizani S, Zerradi H, Rochd S , Moultif R , Dezairi A (2018) Critical Review of Heat Transfer Characteristic Using Nanofluid Flow Around a Set of 2D Cylinder Arrangements ; bionanoscience ; https://doi.org/10.1007/s12668-018-0529-0